Thermochronological evidence for Neogene incision of the Rio Pativilca Canyon, Northern Peru

Abstract of

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Master of Sciences

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Matthew James Montario
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Abstract

The Peruvian Andes have attained modern elevations of ~4000 m. Many peaks along the drainage divide are in excess of 5500 m with ~2-3 km of vertical relief, and canyons cut into the western edge have up to 3.5 km relief. The Rio Pativilica Canyon is cut into a folded Mesozoic marine sequence intruded by granitic rocks of the Coastal Batholith, which are overlain by Tertiary volcanics: this canyon has relief in excess of ~3 km. Based on geomorphological evidence, two episodes of valley incision cut the Puna erosional surface: 1) The Vallé stage, which is characterized by broad valleys with ~2000-2500 m of incision; and 2) the younger Cañón stage, characterized by steep canyons with ~2000-2500 m of incision. The thermochronological record of rocks in the Canyon was evaluated to understand the timing of incision. Zircon fission-track (ZFT) and zircon U+Th/He (ZHe) ages from the canyon are all nearly ~35 Ma except at the very top of the canyon when ages drop to ~25 Ma. These zircon cooling ages most likely represent a late episode of cooling following the last phase of plutonism in the Coastal Batholith.

Helium and fission track ages on apatite allow a detailed understanding of the timing of canyon incision. Here we integrate apatite fission-track (AFT) and apatite U+Th/He (AHe) results with known geomorphology. The Vallé stage surfaces are filled locally by 2000+ m of a Mio-Pliocene ignimbrite. This ignimbrite has ZFT and ZHe ages of ~5 Ma, so this phase of incision must predate these ignimbrite ages. In a transect from the coast across the piedmont and up the modern Canyon, AHe ages decrease up valley from 30 to 5.5 Ma and AFT ages decrease from 60 to 14 Ma. AFT/AHe and

AHe/Surface age pairs allow estimates of erosion rates, and these data suggest substantial increases in erosion rates at ~15 Ma and again at ~5-6 Ma.

Incision of the canyon is probably caused by either increase in erosion rates on a previously uplifted block, or progressive uplift of the block and concurrent incision. Based on available evidence, we propose that uplift of the Peruvian Andes has occurred since ~15 Ma and that the Rio Pativilca has responded by incising down as uplift has progressed. Increases in erosion rates are a result of increased uplift rates and occur at the start of the Vallé stage at ~15 Ma when erosion rates increased from ~75 m/Myr to 150-200 m/Myr. Erosion rates increase again at the start of the Cañón stage at ~5-6 Ma when rates increased to 300-400 m/Myr. These data suggest that uplift of this part of the Andes is slightly younger than uplift of the central Andes (i.e. Altiplano and Puna) farther to the south, and therefore these results support he idea of northward growth of the orogenic belt.

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Chapter 1: Introduction

1.1 Introduction

The Andes extend more than 9000 km along the entire Western coast of South America and are more than 700 km across at their widest extent in the Central Andes which includes the Altiplano and Puna (Kennan, in press) (Figure 1). They thin dramatically to the north and south of the central Andes but the belt continues to maintain average elevations of ~3000-4000 m along much of the range to the north. Elevations track the Equilibrium Line Altitude (ELA), where the amount of accumulated snow and ablated water are equal, to the south and decrease with latitude (Montgomery *et al.,* 2001). In Peru, the drainage divide splits the Cordillera Occidental (West) and Cordillera Oriental (East). In northern Peru, the drainage divide is defined in part by the Cordillera Blanca and the Cordillera Huayhuash which contain two of the highest peaks in Peru, Nevado Huascarán (6768 m) and Nevado Yerupajá (6630m). Vertical relief in the ranges along the drainage divide is dramatic with average relief in this area between 2000-3000 meters (Garver *et al.,* 2005). However, this high topography along the divide overshadows the nearby deeply incised canyons that cut the western slopes of the Cordillera Occidental. These canyons are carved into the Cretaceous Coastal Batholith and surrounding Mesozoic country rock and overlying Tertiary Calipuy volcanics (Cobbing *et al.,* 1981, Farrar & Noble, 1976; McLaughlin, 1924). Near the coastal cities of Barranca and Chimbote, rivers that incise the west flank of the Andes include the Rio Pativilca and the Rio Santa, which have very deep canyons and headwaters in the high, glaciated peaks. This study focuses on the Rio Pativilca, which has a maximum of ~3500

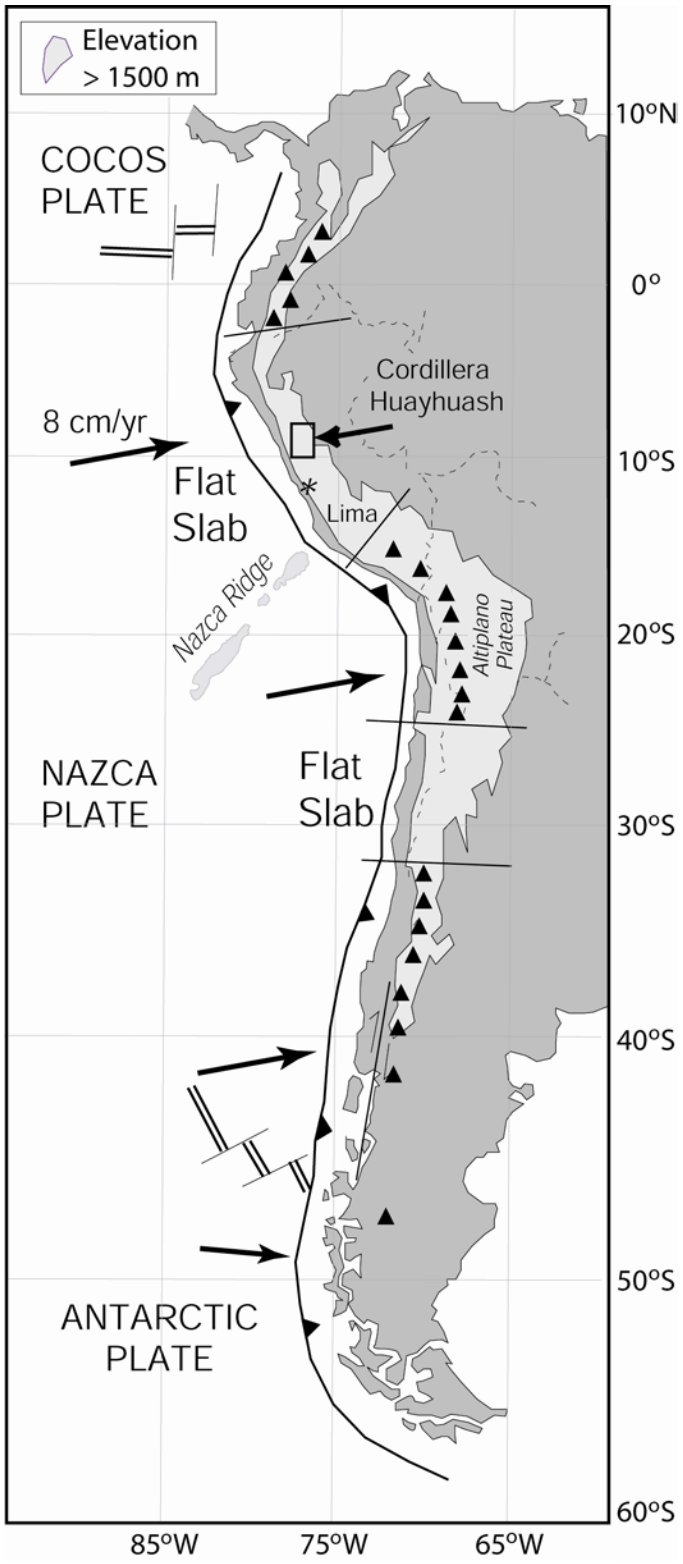

Figure 1. Location of the Cordillera Huayhuash and Rio Pativilca Canyon, Northern Peru. (After Lamb & Davis, 2003; Kennan, 2000) Solid triangles represent active volcanoes ad the light shading represents the Andean Chain with elevations greater than 1500 m.

meters of relief making it one of the deepest canyons in Peru. The headwaters for the Rio Pativilca are the glaciated peaks of the Cordillera Huayhuash. So, unlike many other river canyons on the western flank of the Andes, such as the Rio Fortaleza, the headwaters of the Pativilca have significant snow and ice whereas other drainages that do not cut back all the way to the high peaks along the drainage divide are relatively arid and have much lower annual discharge.

Thermochronology is the study of the thermal history of rock (Gallagher *et al.*, 2005). Various thermochronologic techniques are available to elucidate the thermal history of the upper 10 km of the Earth's crust, these include fission-track and (U+Th)/Helium (hereafter referred to as He) dating. Two important variables that need consideration in applying thermochronology to tectonic problems are the effective closure temperature of the system used and the geothermal gradient of the study area (Gallagher *et al.*, 1998). These two factors control the depth below the surface where a thermochronometer begins "recording" its cooling history. The depth of closure can be envisioned as a line of equal temperature below the surface, or an isotherm. Each thermochronologic technique has its own specific closure isotherm and therefore provides information on the unique cooling history of the area being studied. Low-temperature thermochronology is a potential key to understanding the evolution of this part of the Andes, because the low-temperature isotherms are sensitive to landscape erosion and changes in topography (e.g. Reiners *et al.*, 2003).

A key question regarding the evolution of the Andes is the timing of uplift. In Peru, the relationship of the development of the high topography along the drainage divide and deep canyons on the western flanks to that of uplift is poorly understood. In

general thermochronology has not been very successful in helping decipher this relationship in the Andes (Gregory-Wodzeki, 2000). Because large areas of the Andes are inferred to have been uplifted at the same time (e.g. McLaughlin, 1924) and since uplift there has been little differential erosion (concentrated in narrow valleys)(Kennan, in press), exhumation of isotherms that may record the evolution of the Andes has been insignificant and therefore difficult to measure. The northern Andes in Peru are unique due to the very deep canyons and high topography. Both have 3-4 km of relief that is sufficient to expose low-temperature isotherms. Therefore, compared to many other areas of the Andes without this dramatic relief, this area is special because low-temperature thermochronology can be used to address the timing of the development of relief, including canyon incision. Canyon incision in Peru has progressed deep enough to expose isotherms of interest, and the timing of this incision may shed light on the development of this part of the Andes (Figure 2). More than 4 km of uplift has occurred within the Peruvian Andes and canyon incision has cut ~3-3.5 km into this uplifted rock. The questions that arise from this are: 1) When did these canyons form; and 2) was canyon incision driven by uplift, or a change in base level, or was climate change involved and uplift was just a simple precondition for their formation?

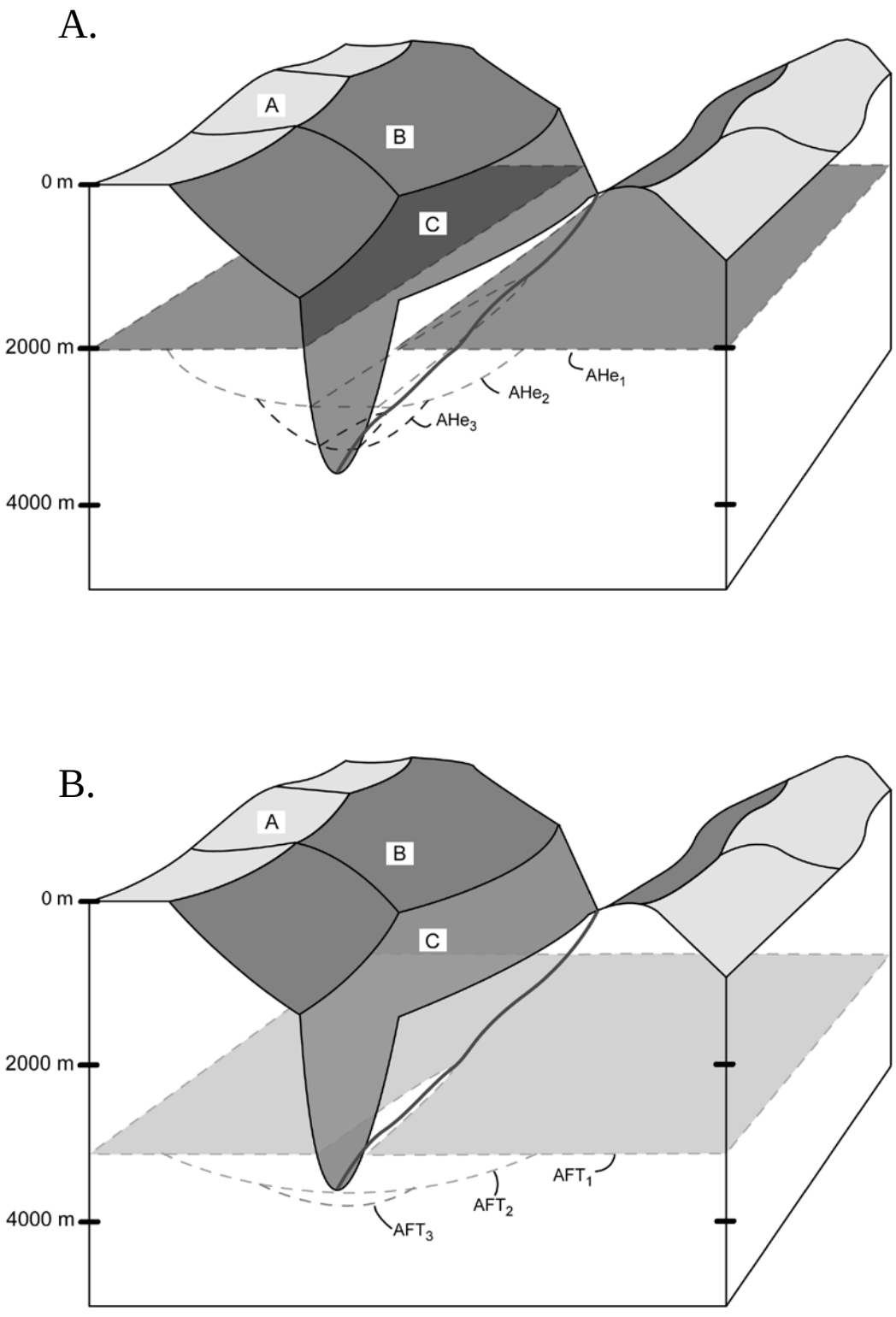

Figure 2. A schematic demonstrating how sampling a river valley will cross paleo-isotherms. The top cartoon (A) shows the possible effects on the Apatite (U+Th)/Helium system while the bottom cartoon (B) shows the apatite FT system. The flat grey layers represent the original undisturbed isotherms. The dotted lines represent the closure depth after incision has occurred after three time intervals.

1.2 Uplift & Exhumation

Uplift refers to displacement of rocks in the direction opposite the gravity vector with respect to an external frame of reference as well defined and outlined in England & Molnar (1990). Three types of displacement can be defined for tectonic processes: (a) Surface uplift is displacement of the Earth's surface with respect to the geoid; (b) rock uplift is the displacement of rocks with respect to the geoid; and (c) exhumation is the relative displacement of rocks with respect to the Earth's surface. The rate of exhumation is the rate of removal of overburden by erosion (England & Molnar, 1990).

Rates and timing of rock or surface uplift are very difficult to determine unambiguously. Determination of the rate of surface uplift requires the preservation of a surface feature (erosional surface, or depositional feature) deposited during or before uplift and that feature to contain evidence of surface elevation (generally sea level) at the time of formation or deposition (England & Molnar, 1990). In many cases these sequences of rock are eroded or they provide little or no evidence about the elevation during deposition.

Exhumation and exhumation rates can be calculated using geothermometry on different minerals in rocks now exhumed to the surface. These calculations require an estimate of the geothermal gradient and the specific closure temperature of the thermochronologic system used.

Paleobotany is a more common method for determining paleo-elevations. Two different methods that are currently used are quite different, one involves taxonomic classification while the other relies on physiognomic classification. The first method relies on the "nearest living relative" technique in which a fossil plant is assigned a

modern living relative. The environment this modern relative is found in is then applied to the fossil plant and an estimate of paleoclimate and elevation is made (Molnar & England, 1990). The Taxonomic classification can also be done using parts of plant such as pollen, however parts such as pollen can sometimes be insensitive to climate change.(Molnar & England, 1990).

The second technique in paleobotany uses what is know about how plants adapt to climates and how that relates to leaf morphology or physiognomy (Gregory-Wodzicki, 2000b; Molnar & England, 1990). This method relies on the fact that a percentage of plant species having smooth leaf margins varies linearly with mean annual temperature. Studies using the second method of physiognomy have been corroborated by other studies where as studies using taxonomy have not (Molnar & England, 1990). However, the paleobotany method is not sensitive to subtle changes in precipitation nor is it useful in frigid or arid climates with little or no vegetation (Wilf, 1997).

1.3 Thermochronology

Low-temperature thermochronometric techniques such as fission-track and (U+Th)/He can provide valuable information about the thermal history for a particular area, including inferred exhumation and erosion rates (Gallagher *et al.*, 2005). Low-temperature thermochronology has progressed significantly due to new quantitative models for fission-track annealing and helium diffusion (e.g. Tagami *et al.*, 1999, Ketcham *et al.*, 1999, Farley, 2000).

1.3.1 Fission-track Thermochronology

The fission-track age of a sample is determined using mathematical formulas similar to those of other radioactive decay dating methods (Naeser, 1979). Dating a sample requires an estimate of the abundance of the parent isotope and the density of fission tracks, which are the daughter product. To estimate the number of tracks, the sample is etched and exposed tracks are counted. Determination of the concentration of ^{238}U is more complicated, but the most common method is by using an external detector. In this method, a mica detector with a very low uranium concentration is placed on top of a sample that has been polished and etched. The sample is then irradiated using "slow" or thermal neutrons which induce fissioning of ^{235}U in the sample. This neutron irradiation causes tracks to be registered in the mica detector which are then etched out and counted to determine the concentration of ^{235}U, provided the neutron flux is known. The ratio of $^{235}U/^{238}U$ is constant in nature the so the concentration of ^{238}U in the sample can be determined. The external detector method allows each individual grain or parts of a grain, to have its uranium concentration determined (see Donelick, *et al.*, 2005; Gallagher *et al.*, 1998 review).

The nominal closure temperature for the apatite fission track system is ~110±10^{o}C and 240±40 ^{o}C for the zircon fission track system (Tagami, 2005, 1999). Annealing of fission tracks occurs at a wide range of temperatures for both systems; this range is called the partial annealing zone or PAZ (Green *et al.,* 1986). The temperature range of the apatite PAZ is a function of how fast a rock cools, composition and temperature (Carlson *et al.,* 1999; Green *et al.,* 1986), but for zircon PAZ radiation damage seems to replace composition in importance (Garver *et al.,* 2005). Mean track lengths for unannealed tracks in apatite fall within the range of 14.5-15.5 μm (Gleadow *et al.,* 1986). If a sample has a narrow track-length distribution around this mean length then it has undergone rapid cooling (Lasslett *et al.,* 1987). A wide range of lengths with one or more peaks indicates the sample has had a much more complex thermal history and spent a significant amount of time in the PAZ (Gleadow *et al.,* 1986). Although recent studies of annealing of tracks in zircon (Tagami, 2005) have advanced thermokinteic models for the zircon system, our understanding of the relationship between track-length and annealing in zircon still lags behind the apatite system and therefore track lengths are not routinely measured in zircon.

1.3.2 (U+Th)/He Thermochronology

(U+Th)/He Thermochronology is based on the alpha decay of uranium and thorium, and in some cases samarium (Reiners, 2005). The age equation for this system is:

$$^{4}\mathrm{He} = 8\,^{238}U\,[\exp(\lambda_{238}\,t) - 1] + 7\,^{235}U\,[\exp(\lambda_{235}\,t) - 1] + 6\,^{232}Th\,[\exp(\lambda_{232}\,t) - 1]$$

where ^{4}He, ^{238}U, ^{235}U, ^{232}Th are the present day atoms, λ is the decay constant for each isotope and *t* is the (U+Th)/He age (Reiners 2002). The number of decays per element is

also significant as several alpha decays will occur in each decay chain and this is represented by the factors 6, 7, and 8 in the equation. Several factors make (U+Th)/He dating different from radioactive decay systems; these include multiple parent isotopes, differences in parent/daughter behaviors and long stopping distances of the daughter product (Reiners, 2002).

Several factors must first be addressed before calculating a (U+Th)/He age. The first factor is the α-ejection correction. Because the production of alpha particles is very energetic, alpha particles travel ~15-20 μm and therefore can be ejected from the grain; as such a daughter is lost, and an age correction needs to be made. When compared to the average grain sizes used in helium dating, ~60-400 μm, the volume where the stopping distance intersects the outside of the crystal can be a significant part of the grain. This ejection of alpha particles from the grain results in a calculated age that is too young if no correction is made, because the system has lost daughter product. Due to this important effect, grains smaller than ~60 μm are generally not used due to a large α-ejection effect (e.g. Reiners & Farley 2001). The second factor that affects a (U+Th)/He age is variable concentrations of uranium and thorium in grains. Because concentrations and concentration gradients can vary from grain to grain, helium, uranium, and thorium must all be measured on the same grain. Helium extraction requires heating a grain to very high temperatures with a laser which does not cause the loss of uranium or thorium (Reiners & Farley, 1999). Heating of the grain for helium analysis is commonly done by laser (or furnace) and laser heating requires the sample to be placed in a small foil packet to avoid direct heating. Helium degassed by heating is measured on a quadrapole mass spectrometer using ^{3}He dilution with cryogenic purification. The degassed crystal is then

dissolved and measured by isotope dilution on an ICP-MS. Typical precision on these analytical steps is 1-2% (see Reiners, 2005 for a complete review).

Like the fission-track system, (U+Th)/He also has a temperature where rapid diffusion of helium out of the crystal is significant, but not complete, called the Partial Retention Zone (PRZ). Laboratory diffusion studies show that for geologic time scales, the PRZ for the apatite helium system ranges from ~40-90^{o}C (e.g. House *et al.,* 1999, Farley, 2000). Composition of apatite crystals seems to have little effect on diffusivity of helium (House *et al.,* 1999). Diffusion studies for zircon yield a PRZ range of ~170-200^{o}C (Reiners, 2005). At high uranium concentrations helium ages will decrease rapidly due to high levels of radiation damage, because radiation damage strongly affects helium retention in zircon (Reiners, 2005).

1.44. Climate Change & the Andes

Climate change and its effects on the erosion of orogenic belts has become a highly debated topic (e.g. Hartley, 2005 & 2003; Lamb & Davis, 2003; Montgomery *et al.*, 2001; Molnar & England, 1990). Molnar and England (1990) proposed that most evidence used to infer Late Cenozoic uplift in the Andes could actually be caused by climate change and not by uplift during the Cenozoic. Major shifts in climate at ~15 Ma and at ~2.5 Ma could have a significant impact on how climate interacts with orogenic belts (Molnar & England, 1990). Changes in climate could cause changes in erosion rates, including the way Alpine glaciers erode mountains, or increase/decrease precipitation (Molnar & England, 1990).

The uplift and internal deformation of the Andes with respect to climate has been a topic of intense discussion in the last few years (Hartly, 2005; Lamb & Davis 2003; Montgomery *et al.*, 2001). The basic observations about the high Andean orogenic wedge are: (1) it occurs in several climate regimes; (2) sits above flat slab and steep slab subduction zones; (3) sits above two different oceanic plates, mostly the Nasca Plate; (4) the orogen is widest where the climate is the most arid; and (5) mean summit elevations decrease southward as does ELA. Therefore external forcing likely acts in these different settings simultaneously.

Aridity may play an important role in limiting erosion. Sedimentological observations from the Atacama Desert indicate the Central Andes had a semi arid/arid climate from 15 Ma to 9 Ma and then hyperaridity between 4 and 3 Ma (Hartley, 2005; Hartley & Chong, 2002; Hartley *et al.*, 2000). This hyperarid climate exists today from the coast of Chile north to Peru. Sedimentological data from the Atacama Desert indicate

that the Andean rain shadow was present by 15 Ma and created or reinforced the existing arid climate (Hartley, 2003). Recent work in the Atacama Desert show that arid conditions could have existed since 34 Ma and hyperarid conditions since 25 Ma (Dunai *et al.,* 2005).

Lamb and Davis (2003) suggest that the height and evolution of the Andes are controlled by shear stress in the subduction zone, and by buoyancy stress contrasts between the trench and highlands. The shear stress in the subduction zone may be dependent on the amount of sediment in the trench, which may act to facilitate plate movement, is generally small. In the case of South America, Cenozoic climate change is proposed by Lamb & Davis, (2003) to have caused sediment starvation of the subduction zone leading to high shear stress that supports the high Andes. More recent studies (Hartley, 2005) suggest that this lack of sediment input into the subduction zone has no significant effect on interplate friction. Instead, Hartley (2005) suggest uplift of the Andes may have been controlled by a combination of factors; 1) limited erosion associated with the arid climate since the Late Jurassic; and 2) a change to more orthogonal convergence in the Oligocene/Miocene. Either way, it is clear the literature that there is no consensus on the timing and driving force for Andean evolution.

1.5. Erosional Surfaces – Peru

One of the key aspects of understanding surface uplift of the Andes is that there are a number of well-preserved surfaces that record bedrock erosion before, and during rock uplift (Figure 3). The oldest and generally the highest surface is the widely recognized Puna surface (McLaughlin, 1924). The Puna is inferred to be an erosional surface, represented by an area of broad shallow valleys and rolling hills in the high Andes. In his original observations, McLaughlin proposed that remnants of a peneplain were recorded by concordant peaks in the Andes which he called the Puna Surface. At the time of formation this surface was probably no more than 500 meters above the general topography (McLaughlin, 1924), but today this surface is at elevations of 4000-4500 meters. A key question is the original elevation of the Puna, and the timing of its development. McLaughlin states that the Puna surface cuts across many different underlying bedrock units. In Northern Peru, it cuts the Calipuy Volcanics, which we now know range in age from 55 to 14.6 Ma (Cobbing *et al.*, 1981, Farrar & Noble, 1976). However, the ages of these youngest rocks and the actual identification of the "Puna" on them is crucial because these are the youngest reported ages. It is possible that the Puna surface has been mis-assigned in this case or that rocks are poorly dated. McLaughlin also noted that a mature drainage basin was in place at the time the Puna Surface was developed and that this drainage pattern was superimposed on the rising mountain chain.

McLaughlin recognized three possible stages for uplift of the Puna in Peru. The first, named the Junin stage after the broad Pampas of Junin, is characterized by broad valleys with flat gradients and gentle side slopes. The Junin stage was inferred to have formed by slight uplift and then a long period of quiescence (McLaughlin, 1924). The

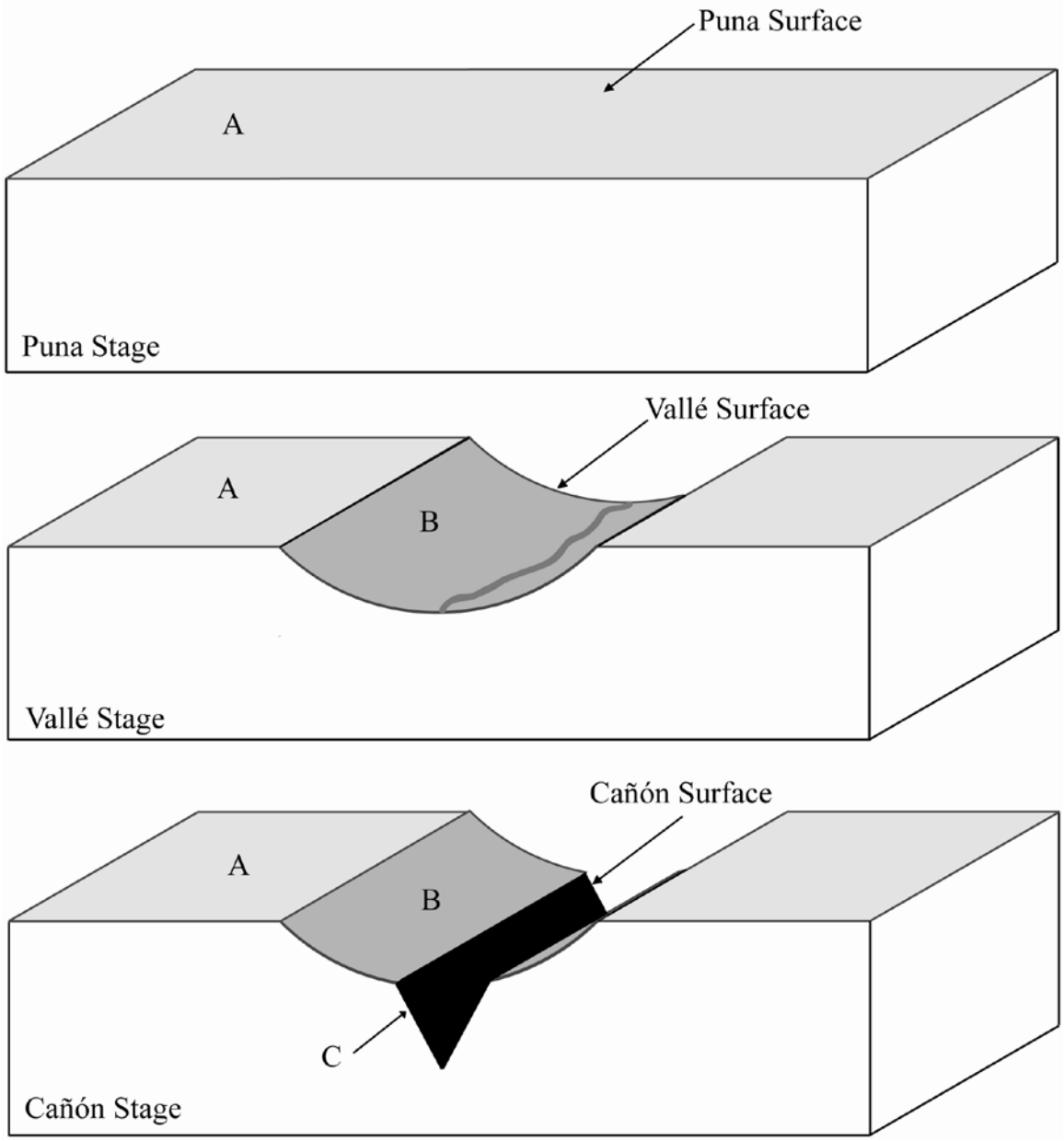

Figure 3. Phases of uplift in Northern Peru based on geomorphologic evidence from McLaughlin 1924, Cobbing *et al* 1991, and others. Surface "A" represents the Puna Surface, "B" the Vallé surface and "C" the Cañón surface. Today the Puna surface sits at elevations of 4000-5000 meters above sea level. The age of the Puna surface is very poorly constrained at 14.6 Ma. The Vallé and Cañón phases represent 2000-2500 meters of river incision.

second stage was slightly more vigorous than that of the Junin stage but still allowed the streams to lessen the slope of their valley walls. The Canyon stage, or final uplift, named after small farms found on its slopes called Chracas, was the most vigorous of the stages.

Estimates of uplift of the Puna planation surface and when it took place vary along the Andean chain (see Gregory-Wodzicki, 2000 for a review). To the north, in Ecuador, the planation surface is younger than 6 Ma because it cuts formations of upper Miocene age (Coltorti & Ollier, 1999). In Northern Peru the planation surface appears to cut rocks as young as 14.6 Ma based on tuffs cut by the planation surface. To the south, the eastern slopes of Bolivia record an erosional surface cutting rocks as young as 8-10 Ma (Kennan *et al.,* 1997, Gregory-Wodzicki *et al.,* 1998). In central Chile the Altiplano-Puna surfacewas formed by at least 25 Ma (Horton *et al.,* 1987). In general there appears to be a N-S age progression of the Puna surface, from 25 Ma in Chile to ~15 Ma in Peru, and at ~6 Ma in Ecuador. After development of the Puna, it is clear that it was deeply incised by intensive erosion and canyon down-cutting.

More recent work, based on McLaughlin's original observations, better defines the main phases of erosion and incision that controlled Andean growth in Northern Peru (Cobbing *et al*., 1997, 1973; Myers, 1976, 1980; Wilson, 1967). These surfaces are recognized as the Puna stage, Vallé stage, and Cañón stage. In Peru, the Puna stage is represented by relatively flat high topography approximately 4000-4500 meters above sea level. The Vallé stage, which clearly cuts the Puna surface, is recorded as shallow sloping valleys. Valleys formed during this stage are filled locally with a 2000+ m thick ignimbrite. Because the base of this ignimbrite has an age of ~6 Ma relief must have been on the order of 2000-2500 meters by this time (Cobbing *et al.*, 1981). The Cañón

stage is the most recent erosion stage, characterized by steeply sloping canyons usually cutting into Vallé stage valleys. The Cañón stage has at least another 2000 meters of additional relief compared to the Vallé stage surfaces (Figure 3). Once again the erosion question revolves around the age of these erosional surfaces. The only dating that has been done, other than the ignimbrites discussed above, are studies constraining the youngest rocks cut by these surfaces. For the most part it seems clear that the post-Puna erosion has affected rocks as old as Middle Miocene.

1.6. Tectonic & Geologic Setting

The South American margin has evolved during the subduction of three distinct oceanic plates under the South American continent. Convergence rates for these plates range from 20 mm/yr for the Antarctic Plate, 78 mm/yr for the Nazca plate and 84 mm/yr for the Caribbean Plate (Kennan, in press). However, almost the entire belt \ between Colombia and Southern Chile is affected by subduction of only the Nazca plate. In two sections, subduction of the Nazca plate is flat slab and lacks a distinctive continental arc with active volcanism. The Northern Andes of Peru are located above one of these flat slab zones. Flat slab conditions in Peru could be due to the subduction of the more buoyant Nazca Ridge (McNulty & Farber, 2002). Because there has been little or no volcanic activity in this section of the Andes since ~5 Ma it is thought that flat slab conditions in Peru began at this time (McNulty & Farber, 2002). A simplified geologic map of the study area is provided (Figure 4).

1.6.1 Passive Margin Sequence

The Late Jurasic to Early Cretaceous passive margin sequence in Northern Peru consists of four major formations: Chicama Formation; Chimu Formation; Santa Formation; and Carhuaz Formation. First identified by Strappenbeck (1924), the Late Jurassic Chicama Fm is comprised of shales with interbedded siltstones and quartzites and is at least 1500 meters thick. Disconformably on the Chicama Fm is the Early Cretaceous Chimu Fm which is ~700 meters of orthoquartzites with thin shale layers, coal seams and plant debris. The Santa Fm is several hundreds of meters of limestone and shale and is made up of a more carbonate rich facies to the south and shale rich facies to the north. The Early Cretaceous Carhuaz Fm is ~500-1500 meters of shale, siltstone

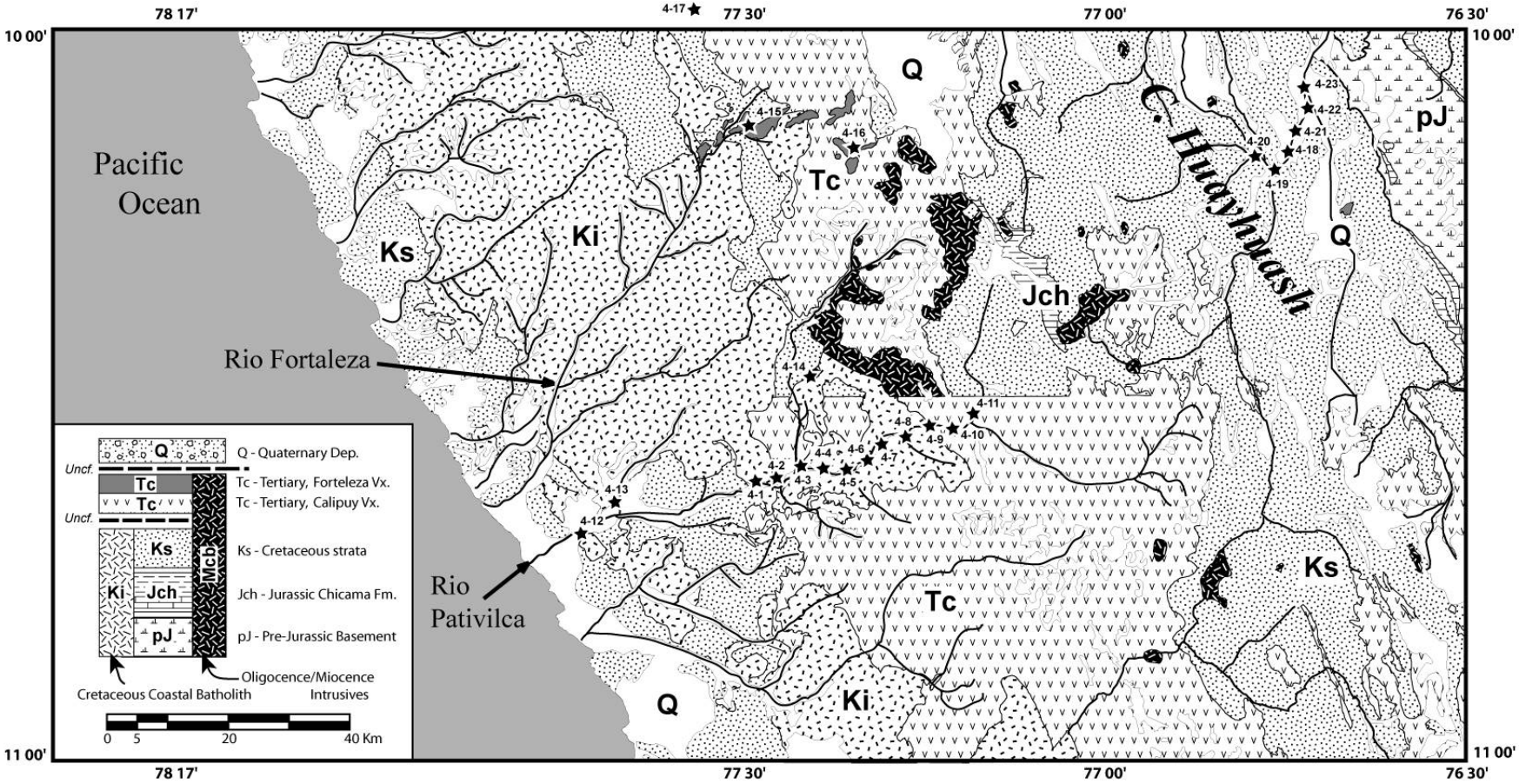

Figure 4: Simplified geologic map of the Cordillera Huayhuash and surrounding region. Sample locations are marked with a star and the sample number. Dashed limes represent the divisions between the Pacific Piedmont (lowlands), the topographic rise and the high topography. The Pacific piedmont is very arid and has little topography. The topographic ramp is cut by many rivers and increases in elevation from near sea level to over 4000 meters and has up to ~3500 meters relief locally. The high topography in the Peruvian Andes is relatively flat with small relief (about 500 meters) with the exception of the high cordilleras that occur along the drainage divide (i.e. C. Blanca and C. Huayhuash). The flat line across the center of the map is a result of inconsistencies between published geologic maps from which this map was created (after Cobbing *et al.*, 1997, 1973; Myers, 1980: Yanahuanca, Barranca, Chiquian, Ambar, Huayllapampa, and Oyon quadrangles)

and quartzite with thin beds of limestone and anhydrites (Cobbing *et al.*, 1981, Myers, 1975).

1.6.2 Arc Related Intrusion & Deposition

The Cretaceous Casma Group was deposited on the western edge of the Precambrian Paramonga basement block and represents the first volcanic activity in this area. The Casma Group is made up of andesitic volcanics with some marine sediments that locally contain mid-Cretaceous ammonites (c.100 Ma), which agrees well with the oldest emplacement ages of plutons, the Patap Complex, in the coastal batholith. The Coastal Batholith was locally emplaced into the Casma Group (Myers, 1975b).

The Casma Group was strongly folded during pulses of deformation associated with the intrusion of the coastal batholith. To the east, on the Chavin Block, deformation was very different. Limestones and sandstones were folded as one unit over a décollement on the Lower Cretaceous Oyon & Chicama Formations. Still farther east, normal and reverse faulting controlled deformation of Cretaceous rocks on the Marañon block (Myers, 1975).

1.6.3 The Coastal Batholith

The Coastal batholith is represented by a series of igneous intrusions that were mainly emplaced in the Cretaceous. Detailed mapping of the batholithic rocks suggests it is comprised of several phases. The Patap complex, ~105-95 Ma, is composed of gabbro and diorite. The Paccho complex, 95-90 Ma, is composed of diorite and tonalite. The Santa Rosa complex, 90-70 Ma, is composed of mainly diorite tonalite and monzogranite. The Puscao-San Jeromino, 70-50 Ma, is comprised of granite dikes, aplite sheets and monzogranite plutons (Cobbing *et al.*, 1981, Myers, 1975). Most samples collected along

the Rio Pativilca transect belong to the Pativilca pluton. The Pativilca pluton has a K/Ar age of ~35 Ma and is located in the Rio Pativilca valley. This pluton is the largest monzogranite body recognized in the coastal batholith (Cobbing *et al.*, 1981).

1.6.4 The Calipuy Volcanics

The Calipuy Group is a 2000-4000 meter thick sequence of Tertiary andesite, dacite, rhyolite, lava and pyroclastic flows. The Calipuy Gp. sits unconformably on the folded Casma volcanics on the Paramonga block and on Cretaceous sedimentary rocks of the Chavin block (Myers 1975). Reported K-Ar ages on the Calipuy Group range from 53.9 to 14.6 Ma. (Cobbing *et al.*, 1981, Farrar & Noble, 1976)

1.6.5 Miocene Plutonism

A short period of plutonism during the Miocene is thought to have been caused by oblique convergence of the Nazca Plate and associated strike-slip partitioning (McNulty *et al.*, 1998). This plutonism produced the leucogranodioritic Cordillera Blanca batholith, which has a youngest emplacement age of 8.2±0.2 Ma, but U/Pb ages range from 8.2 to 12 Ma (Stewart *et al.*, 1974).

1.6.6 Mio-Pliocene Ignimbrites

Widespread but patchily exposed are a number of ignimbrites that record the last stage of volcanism in this part of Peru. The deposits have different names regionally, and in this study area they are referred to as the Fortaleza, Yungay, Huayllay and Puscanterpa Formations. Thicknesses of these formations range from 10's of meters to hundreds of meters and commonly have spectacular vertical columnar jointing (Cobbing *et al.*, 1997 & 1981). They occur on many different erosion surfaces that post-date the Calipuy Group. However, these ignimbritic units are clearly cut by the Canyon Stage of erosion

described by McLaughlin (1924). Isotopic ages on these tuffs range from 7.15 to 6.4 Ma (See Garver *et al.,* 2005; Giovanni *et al.,* 2003; Wise & Noble, 2002).

Chapter 2: Methods

2.1 Sample Preparation

A total of 24 samples were collected in a transect from Barranca along the coast, up the Rio Pativilca Valley and into the crest of the Andes. Rocks were collected from fresh, accessible outcrops of granite and quartzite in the field. About 2-4 Kg of crushed sample was then pulverized and apatite and zircon were separated using standard heavy liquid and magnetic separation techniques at Union College. Rocks were crushed using a jaw crusher and pulverized in a disc mill. Samples were then run down a Rogers table for density separation. The sample remaining from the Rogers table was then sieved for the appropriate 200 μm size fraction. Tetrabromoethane was used to separate out the heavy minerals from this size fraction. Samples were then magnetically separated using a Frantz Magnetic Separator. The final step was separation of zircon and apatite using Methylene Iodide.

Several low temperature thermochronologic techniques were used to date the samples collected in this transect. These include the apatite & zircon fission track (AFT & ZFT and Apatite & Zircon U/Th helium methods (AHe & ZHe). Fission track dating was done at Union College FT Lab while helium analysis was done at the helium lab of P. Reiners at Yale University.

2.2 (U+Th)/Helium Analysis

2.2.1 Apatite

Single apatite grains were picked from concentrated separates under 120x magnification using #5 Dumoxel biology grade tweezers. The grains were checked in plain light and polarized light for inclusions. Inclusion-free grains analyzed were photographed using a digital camera and then measured using the digital picture. Grains are measured on two sides, both length and width, for determining the alpha ejection correction (HAC of Farley, 2002). Apatite grains smaller than 60 μm in width were avoided because grains this small and smaller have relatively large HAC correction factors, which introduces considerable error. After photographing, grains were wrapped in one millimeter platinum tubes. Platinum tubes were then placed under high vacuum in the helium line and degassed with a Nd-YAG or CO_2 laser for three minutes, which is inferred (from previous calibration experiments) to cause crystal heating to 1100 - 1300^{o}C. The helium degassed from the apatite crystal was then spiked with ^{3}He and trapped in a cryotrap at 16°K, then released into a quadrapole mass spectrometer for analysis. Degassed apatite grains were then placed in Teflon™ micro-vials with a ^{229}Th and ^{233}U spike and dissolved. The single-grain solutions for each grain were analyzed in a separate analytical run for ^{232}Th, ^{229}Th, ^{238}U, ^{235}U, ^{233}U, ^{152}Sm and ^{147}Sm on a Finnigan Element2 ICP-MS in the helium lab at Yale University.

2.2.2 Zircon

Zircons did not need to be checked for inclusions because they are fully digested in the dissolution process. Zircons were picked, photographed and measured like the apatite but in addition the tip lengths of zircons were measured along with the length and

width for better calculation of the HAC. Zircons were then wrapped in Niobium foil and degassed with a Nd-YAG laser for 15 minutes. The helium degassed from the zircon crystal was then analyzed with the same technique as stated in the previous section. A re-extract on the same zircon is routinely done to check if all helium has been degassed. Re-extracts are done on a grain until the amount of helium degassed is less than 2% of the first helium extract. Degassed zircons were then placed in Teflon™ micro-vials with a U/Th spike, HF, and HNO_3 and digested at 225°C for three days. The vials were then removed from the bomb and the HF and HNO_3 were evaporated, and HCl was added then heated for 24 hr at 200°C. The single-grain solutions for each grain were analyzed in a separate analytical run for ^{232}Th, ^{229}Th, ^{238}U, ^{235}U and ^{233}U on a Finnigan Element2 ICP-MS (Reiners *et al.,* 2003). Samarium is not analyzed for due to low concentrations in zircon.

2.3 Fission-track Analysis

2.3.1 Apatite

Apatite grains were mounted in epoxy on glass slides, ground and polished using 9μm and 1μm diamond polishing paste. The sample was then etched in 5m HNO_3 for 20 seconds at 20-22^{o}C. Etched samples were covered with pre-annealed, fresh cleaved mica as an external detector. The samples were irradiated with a nominal fluence of $8x10^{15}$ n/cm^2 at the Oregon State University nuclear reactor. After irradiation, the mica detector was etched in 48% HF for 20 minutes. Samples and mica were then mounted on glass petrographic slides for counting.

2.3.2 Zircon

Zircon grains were mounted in Teflon, ground and polished using 9μm and 1μm diamond polishing paste. Etched samples were covered with pre-annealed, fresh cleaved mica as an external detector. The sample was then etched in a potassium hydroxide and sodium hydroxide eutectic (50:50) for 15-30 hours until tracks were well revealed.

2.3.3 Fluence & Zeta

Glass monitors (CN-1 for apatite & CN-5 for zircon), placed at the top and bottom of the irradiation package were used to determine the fluence gradient. All samples were counted at 1250x using a dry 100x objective (10x oculars and 1.25x tube factor) on an Olympus BMAX 60 microscope fitted with an automated stage and a Calcomp digitizing tablet. Apatite & Zircon fission track ages (± 1σ) were determined using the Zeta method. A CN-1 Zeta factor for the author of 101.5 ± 2.7 (± 1σ) is based on 18 determinations from both the Fish Canyon Tuff and the Durango apatite. A Zeta factor for zircon for the author of 360.2±8.0 (± 1σ) is based on 11 determinations from

the Fish Canyon Tuff and the Buluk tuff. Ages were calculated using the computer program and equations in Brandon (1992). All ages with $\chi^2 > 5\%$ are reported as pooled ages, otherwise, central ages are used.

Chapter 3: Results & Conclusions

3.1. Results

3.1.1 Zircon Fission-track

Zircon fission track ages (Table 1 & Figure 5) get progressively younger up canyon and range from Late Cretaceous to Late Eocene. Ages near the coast are older, Late Cretaceous to Early Paleocene, 93 Ma, 77 Ma, and 61 Ma (4-12, 4-13, and 4-01). Within the Pativilca pluton two distinct sets of ages are apparent. The first set spans most of the distance across the pluton and ranges from 31-38 Ma with an average of ~34.5 Ma. The second group makes up the eastern end of the pluton and has an average age of ~26 (4-08 and 4-10). Not far from the eastern end of the Pativilca pluton is a distinctly different pluton, (4-14) which has a ZFT cooling age of 28 Ma.

ZFT ages were obtained on samples (4-15 &16) collected from the Fortaleza Tuffs. The Fortaleza Tuff has ages of 6.7 Ma and 5.3 Ma while the Yungay Tuff (4-17) to the north has a slightly older age at 7.2 Ma.

Ages from two samples in the core of the Cordillera Huayhuash are relatively young and fully reset. A quartzite (4-19) from 4445m has a ZFT age of 9.9 Ma while granite float from a moraine at 4340m yielded an age of 11 Ma. Samples from the east side of the high of Cordillera Huayhuash are significantly older and wide ranging. These quartzites (4-21, 22, and 24) have ages ranging from 250 Ma to 370 Ma. Poor grain quality and low uranium content contributed to large errors (~10-20%) on these quartzite ages.

3.1.2 Zircon (U+Th)/Helium

Zircon helium ages (Table 2 & Figure 5) get progressively younger up canyon,

Table I: Summary of zircon fission-track data from the Cordillera Occidental

Sample	Elev	Mineral	ρ_s	N_s	ρ_i	N_i	ρ_d	N_d	n	χ^2	Age	-1σ	+1σ	U ± 2se
Western Range, Coastal Batholith, Rio Pativilca														
04-12	90	Zircon	9.44×10^6	786	4.95×10^6	382	2.546×10^5	1711	15	58.5	93.6	-11.9	+13.6	221.7 ±24.6
04-13	200	Zircon	1.02×10^7	951	6.01×10^6	560	2.535×10^5	1689	15	43	77.0	-8.8	+9.9	291.4 ±27.8
04-01	570	Zircon	4.32×10^6	610	3.41×10^6	481	2.703×10^5	1800	15	97.5	61.4	-7.5	+8.6	155.0 ±15.1
04-02	590	Zircon	4.17×10^6	481	5.89×10^6	679	2.692×10^5	1792	15	61.2	34.3	-4.1	+4.7	269.3 ±22.6
04-03	655	Zircon	8.03×10^6	476	1.16×10^7	685	2.681×10^5	1785	15	27.6	33.5	-4.1	+4.6	530.2 ±44.5
04-04	760	Zircon	7.42×10^6	326	9.99×10^6	439	2.670×10^5	1778	15	3.2	35.8	-6.5	+8.0	460.1 ±46.8
04-05	780	Zircon	7.00×10^6	657	8.83×10^6	829	2.658×10^5	1770	15	65.5	37.7	-4.2	+4.7	408.5 ±31.9
04-06	850	Zircon	7.91×10^6	585	1.06×10^7	787	2.647×10^5	1763	15	50.6	35.3	-4.0	+4.5	494.7 ±39.5
04-07	980	Zircon	9.01×10^6	552	1.38×10^7	845	2.636×10^5	1755	15	21.9	30.9	-3.5	+4.0	643.5 ±50.1
04-08	1035	Zircon	3.84×10^6	476	7.07×10^6	876	2.613×10^5	1740	15	4.6	25.5	-3.6	+4.2	332.9 ±25.8
04-10	1175	Zircon	5.61×10^6	437	1.01×10^7	787	2.580×10^5	1718	15	0.2	26.1	-4.5	+5.4	481.5 ±39.5
Intrusives & Volcanics														
04-14	2300	Zircon	8.29×10^6	447	1.32×10^7	714	2.501×10^5	1674	15	77.5	28.1	-3.5	+4.0	650.9 ±57.8
04-15	2075	Zircon	1.05×10^6	131	8.20×10^6	1021	2.897×10^5	1929	15	75.5	6.7	-1.2	+1.4	348.2 ±26.6
04-16	4310	Zircon	6.78×10^5	112	6.67×10^6	1101	2.870×10^5	1912	15	93.5	5.3	-1.0	+1.2	285.7 ±20.8
04-17	3127	Zircon	9.34×10^5	120	6.70×10^6	861	2.844×10^5	1894	15	69.3	7.2	-1.3	+1.6	289.7 ±22.6
04-23	4340	Zircon	1.07×10^6	218	4.57×10^6	929	2.633×10^5	1754	15	35.7	11.1	-1.6	+1.9	213.6 ±16.5
Quartzites, Cordillera Huayhuash														
04-19	4445	Zircon	8.72×10^5	86	4.28×10^6	422	2.699×10^5	1815	15	21.4	9.9	-2.1	+1.7	195.1 ±20.1
04-18	4048	Zircon	1.71×10^7	591	2.45×10^6	85	2.738×10^5	1833	9	0.0	294.7	-121.9	+204.7	110.3 ±24.2
04-21	4164	Zircon	1.38×10^7	61	1.25×10^6	166	2.672×10^5	1789	15	27.5	250.7	-39.6	+46.8	119.5 ±19.1
04-22	4161	Zircon	1.94×10^7	512	2.71×10^6	72	2.659×10^5	1772	10	79.2	332.4	-72.6	+92.2	125.3 ±29.9
04-24	4254	Zircon	1.23×10^7	748	1.52×10^6	92	2.606×10^5	1737	15	90.2	369.0	-72.6	+89.7	71.6±15.3

Note: Elevations are given in meters, ρs is the density (cm^2) of spontaneous tracks and Ns is the number of spontaneous tracks counted; ρi is the density (cm^2) of induced tracks; and ρd is the density (cm^2) of tracks on the fluence monitor (CN5); n is the number of grains counted; and χ^2 is the Chi-squared probability (%). Fission track ages (± 1σ) were determined using the Zeta method, and ages were calculated using the computer program and equations in Brandon (1992). All ages with χ^2 >5% are reported as pooled ages. A Zeta factor for zircon of 360.20±8.04 (± 1 se) is based on 11 determinations from both the Fish Canyon Tuff and the Buluk tuff. Glass monitors (CN5 for zircon), placed at the top and bottom of the irradiation package were used to determine the fluence gradient. All samples were counted at 1250x using a dry 100x objective (10x oculars and 1.25x tube factor) on an Olympus BMAX 60 microscope fitted with an automated stage and a digitizing tablet

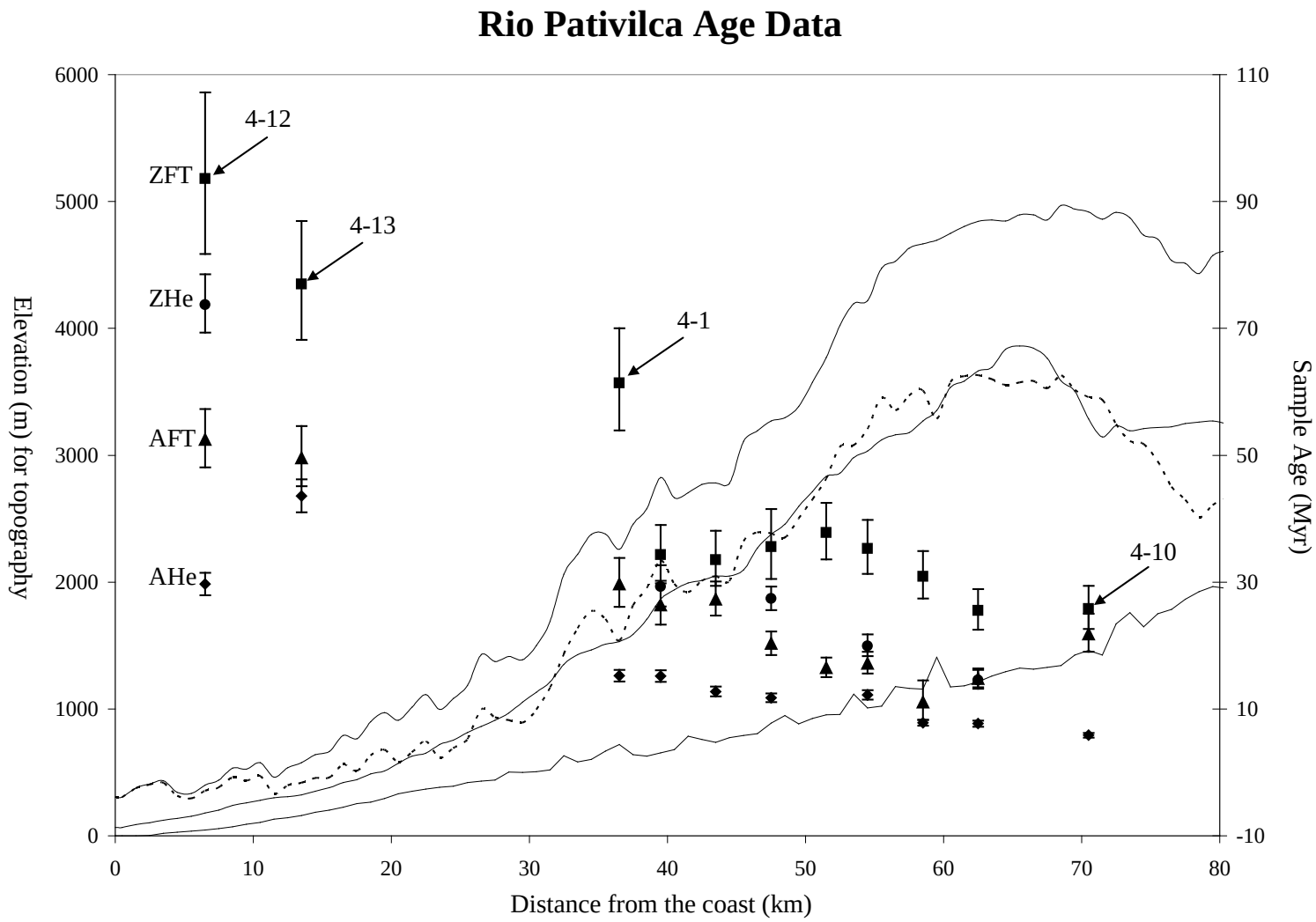

Figure 5. Age data from the Rio Pativilca sampling transect. Squares are ZFT ages, circles are ZHe ages, triangles are AFT ages and flat lines are the AHe ages. The solid lines represent minimum, maximum and mean topography. The dashed line represents relief along the canyon. The samples become younger up valley with the youngest sample being an Apatite Helium age from sample 4-10.

Table II: (U+Th)/He dating of single zircon grains from the Cordillera Occidental

Sample	Elev (masl)	mass (μg)	sgr (μm)	^{4}He (ncc)	U (ppm)	Th (ppm)	Th/U	Raw age (Ma)	err (2σ)	HAC	AGE (Ma)	1σ err (Ma)	ZAC
Western Range, Coastal Batholith, Rio Pativilca													
04 - 12Z1	90	19.2	56	38.8	293	94.6	0.33	52.66	1.03	0.832	63.3	1.24	
04 - 12Z2	90	14.0	44	23.6	213	105	0.51	58.37	1.12	0.792	73.7	1.42	
04 - 02Z1	590	6.07	37	9.07	547	286	0.54	20.11	0.37	0.751	26.7	0.49	
04 - 02Z2	590	6.85	38	2.26	107	68.7	0.66	22.10	0.42	0.755	29.2	0.56	
04 - 04Z1	760	5.89	46	15.6	1080	458	0.43	18.41	0.35	0.780	23.6	0.45	
04 - 04Z2	760	4.21	40	16.3	1430	547	0.39	20.58	0.39	0.751	27.3	0.52	
04 - 06Z1	850	5.00	38	18.5	1890	609	0.33	14.99	0.30	0.752	19.9	0.39	
04 - 06Z2	850	3.15	36	3.48	731	299	0.42	11.43	0.23	0.727	15.7	0.31	
04 - 08Z1	1035	3.19	32	7.62	2290	670	0.30	8.08	0.15	0.712	11.3	0.22	
04 - 08Z2	1035	4.12	37	3.54	580	337	0.60	10.78	0.20	0.740	14.5	0.27	
Intrusives & Volcanics													
04 - 15Z3	2075	2.48	31	0.61	504	144	0.29	3.79	0.07	0.693	4.9	0.11	0.761
04 - 15Z4	2075	9.03	45	6.22	1240	433	0.37	4.23	0.08	0.788	5.0	0.10	0.838
04 - 16Z3	4310	3.85	41	0.83	425	79.2	0.19	3.99	0.08	0.749	4.9	0.11	0.809
04 - 16Z4	4310	1.32	25	0.48	720	213	0.30	3.89	0.08	0.623	5.4	0.13	0.713

Note: HAC is the alpha ejection correction (Farley, 2002), SGR is single grain radius. Each zircon was photographed, measured, and wrapped in a Nb Foil. Samples were degassed with a Nd-YAG laser for 3 min at ~1100-1300°C. The gas was then spiked with He^3, and trapped in a Cryotrap at 16°K, then released into a quadrapole mass spectrometer. Degassed zircons were then placed in Teflon™ micro-vials with a U/Th spike, HF, and HNO_3 and digested at 225°C for three days. The vials were then removed from the bomb and the HF and HNO_3 were evaporated, and HCl was added then heated for 24 hr at 200°C. The single-grain solutions for each grain were analyzed by ^{229}Th and ^{233}U isotope dissolution on a Finnigan Element2 ICP-MS (Reiners et al., 2003). ZAC is the alpha ejection correction made for grains pulled from a fission track mount

and range from Late Cretaceous to Middle Miocene. Intra-sample ZHe ages from the Pativilca transect reproduce well. Ages do fit within expected ranges based on zircon and apatite FT ages with the exception of 4-08 which has a younger zircon helium age than the apatite FT age. Zircon helium ages for the Fortaleza Tuff (4-15 and 4-16) are ~5 Ma. The Yungay Formation (4-17) yielded a ZHe age of 6.5 Ma.

3.1.3 Apatite Fission-track

Apatite FT ages (Table 3 & Figure 6) show a well-defined trend of younger ages up valley. Ages from the coast are relatively old, ~50 Ma (4-12 &13). Samples 4-01, 02 and 03 are Early Oligocene averaging about 28 Ma. Farther up valley (4-04 through 4-06) AFT ages are ~18 Ma. The samples in the deepest part of the valley are 11-15 Ma (4-07 and 4-08). A single sample from the deep canyon (4-10) has an age of 21 Ma. A similar trend can be seen in the apatite fission track ages from the granites of the Rio Fortaleza (Table 3 & Figure 7).

3.1.4 Apatite (U+Th)/Helium

Helium ages from the Rio Pativilca that complement the AFT results also produce this pattern of younger ages up valley (Table 4 & Figure 6). Ages by the coast (4-12 and 4-13) are Middle Oligocene to Early Miocene. Not far from the coast (4-01 and 4-02) helium ages are ~15 Ma; they decrease up valley to ~12 Ma (4-03 through 4-06), and this gradient continues to the final samples in the Pativilca canyon (4-07, 4-08 and 4-10) which are the youngest at ~7.5 Ma & 5.8 Ma. Intra-sample AHe ages from the Mio-Pliocene ignimbrites (4-15, 16 & 17) are variedand do not reproduce well probably because the apatite grains from these ignimbrites are loaded with inclusions.

Table III: Summary of apatite fission-track data from the Cordillera Occidental

Sample	Elev	Mineral	ρ_s	N_s	ρ_i	N_i	ρ_d	N_d	n	χ^2	Age	-1σ	+1σ	U ± 2se
Western Range, Coastal Batholith, Rio Fortaleza														
03-101	115	Apatite	1.52×10^5	60	6.43×10^5	254	3.628×10^6	3351	15	99	45.0	-6.1	+7.1	7.0 ±0.9
03-106	400	Apatite	9.44×10^5	179	4.15×10^6	787	3.772×10^6	3328	15	100	44.2	-3.8	+4.2	43.8 ±3.4
03-105	1126	Apatite	7.00×10^5	81	5.23×10^6	605	3.133×10^6	3274	15	94	21.4	-2.5	+2.8	66.4 ±5.8
03-104	1725	Apatite	3.22×10^5	49	2.16×10^6	329	3.736×10^6	3337	15	19	28.7	-4.4	+5.0	23.0 ±2.6
03-103	2090	Apatite	1.00×10^5	22	1.41×10^6	310	3.718×10^6	3342	15	68	13.7	-3.1	+3.6	15.2 ±1.8
03-102	2750	Apatite	1.29×10^5	29	1.93×10^6	434	3.700×10^6	3347	15	76	12.8	-2.5	+2.9	20.8 ±2.1
Western Range, Coastal Batholith, Rio Pativilca														
04-12	90	Apatite	1.17×10^6	187	4.14×10^6	664	3.678×10^6	3845	15	98	52.5	-4.4	+4.8	44.9 ±3.7
04-13	200	Apatite	7.65×10^5	153	2.85×10^6	571	3.655×10^6	3821	15	99	49.6	-4.5	+5.0	31.1 ±2.7
04-01	570	Apatite	2.20×10^5	72	1.50×10^6	490	3.972×10^6	4106	15	97	29.7	-3.6	+4.1	15.0 ±1.4
04-02	590	Apatite	4.46×10^5	79	3.36×10^6	596	3.905×10^6	4082	15	54	26.4	-3.1	+3.4	34.3 ±3.0
04-03	655	Apatite	3.30×10^5	128	2.40×10^6	922	3.882×10^6	4059	15	99	27.4	-2.6	+2.8	24.6 ±1.8
04-04	760	Apatite	3.45×10^5	150	3.33×10^6	1450	3.859×10^6	4035	15	96	20.3	-1.8	+1.9	34.4 ±2.1
04-05	780	Apatite	2.91×10^5	134	3.43×10^6	1580	3.836×10^6	4011	15	97	16.5	-1.5	+1.6	35.6 ±2.0
04-06	850	Apatite	2.22×10^5	126	2.51×10^6	1425	3.814×10^6	3987	15	97	17.2	-1.6	+1.8	26.2 ±1.6
04-07	980	Apatite	2.71×10^5	17	4.75×10^6	298	3.791×10^6	3964	6	96	11.1	-2.8	+3.4	49.8 ±5.9
04-08	1035	Apatite	3.31×10^5	115	4.28×10^6	1488	3.768×10^6	3940	15	100	14.8	-1.4	+1.6	45.3 ±2.6
04-10	1175	Apatite	3.87×10^5	60	3.38×10^6	254	3.723×10^6	3892	15	54	21.8	-2.8	+3.2	36.1 ±3.3
Intrusives & Volcanics														
04-14	2300	Apatite	4.40×10^5	199	3.08×10^6	1393	3.428×10^6	3583	15	93	24.9	-1.9	+2.1	35.7 ±2.1
04-15	2075	Apatite	1.75×10^4	10	7.17×10^5	409	3.405×10^6	3559	15	97	4.3	-1.4	+1.8	8.4 ±0.9
04-16	4310	Apatite	1.24×10^4	7	5.27×10^5	298	3.382×10^6	3535	15	92	4.1	-1.6	+2.1	6.2 ±0.7

Note: Elevations are given in meters, ρs is the density (cm^2) of spontaneous tracks and Ns is the number of spontaneous tracks counted; ρi is the density (cm^2) of induced tracks; and ρd is the density (cm^2) of tracks on the fluence monitor (CN1); n is the number of grains counted; and χ^2 is the Chi-squared probability (%). Fission track ages (± 1σ) were determined using the Zeta method, and ages were calculated using the computer program and equations in Brandon (1992). All ages with χ^2 >5% are reported as pooled ages. For apatite, a Zeta factor of 101.52 ± 2.7 (± 1 se) is based on determinations from both the Fish Canyon Tuff and the Durango apatite. Glass monitors (CN1 for apatite), placed at the top and bottom of the irradiation package were used to determine the fluence gradient. All samples were counted at 1250x using a dry 100x objective (10x oculars and 1.25x tube factor) on an Olympus BMAX 60 microscope fitted with an automated stage and a digitizing tablet.

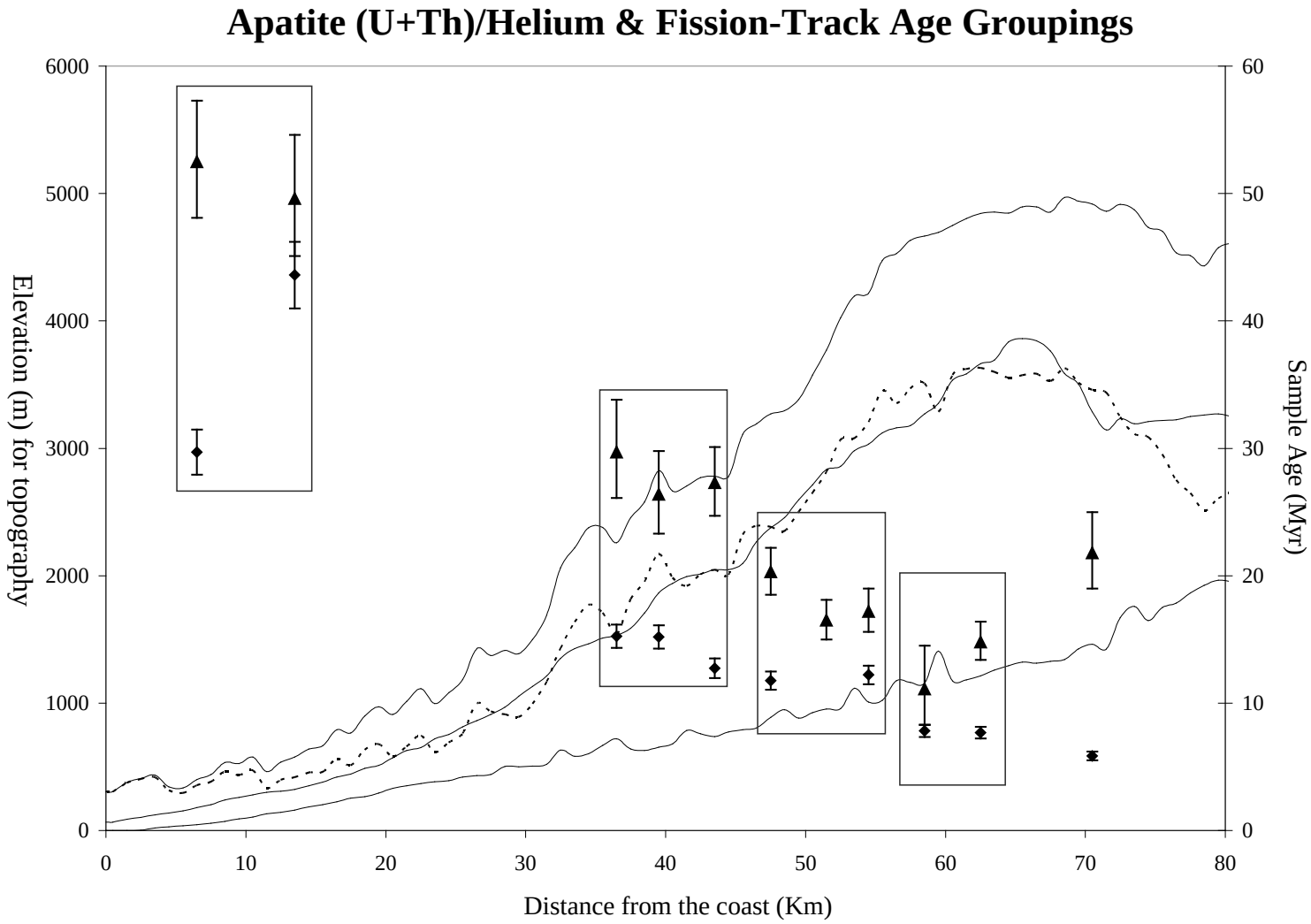

Figure 6. Age data from the Rio Pativilca sampling transect. Triangles are AFT ages and flat lines are the AHe ages. The solid lines represent minimum, maximum and mean topography. The dashed line represents relief along the canyon. The graph shows an apparent stepwise decrease in ages up canyon. This could be a result of episodic cooling or an artifact of sampling.

Table IV: (U+Th)/He dating of single apatite grains from the Cordillera Occidental

Sample	Elev (masl)	mass (μg)	sgr (μm)	^{4}He (ncc)	U (ppm)	Th (ppm)	Th/U	Raw age (Ma)	err (2σ)	HAC	AGE (Ma)	1σ err (Ma)
Western Range, Coastal Batholith, Rio Pativilca												
04 - 12 A1	90	1.97	42		28.9	26.3	0.93	19.1	0.52	0.687	27.8	1.67
04 - 12 A2	90	1.11	35		14.0	21.0	1.54	20.2	0.62	0.638	31.6	1.90
04 - 13 A2	262	1.28	40	0.035	2.70	20.7	7.84	28.8	1.77	0.655	43.9	3.42
04 - 13 A3	262	2.51	51	0.127	7.56	23.0	3.12	35.5	1.35	0.729	43.2	5.22
04 - 01 A2	570	1.77	36	0.122	41.0	67.4	1.69	9.9	0.18	0.652	15.2	0.91
04 - 01 A3	570	1.59	42		23.1	64.6	2.87	10.2	0.28	0.668	15.3	0.91
04 - 02 A1	590	1.77	36	0.043	14.0	30.5	2.24	9.36	0.28	0.649	14.4	0.86
04 - 02 A4	590	3.11	46	0.941	13.7	35.4	2.65	11.1	0.33	0.696	16.0	0.94
04 - 03 A1	655	1.57	32	0.045	19.4	47.1	2.49	7.63	0.16	0.618	12.4	0.74
04 - 03 A3	655	4.78	48	0.269	32.0	67.6	2.16	9.46	0.15	0.721	13.1	0.42
04 - 04 A1	760	6.50	46	0.354	34.0	92.5	2.79	7.93	0.13	0.667	11.9	0.71
04 - 04 A5	760	2.22	40	0.162	46.5	133	2.93	7.66	0.24	0.656	11.6	0.72
04 - 06 A1	850	2.09	41	0.110	33.5	80.3	2.46	8.06	0.25	0.678	11.9	0.71
04 - 06 A2	850	1.80	37	0.054	19.8	40.7	2.11	8.24	0.18	0.656	12.6	0.75
04 - 07 A1	980	8.49	65		42.7	98.6	2.37	6.24	0.16	0.798	7.8	0.47
04 - 08 A1	1035	2.89	33	0.093	35.7	75.0	2.16	4.90	0.10	0.650	7.5	0.45
04 - 08 A3	1035	1.75	38		38.7	85.1	2.26	4.75	0.13	0.660	7.2	0.43
04 - 10 A1	1175	1.58	33		46.9	56.4	1.23	3.55	0.11	0.615	5.7	0.35
04 - 10 A2	1175	1.52	35		36.1	28.2	0.80	3.72	0.12	0.628	5.9	0.36
Intrusives & Volcanics												
04 - 14 A1	2300	1.38	35		33.1	55.9	1.74	10.94	0.30	0.638	17.1	1.03
04 - 14 A2	2300	1.80	36	0.179	51.0	87.6	1.76	11.34	0.19	0.636	17.8	0.58
04 - 15 A1	2075	3.18	55		21.2	55.8	2.70	2.35	0.07	0.737	3.2	0.19
04 - 15 A2	2075	7.01	68		5.2	18.1	3.59	8.03	0.23	0.787	10.2	0.61
04 - 16 A1	2075	8.09	57		7.5	18.7	2.55	4.36	0.12	0.761	5.7	0.34
04 - 16 A2	4310	9.99	61		11.2	16.4	1.51	5.56	0.15	0.788	7.0	0.42
04 - 17 A2	3200	4.72	48		12.7	33.2	2.69	5.08	0.14	0.732	6.9	0.42

Note: HAC is the alpha ejection correction (Farley, 2002), SGR is single grain radius. Each apatite was photographed, measured, and wrapped in a Pt tube. Samples were degassed with a Nd-YAG or CO_2 laser for 3 min at ~1100-1300°C. The gas was then spiked with He^3, and trapped in a Cryotrap at 16°K, then released into a quadrapole mass spectrometer. Degassed apatites were then placed in Teflon™ micro-vials with a U/Th spike, HF, and HNO_3 and digested at 225°C for three days. The vials were then removed from the bomb and the HF and HNO_3 were evaporated, and HCl was added then heated for 24 hr at 200°C. The single-grain solutions for each grain were analyzed by ^{229}Th and ^{233}U isotope dissolution on a Finnigan Element2 ICP-MS (Reiners et al., 2003).

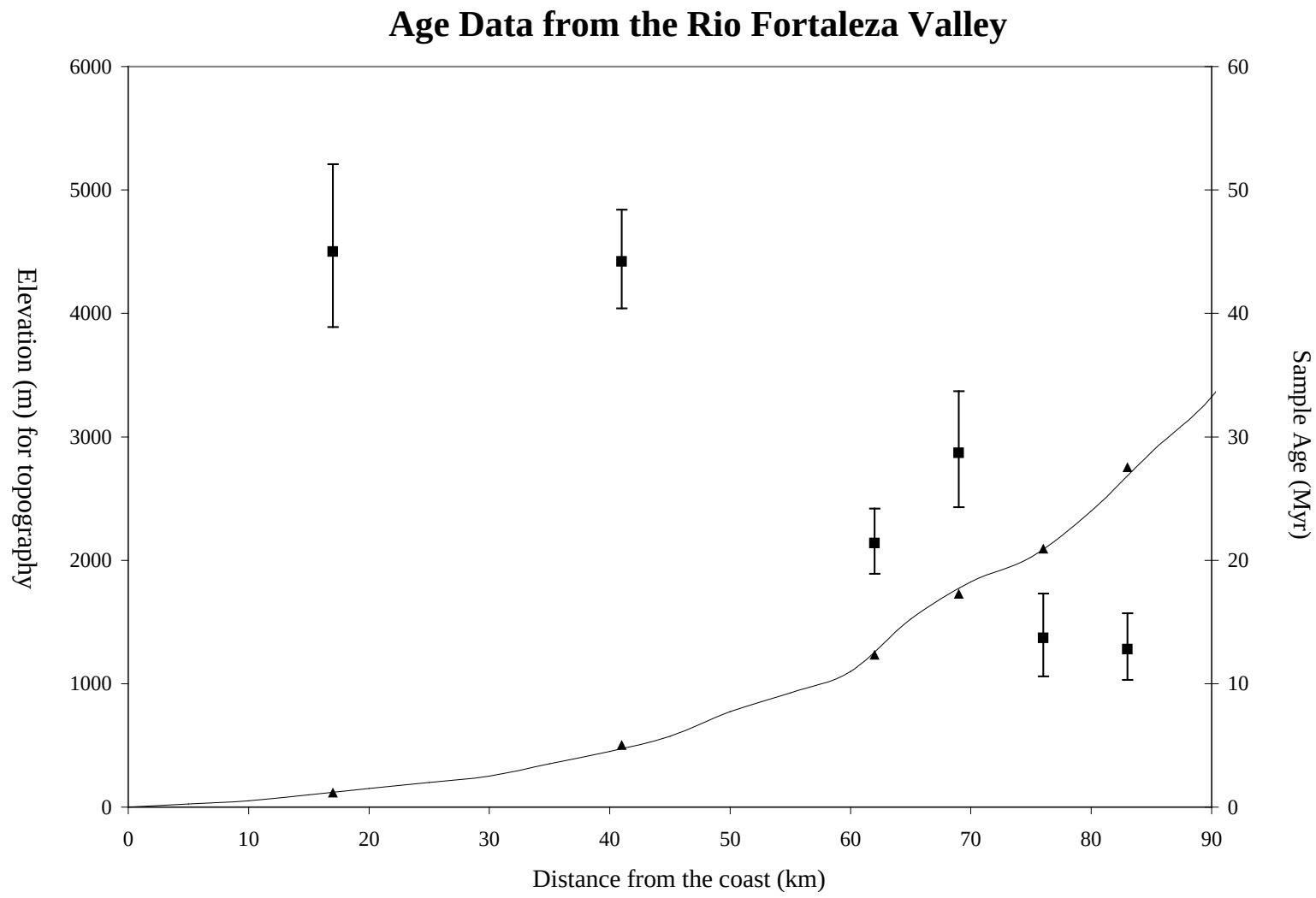

Figure 7. Apatite fission-track ages form the Rio Fortaleza Valley in Peru. These date show a similar decreasing ages up valley trend as AFT data from the Rio Pativilca. AFT ages are represented by squares, sample locations are triangles. The solid black line is elevation of the valley floor.

3.2. Interpretation

3.2.1 Ignimbrites

ZFT ages for the Fortaleza & Yungay Tuffs are similar to published K-Ar ages (e.g. Farrar & Noble 1976, Cobbing *et al.*, 1981, 1996) and are probably deposition ages for these units. The ages from these units show a clear trend of older ages in the Yungay Fm near the C. Blanca and younger ages, ~6.0 Ma, in the Fortaleza Fm to the south. Because these ignimbrites fill valleys cut during the Vallé stage and are cut themselves by valleys formed during the Cañón stage, they provide an independent maximum age for the start of the Cañón Stage at ~5-6 Ma.

3.2.2 Canyon Transect

A plot of ages versus elevation and distance from the coast for the canyon transect shows a decreasing age pattern up valley (Figure 5). The decrease in ages appears to happen in steps along the canyon transect; this can be seen more easily in the apatite ages (Figure 6). This "stepping" may be an artifact of sampling or it may also represent episodic cooling. Several of these age clusters coincide with tectonic phases outlined by Sébrier (1988). These include Late Oligocene (26-28 Ma), Early Miocene (15-17 Ma) and Late Miocene events (7 Ma).

Zircon cooling ages for the canyon transect indicate that the Pativilca pluton was probably emplaced at a relatively shallow depths, ~5-6 km below the surface. However the cooling ages of samples from the pluton differs from one side of it to the other along the canyon. The majority of the samples have a mean of ~34.5 Ma while the samples from the eastern part of the pluton have a mean of ~25 Ma. The ZFT ages of 25 Ma (4-08 & 4-10) may actually be associated with the thermal affects of the intrusion of a

younger high-level pluton previously undated (see 4-14). Because samples 4-08 and 4-10 are in close proximity to this intrusion these samples were probably reset during that high-level intrusive event. Almost a 10 Myr difference exists between two ends of the same pluton, and only the older set is concordant with previously published K/Ar ages from the Pativilca pluton (Cobbing *et al*., 1997).

Using mineral pairs for cooling ages, incision rates can be calculated for the samples (e.g. AFT to AHe, AHe to surface pairs). Incision rates were calculated using an average geothermal gradient of 25^{o}C and a closure temperature of 70^{o}C for the helium system and 110^{o}C for the FT system. Because the cooling rates are generally slow, about 5-10^{o}C/Myr, isotherm advection associated with rapid exhumation would not have been significant, and therefore we can use average cooling gradients. A plot of incision rates verses distance along the valley transect shows a clear trend of increasing rates in the deeper section of the valley (Figure 8). The AFT to AHe age pair incision rates drop off dramatically just past the deepest part of the canyon, a possible explanation for this is that these last samples sat in the partial annealing zone for the fission-track system. This would produce an older age than expected and in turn cause a decrease in our calculated incision rates. Unfortunately low track density prevented track length studies on most samples from this transect.

Plotting these incision rates versus the time interval illustrates changes in incision rates (Figure 9). Because it has been inferred that this entire area was once at the same elevation when the Puna surface formed, we suggest that the coastal samples are a good proxy for cooling during Puna development. From 50 Ma to 15 Ma, exhumation occurred at the relatively slow rates of c. 50-100 m/Myr as indicated by the samples

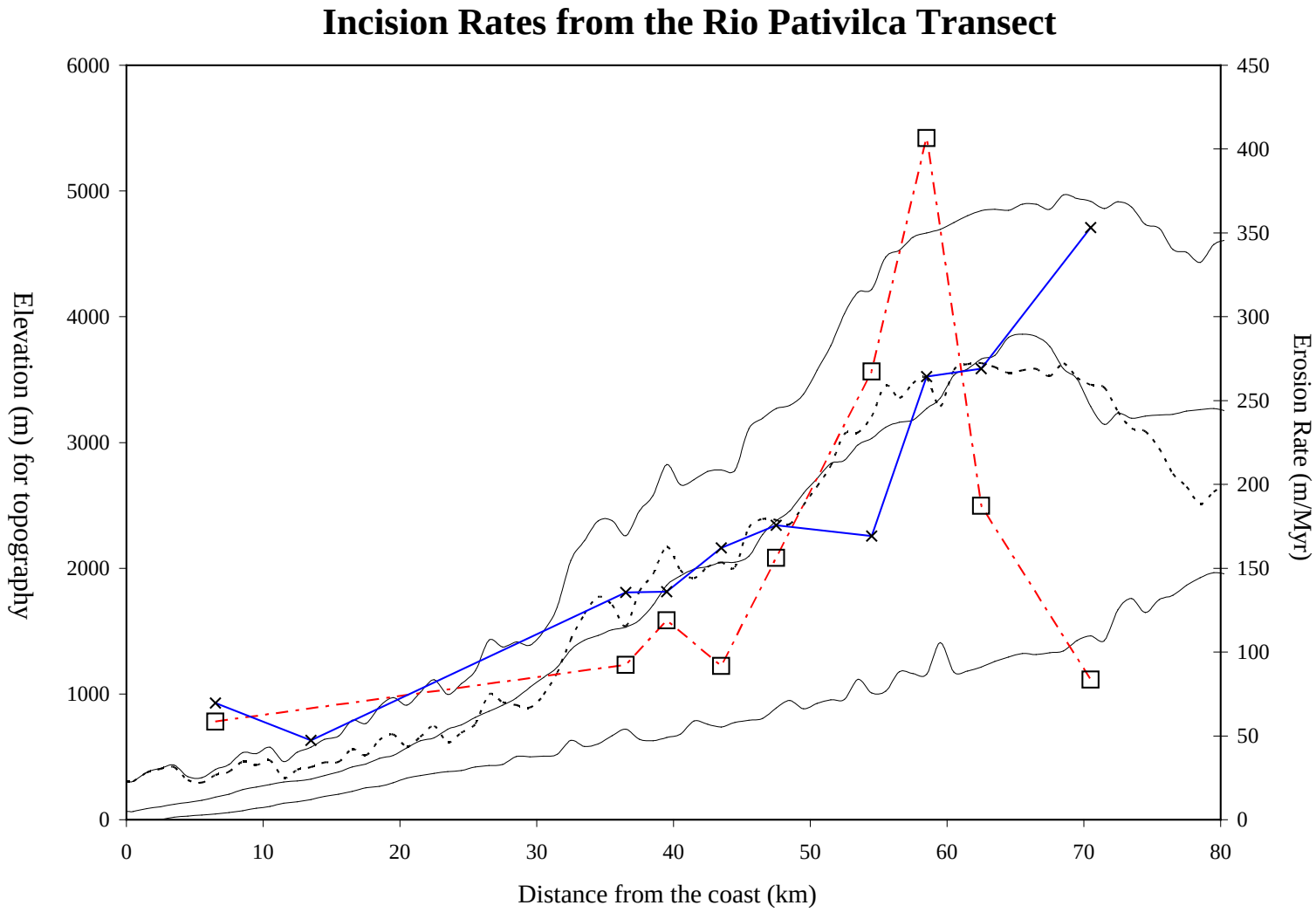

Figure 8. Calculated incision rates from AFT to AHe and AHe to surface pairs plotted against topography and distance from the coast. AFT to AHe age pair incision rates are squares and AHe to surface are x's. Incision rates show a clear increasing trend into the deepest section of the valley. The dramatic decrease in AFT to AHe incision rates could be attributed to fission-track samples affected by time spent in the partial annealing zone

Incision Rates for Puna, Vallé & Cañón Stages in the Pativilca valley of Peru

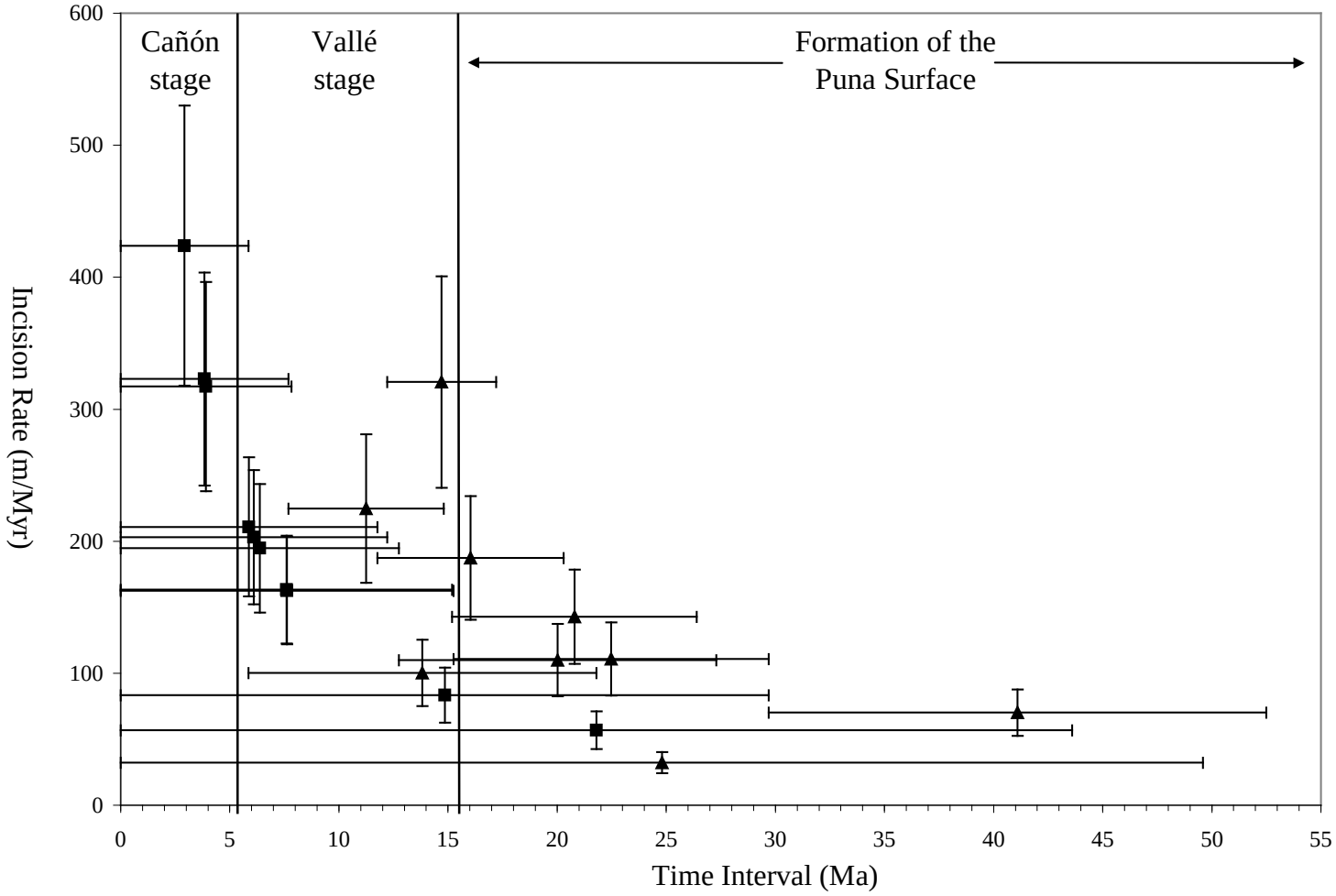

Figure 9. Graph of incision/erosion rates versus age interval. Triangles are AFT-AHe age pair rates, squares are AHe-surface age pair rates. The dark grey box (right) represents erosion rates, 75-100 m/Myr, for the formation of the Puna surface. The medium grey box (middle) represents incision rates of the Vallé stage 150-250 m/Myr, and the light grey box (left) represents Cañón stage incision rates 300-400 m/Myr.

collected near the coast. It is possible that this slow rate represents the slow erosion that formed the Puna Surface.

The Vallé stage is recorded as ~2000-2500 m of incision in the geomorphologic record (Cobbing *et al.,* 1981). This stage cuts into the older rocks on which the Puna surface is developed. According to our erosion rate estimates, incision rates for this area at ~15 Ma increased to ~150-250 m/Myr. This increase in incision rates is inferred to be the start of the Vallé stage incision. Based on these incision rates the Vallé stage appears to have lasted ~10 myr. Using this rate, the Pativilca canyon would have cut downward 1500-2500 meters between the start of the Vallé and the start of the Cañón Stage, and this agrees well with the geomorphologic record.

The Cañón stage is described as another 2000-2500 meters of incision which cuts into the ignimbrites that fill the Vallé canyons (Cobbing *et al.,* 1981). Subsequent to ~5-6 Ma our data indicate incision increased to ~300-400 m/Myr, this change is inferred to be the start of the Cañón stage of incision. This incision rate, like that of the Vallé stage, agrees well with the geomorphologic record. The start of the Cañón stage also appears to correspond to the start of maximum exhumation along the crest of the Andes (Garver *et al.,* 2005).

3.2.3 Crest of the Transect

The ~11 Ma granite float and ~10 Ma quartzite from the high peaks are similar to other ages obtained in this area and are associated with Middle Miocene plutonism along the axis of the Andes (Garver *et al.,* 2005). The wide range in grain ages and old ages from the Paleozoic quartzites east of the high peaks, indicate that they have not been deeply buried or heated to any great degree. This Miocene thermal event characterized

by the rocks along the crest of the Andes does not seem to have affected rocks in the Rio Pativilca canyon.

3.3. Driving Mechanisms

Today the Puna is a high-standing surface along the crest of the Andes and it is deeply incised by rivers along its western edge. Two relevant surfaces have formed due to the erosion of these rivers into the Puna surface; these are the Vallé and Canon surfaces. Incision can be caused by several factors: 1) erosion driven by an increase in discharge (increase in rain and/or snow which would be marked by glaciation); or 2) an increase in potential energy due to a base level shift (drop in sea level fall or surface uplift).

The first scenario requires a starting point where surface uplift largely preceded incision, and that incision was then caused by a change in erosion rates. This setting implies that the change in erosion rates created the canyons, so the closure of low-temperature thermochronometers has nothing to do with uplift. Geomorphologic and thermochronologic data discussed previously suggest that the Vallé phase of valley incision began to incise the Puna Surface at ~15-17 Ma at rates of 150-250 m/Myr. The increased erosion rates determined by this study could be a result of increased precipitation at this time. However, data from Hartley and others show just the opposite: at 15 Ma there is an increase in the Andean rain shadow, which is especially pronounced on the west side of the Andes in this area (Hartley & Chong, 2003; Hartley *et al.*, 2000). This aridity made most of western Peru hyperarid and therefore it is unlikely that increased erosion would be due to increased precipitation. The second increase in incision rates occurs at ~5-6 Ma or the start of the Cañón phase of valley incision. It seems unlikely that this stage would be influenced by an increase in rainfall as it just before the onset of hyperaridity and after formation of the Andean rain shadow.

Glaciers and ice fields could also cause an increase in erosion and incision due to focused discharge of melt water. Today, the drainage divide is widely glacierized, so the timing of the onset of glaciation in this area is an important aspect of the problem. Little is known about the timing of the onset of glaciation in Peru. Based on the age of a diamictite inferred to be glacial in origin, major glaciation did not begin in the Bolivian Andes (farther south) until ~3.6 Ma (Clapperton, 1993). In order to increase Cañón phase erosion rates in the Peruvian Andes glaciation would need to begin at or before ~5-6 Ma which is unlikely given what is known about the onset of glaciation worldwide (see Benn & Evans, 1998). Because average global temperatures were warmer during the Miocene-Pliocene, the snow line would likely have been at a higher elevation in this equatorial region than the modern snow line of ~5000 m (Herbert & Schuffert, 1998; Barron, 2000). Due to higher snow/ice lines and probable lower average elevations glaciation has probably been only significant in the last 3 million years.

The second scenario requires an initial low-relief setting that was then progressively uplifted to current elevations of c. 4-5 km. In this scenario, incision is a direct response to uplift, which has driven an increase in potential energy of the rivers. If river incision was driven by uplift, these data provide a unique view of uplift in this area of the Andes. The apatite FT and (U+Th)/He data suggest that the low Puna surface erosion rates existed from ~50 Ma until ~15 Ma when more rapid uplift began. The only other age data available for the end of the Puna stage in Peru is based on a tuff that appears to be cut by the Puna erosion surface. This is the youngest rock cut thought to be cut by this erosion surface and was dated by Farrar & Noble (1976) using K/Ar at 14.6

Ma. However, it is possible that this erosion surface may be unrelated to the erosion of the Puna surface.

The initial 2000-2500 meters of incision is probably in response to uplift caused during the Lower and Middle Miocene by compressional tectonic pulses occurring at ~15-17 Ma and ~7 Ma (Sébrier *et al.*, 1988). If the cooling age-pattern is related to surface uplift, it would appear that the second stage of uplift began at ~5-6 Ma based on erosion rates from apatite (U+Th)/Helium data. The evidence for the timing of this second incision phase is also supported by the age of the Fortaleza ignimbrite. The Vallé stage erosional surface exposed in the nearby Rio Fortaleza is filled by this Mio-Pliocene ignimbrite dated at ~5 Ma. This ignimbrite is cut by the incision of the Cañón stage and so must predate this stage of erosion.

3.4. Canyon erosion & exhumation along the crest

An important question surrounds the relationship between canyon incision along the west flank of the Andes, and the exhumation along the crest that resulted in such high dramatic topography. Initial canyon incision does not appear related to exhumation of the crest of the Peruvian Andes. Along the crest there is a poor record of geologic events at c. 15 Ma, but soon thereafter, there was a major pulse of high level plutonism and heating from about 13 to 10 Ma (see Garver *et al.,* 2005). Based on our erosion rates from the rocks in the western canyons, incision began at ~15 Ma, while exhumation of the crest began sometime after the ~10-11 Ma thermal event clearly seen in rocks of the Cordillera Huayhuash (Garver *et al.,* 2005). However, since ~6 Ma rocks in both the Cordillera Huayhaush and Cordillera Blanca have undergone significant exhumation (between 2 and 9 km) (Garver *et al.,* 2005). This timing corresponds to the increased incision rates in the Rio Pativilca Canyon at the start of the Cañón stage. It is possible that these events are related to a Late Miocene compressional tectonic pulse (Sébrier *et al.,* 1988), but in all three study areas (Blanca, Huayhaush, and Pativilca), the last phase must continue to the present.

3.5. Regional Discussion

In terms of the large-scale growth of the Andes, these data may provide evidence that the Andes have grown and expanded northward over time (Figure 10). Gregory-Wodzeki (2000) concluded that the Western Cordillera of the central Andes had reached no more than half the modern height by 18-25 Ma. According to our estimates based on the uplift-incision hypothesis, half of the modern height of the Peruvian Andes was attained after 15 Ma but before 5 Ma: much later then in the main part of the Andes to the south. The final 2-3 km of uplift must have occurred in the last 5-6 Myr. To the north in Ecuador, inferred uplift is slightly younger at ~6 Ma (Coltorti & Ollier, 199) based on planation of Early Pliocene Chota Formation strata. This result from Ecuador would suggest that in last 6 Myr ~3500 meters of uplift (total amount) has occurred there. More recent work done with thermochronology supports uplift beginning in the Miocene but the most uplift taking place in during the Plio-Pleistocene (Coltorti & Ollier, 1999, Spikings *et al.*, 2000).

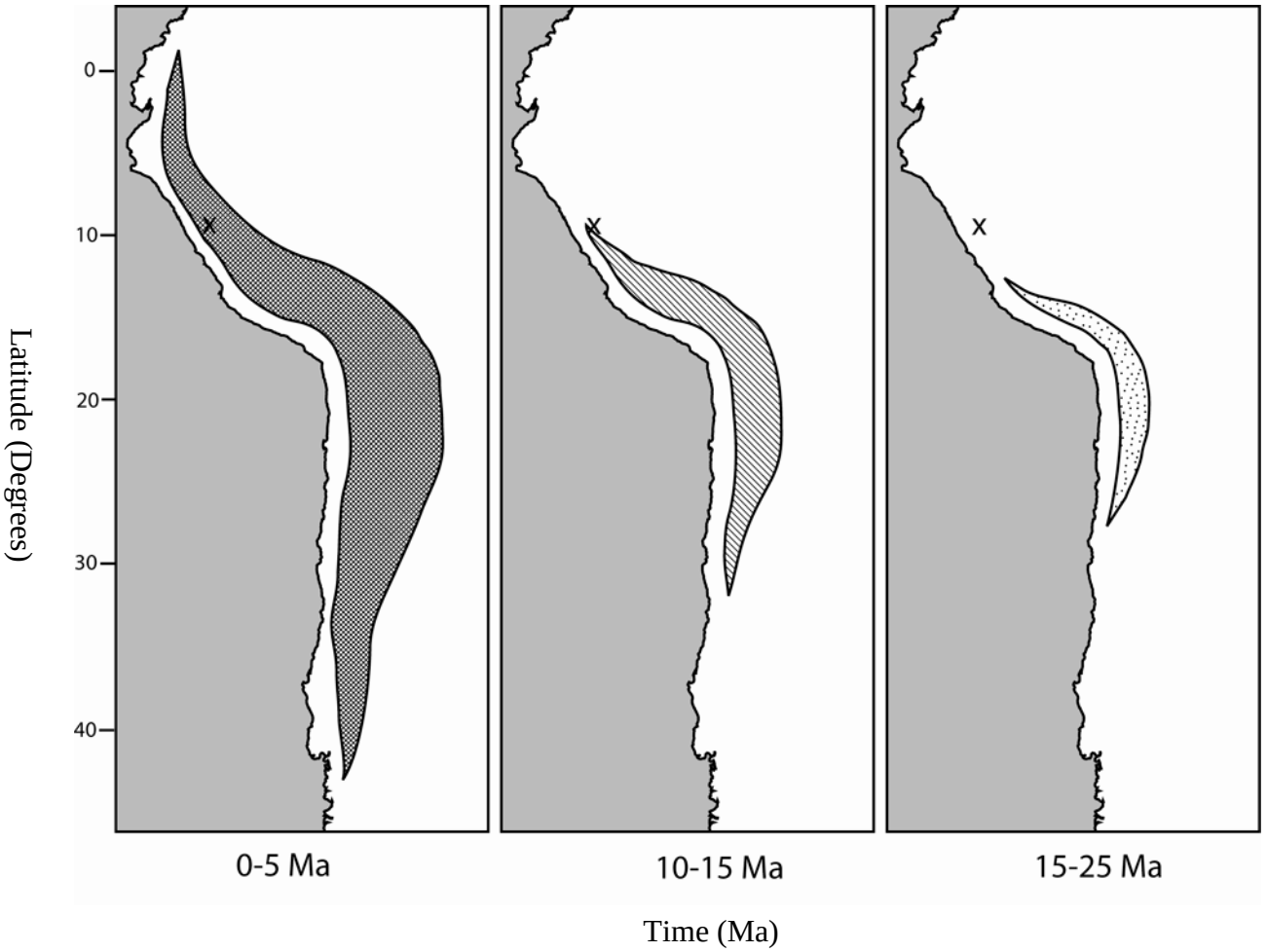

Figure 10. Cartoon demonstrating northward orogenic growth for the Andes. The X represents the study area of this project. The northern tip of the higher part of the Andes has extended up through Peru in the last 10-15 myr.

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APPENDIX A

Zircon Calibration

1. Fluence Calculations

2. Age Standards

3. Zeta Summary

Fluence Calculations

 ==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 05-01-2005/15:41:45

U33Z Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2022	3.040E+05	2.22
	2	2.0	2015	3.029E+05	2.19
	3	4.1	2007	3.018E+05	2.15
	4	6.1	2000	3.006E+05	2.11
	5	8.2	1992	2.995E+05	2.08
	6	10.2	1985	2.984E+05	2.05
	7	12.2	1978	2.973E+05	2.01
	8	14.3	1970	2.961E+05	1.98
	9	16.3	1963	2.950E+05	1.95
	10	18.4	1955	2.939E+05	1.92
	11	20.4	1948	2.928E+05	1.89
	12	22.4	1941	2.917E+05	1.86
	13	24.5	1933	2.905E+05	1.83
	14	26.5	1926	2.894E+05	1.81
	15	28.6	1918	2.883E+05	1.78
	16	30.6	1911	2.872E+05	1.76
	17	32.7	1903	2.860E+05	1.74
	18	34.7	1896	2.849E+05	1.72
	19	36.7	1889	2.838E+05	1.70
	20	38.8	1881	2.827E+05	1.69
	21	40.8	1874	2.816E+05	1.67
	22	42.9	1866	2.804E+05	1.66
	23	44.9	1859	2.793E+05	1.66
	24	46.9	1852	2.782E+05	1.65
	25	49.0	1844	2.771E+05	1.65
	26	51.0	1837	2.759E+05	1.65
	27	53.1	1829	2.748E+05	1.65
	28	55.1	1822	2.737E+05	1.66
	29	57.1	1815	2.726E+05	1.67
	30	59.2	1807	2.714E+05	1.68
	31	61.2	1800	2.703E+05	1.69
	32	63.3	1792	2.692E+05	1.71
	33	65.3	1785	2.681E+05	1.73
	34	67.3	1778	2.670E+05	1.75
	35	69.4	1770	2.658E+05	1.78
	36	71.4	1763	2.647E+05	1.80
	37	73.5	1755	2.636E+05	1.83
	38	75.5	1748	2.625E+05	1.87
	39	77.6	1740	2.613E+05	1.90
	40	79.6	1733	2.602E+05	1.94
	41	81.6	1726	2.591E+05	1.98
	42	83.7	1718	2.580E+05	2.03
	43	85.7	1711	2.569E+05	2.07
	44	87.8	1703	2.557E+05	2.12
	45	89.8	1696	2.546E+05	2.17
	46	91.8	1689	2.535E+05	2.23
	47	93.9	1681	2.524E+05	2.28
	48	95.9	1674	2.512E+05	2.34
	49	98.0	1666	2.501E+05	2.39
SECOND MONITOR:	50	100.0	1659	2.490E+05	2.46

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 05-01-2005/15:29:16

U33Y Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	1938	2.910E+05	2.27
	2	4.0	1929	2.897E+05	2.19
	3	8.0	1920	2.884E+05	2.12
	4	12.0	1912	2.870E+05	2.04
	5	16.0	1903	2.857E+05	1.97
	6	20.0	1894	2.844E+05	1.91
	7	24.0	1885	2.831E+05	1.85
	8	28.0	1877	2.818E+05	1.80
	9	32.0	1868	2.804E+05	1.75
	10	36.0	1859	2.791E+05	1.72
	11	40.0	1850	2.778E+05	1.69
	12	44.0	1842	2.765E+05	1.67
	13	48.0	1833	2.752E+05	1.65
	14	52.0	1824	2.738E+05	1.65
	15	56.0	1815	2.725E+05	1.67
	16	60.0	1807	2.712E+05	1.69
	17	64.0	1798	2.699E+05	1.72
	18	68.0	1789	2.686E+05	1.76
	19	72.0	1780	2.672E+05	1.81
	20	76.0	1772	2.659E+05	1.88
	21	80.0	1763	2.646E+05	1.95
	22	84.0	1754	2.633E+05	2.03
	23	88.0	1745	2.620E+05	2.11
	24	92.0	1737	2.606E+05	2.21
	25	96.0	1728	2.593E+05	2.31
SECOND MONITOR:	26	100.0	1719	2.580E+05	2.41

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 05-01-2005/16:03:43

U30Z Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2140	3.210E+05	2.16
	2	2.2	2133	3.199E+05	2.12
	3	4.3	2126	3.189E+05	2.08
	4	6.5	2119	3.178E+05	2.05
	5	8.7	2112	3.167E+05	2.01
	6	10.9	2105	3.157E+05	1.97
	7	13.0	2097	3.146E+05	1.94
	8	15.2	2090	3.135E+05	1.90
	9	17.4	2083	3.125E+05	1.87
	10	19.6	2076	3.114E+05	1.84
	11	21.7	2069	3.103E+05	1.81
	12	23.9	2062	3.093E+05	1.78
	13	26.1	2055	3.082E+05	1.75
	14	28.3	2048	3.072E+05	1.72
	15	30.4	2041	3.061E+05	1.70
	16	32.6	2034	3.050E+05	1.68
	17	34.8	2027	3.040E+05	1.66
	18	37.0	2020	3.029E+05	1.64
	19	39.1	2012	3.018E+05	1.63
	20	41.3	2005	3.008E+05	1.61
	21	43.5	1998	2.997E+05	1.60
	22	45.7	1991	2.986E+05	1.60
	23	47.8	1984	2.976E+05	1.59
	24	50.0	1977	2.965E+05	1.59
	25	52.2	1970	2.954E+05	1.59
	26	54.3	1963	2.944E+05	1.60
	27	56.5	1956	2.933E+05	1.60
	28	58.7	1949	2.922E+05	1.61
	29	60.9	1942	2.912E+05	1.63
	30	63.0	1934	2.901E+05	1.65
	31	65.2	1927	2.890E+05	1.67
	32	67.4	1920	2.880E+05	1.69
	33	69.6	1913	2.869E+05	1.71
	34	71.7	1906	2.858E+05	1.74
	35	73.9	1899	2.848E+05	1.78
	36	76.1	1892	2.837E+05	1.81
	37	78.3	1885	2.827E+05	1.85
	38	80.4	1878	2.816E+05	1.89
	39	82.6	1871	2.805E+05	1.93
	40	84.8	1864	2.795E+05	1.97
	41	87.0	1857	2.784E+05	2.02
	42	89.1	1849	2.773E+05	2.07
	43	91.3	1842	2.763E+05	2.12
	44	93.5	1835	2.752E+05	2.18
	45	95.7	1828	2.741E+05	2.23
	46	97.8	1821	2.731E+05	2.29
SECOND MONITOR:	47	100.0	1814	2.720E+05	2.35

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 05-01-2005/16:00:12

U26Z Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2073	3.110E+05	2.20
	2	2.1	2067	3.101E+05	2.16
	3	4.2	2061	3.092E+05	2.12
	4	6.3	2055	3.083E+05	2.08
	5	8.3	2049	3.074E+05	2.04
	6	10.4	2043	3.065E+05	2.01
	7	12.5	2037	3.056E+05	1.97
	8	14.6	2031	3.047E+05	1.94
	9	16.7	2025	3.038E+05	1.91
	10	18.8	2019	3.029E+05	1.87
	11	20.8	2013	3.020E+05	1.84
	12	22.9	2007	3.011E+05	1.81
	13	25.0	2001	3.003E+05	1.79
	14	27.1	1995	2.994E+05	1.76
	15	29.2	1989	2.985E+05	1.74
	16	31.3	1983	2.976E+05	1.71
	17	33.3	1977	2.967E+05	1.69
	18	35.4	1971	2.958E+05	1.67
	19	37.5	1965	2.949E+05	1.66
	20	39.6	1959	2.940E+05	1.64
	21	41.7	1953	2.931E+05	1.63
	22	43.8	1947	2.922E+05	1.62
	23	45.8	1941	2.913E+05	1.62
	24	47.9	1935	2.904E+05	1.61
	25	50.0	1929	2.895E+05	1.61
	26	52.1	1923	2.886E+05	1.61
	27	54.2	1917	2.877E+05	1.62
	28	56.3	1911	2.868E+05	1.62
	29	58.3	1905	2.859E+05	1.63
	30	60.4	1899	2.850E+05	1.65
	31	62.5	1893	2.841E+05	1.66
	32	64.6	1887	2.832E+05	1.68
	33	66.7	1881	2.823E+05	1.70
	34	68.8	1875	2.814E+05	1.73
	35	70.8	1869	2.805E+05	1.75
	36	72.9	1863	2.796E+05	1.78
	37	75.0	1857	2.788E+05	1.81
	38	77.1	1851	2.779E+05	1.85
	39	79.2	1845	2.770E+05	1.88
	40	81.3	1839	2.761E+05	1.92
	41	83.3	1833	2.752E+05	1.97
	42	85.4	1827	2.743E+05	2.01
	43	87.5	1821	2.734E+05	2.05
	44	89.6	1815	2.725E+05	2.10
	45	91.7	1809	2.716E+05	2.15
	46	93.8	1803	2.707E+05	2.20
	47	95.8	1797	2.698E+05	2.26
	48	97.9	1791	2.689E+05	2.31
SECOND MONITOR:	49	100.0	1785	2.680E+05	2.37

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 05-01-2005/15:57:23

U21Z Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2013	3.020E+05	2.23
	2	2.0	2009	3.014E+05	2.19
	3	3.9	2004	3.007E+05	2.15
	4	5.9	2000	3.001E+05	2.11
	5	7.8	1996	2.994E+05	2.08
	6	9.8	1992	2.988E+05	2.04
	7	11.8	1987	2.981E+05	2.01
	8	13.7	1983	2.975E+05	1.97
	9	15.7	1979	2.968E+05	1.94
	10	17.6	1974	2.962E+05	1.91
	11	19.6	1970	2.955E+05	1.88
	12	21.6	1966	2.949E+05	1.85
	13	23.5	1961	2.942E+05	1.82
	14	25.5	1957	2.936E+05	1.80
	15	27.5	1953	2.929E+05	1.77
	16	29.4	1949	2.923E+05	1.75
	17	31.4	1944	2.916E+05	1.72
	18	33.3	1940	2.910E+05	1.71
	19	35.3	1936	2.904E+05	1.69
	20	37.3	1931	2.897E+05	1.67
	21	39.2	1927	2.891E+05	1.66
	22	41.2	1923	2.884E+05	1.65
	23	43.1	1919	2.878E+05	1.64
	24	45.1	1914	2.871E+05	1.63
	25	47.1	1910	2.865E+05	1.62
	26	49.0	1906	2.858E+05	1.62
	27	51.0	1901	2.852E+05	1.62
	28	52.9	1897	2.845E+05	1.62
	29	54.9	1893	2.839E+05	1.63
	30	56.9	1888	2.832E+05	1.64
	31	58.8	1884	2.826E+05	1.65
	32	60.8	1880	2.819E+05	1.66
	33	62.7	1876	2.813E+05	1.67
	34	64.7	1871	2.806E+05	1.69
	35	66.7	1867	2.800E+05	1.71
	36	68.6	1863	2.794E+05	1.73
	37	70.6	1858	2.787E+05	1.76
	38	72.5	1854	2.781E+05	1.79
	39	74.5	1850	2.774E+05	1.81
	40	76.5	1846	2.768E+05	1.85
	41	78.4	1841	2.761E+05	1.88
	42	80.4	1837	2.755E+05	1.91
	43	82.4	1833	2.748E+05	1.95
	44	84.3	1828	2.742E+05	1.99
	45	86.3	1824	2.735E+05	2.03
	46	88.2	1820	2.729E+05	2.07
	47	90.2	1815	2.722E+05	2.12
	48	92.2	1811	2.716E+05	2.16
	49	94.1	1807	2.709E+05	2.21
	50	96.1	1803	2.703E+05	2.26
	51	98.0	1798	2.696E+05	2.31
SECOND MONITOR:	52	100.0	1794	2.690E+05	2.36

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:10:52 FILENAME: F:\FISSIO~1\U33Z\BLK3_33Z.FTZ
BLK-3, u33z-20, montario, 03/31/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 16.40 0.20
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.827E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.69
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	9.760E+05	(39)	3.003E+06	(120)	60	357.45	66.2	66.3
2	1.441E+06	(24)	3.003E+06	(50)	25	242.02	60.2	60.3
3	8.886E+05	(29)	2.176E+06	(71)	49	284.42	62.9	63.0
4	3.378E+06	(45)	1.344E+07	(179)	20	462.11	77.5	77.7
5	1.084E+06	(26)	3.587E+06	(86)	36	384.26	86.2	86.4
6	9.760E+05	(39)	3.529E+06	(141)	60	420.01	76.3	76.5
7	1.126E+06	(45)	4.104E+06	(164)	60	423.38	71.6	71.8
8	1.451E+06	(29)	3.704E+06	(74)	30	296.44	65.1	65.2
9	1.195E+06	(39)	2.819E+06	(92)	49	274.05	52.6	52.7
10	9.384E+05	(25)	3.303E+06	(88)	40	408.92	92.9	93.1
POOLED	1.190E+06	(340)	3.728E+06	(1065)	429	363.89	23.5	23.9
MEAN ZETA (using grain ratios)						339.88	25.2	25.6

CHI-SQUARED PROBABILITY (%): 28.1

MEAN (RhoS/RhoI) +/- 1 SE: 0.342 +/- 0.0247

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:11:02 FILENAME: F:\FISSIO~1\U33Z\BLK4_33Z.FTZ
BLK-4, u33z-21, montario, 03/28/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 16.40 0.20
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.816E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.67
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.043E+06	(25)	3.128E+06	(75)	36	349.88	81.0	81.1
2	1.164E+06	(31)	3.378E+06	(90)	40	338.59	70.7	70.9
3	1.261E+06	(21)	3.423E+06	(57)	25	316.56	81.0	81.1
4	1.562E+06	(26)	4.384E+06	(73)	25	327.45	75.0	75.1
5	1.408E+06	(30)	3.895E+06	(83)	32	322.66	68.9	69.1
6	1.301E+06	(26)	3.504E+06	(70)	30	313.99	72.3	72.4
7	1.502E+06	(32)	3.707E+06	(79)	32	287.92	60.5	60.6
8	6.971E+05	(13)	2.306E+06	(43)	28	385.76	122.3	122.4
9	1.291E+06	(43)	3.453E+06	(115)	50	311.91	56.0	56.1
10	1.103E+06	(47)	3.660E+06	(156)	64	387.10	64.7	64.9
POOLED	1.219E+06	(294)	3.488E+06	(841)	362	333.61	23.3	23.6
MEAN ZETA (using grain ratios)						331.53	11.2	11.9

CHI-SQUARED PROBABILITY (%): 99.4

MEAN (RhoS/RhoI) +/- 1 SE: 0.352 +/- 0.0103

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:11:13 FILENAME: F:\FISSIO~1\U33Z\FCT4_33Z.FTZ
FCT-4, U33Z-17, Montario, 04/07/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.860E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.74
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	5.255E+06	(28)	9.384E+06	(50)	8	349.16	82.6	82.9
2	5.818E+06	(31)	1.220E+07	(65)	8	409.98	89.8	90.1
3	5.068E+06	(27)	1.201E+07	(64)	8	463.47	106.7	107.0
4	4.354E+06	(29)	6.156E+06	(41)	10	276.44	67.2	67.4
5	6.006E+06	(24)	1.301E+07	(52)	6	423.64	104.8	105.1
6	5.631E+06	(30)	1.351E+07	(72)	8	469.27	102.3	102.6
7	6.944E+06	(37)	1.239E+07	(66)	8	348.78	71.9	72.2
8	5.818E+06	(31)	1.164E+07	(62)	8	391.06	86.3	86.6
9	4.505E+06	(24)	9.197E+06	(49)	8	399.20	99.7	100.0
10	3.904E+06	(26)	7.057E+06	(47)	10	353.45	86.6	86.8
POOLED	5.255E+06	(287)	1.040E+07	(568)	82	386.97	28.8	29.6
MEAN ZETA (using grain ratios)						379.82	21.1	22.1

CHI-SQUARED PROBABILITY (%): 90.1

MEAN (RhoS/RhoI) +/- 1 SE: 0.515 +/- 0.0271

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:11:23 FILENAME: F:\FISSIO~1\U33Z\FCT5_33Z.FTZ
FCT-5, U33Z-18, montario, 04/9/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.849E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.72
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.440E+06	(13)	5.443E+06	(29)	8	437.86	146.3	146.6
2	2.815E+06	(15)	8.446E+06	(45)	8	588.85	175.9	176.2
3	3.566E+06	(19)	9.384E+06	(50)	8	516.53	139.5	139.8
4	5.631E+06	(30)	1.164E+07	(62)	8	405.65	90.5	90.8
5	2.503E+06	(15)	4.671E+06	(28)	9	366.39	117.4	117.6
6	5.255E+06	(28)	7.883E+06	(42)	8	294.42	72.0	72.2
7	5.255E+06	(28)	9.009E+06	(48)	8	336.48	80.2	80.5
8	6.507E+06	(26)	1.251E+07	(50)	6	377.47	91.5	91.7
9	5.631E+06	(30)	1.051E+07	(56)	8	366.39	83.1	83.4
10	6.194E+06	(33)	1.126E+07	(60)	8	356.88	77.6	77.9
POOLED	4.505E+06	(237)	8.933E+06	(470)	79	389.25	31.7	32.5
MEAN ZETA (using grain ratios)						389.69	24.7	25.7

CHI-SQUARED PROBABILITY (%): 81.6

MEAN (RhoS/RhoI) +/- 1 SE: 0.504 +/- 0.0308

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 05-01-2005/15:38:50 FILENAME: F:\FISSIO~1\U33Y\BLK2_33Y.FTZ
BLK-2, U33Y-9, montario, 04/21/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 16.40 0.20
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.804E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.75
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	6.256E+05	(15)	2.169E+06	(52)	36	406.03	119.2	119.3
2	1.314E+06	(35)	3.416E+06	(91)	40	304.52	60.8	60.9
3	9.009E+05	(15)	2.943E+06	(49)	25	382.61	113.1	113.2
4	1.126E+06	(30)	3.116E+06	(83)	40	324.04	69.3	69.4
5	1.157E+06	(37)	2.940E+06	(94)	48	297.56	58.0	58.1
6	1.210E+06	(29)	2.961E+06	(71)	36	286.75	63.4	63.5
7	4.171E+05	(10)	1.543E+06	(37)	36	433.36	154.6	154.7
8	1.099E+06	(41)	2.949E+06	(110)	56	314.24	57.8	57.9
9	8.408E+05	(14)	2.222E+06	(37)	25	309.54	97.3	97.4
10	1.111E+06	(37)	2.793E+06	(93)	50	294.39	57.5	57.6
POOLED	1.007E+06	(263)	2.746E+06	(717)	392	319.31	23.7	24.0
MEAN ZETA (using grain ratios)						328.82	15.5	16.0

CHI-SQUARED PROBABILITY (%): 98.3

MEAN (RhoS/RhoI) +/- 1 SE: 0.356 +/- 0.0156

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:06:24 FILENAME:
F:\FISSIO~1\ZIRCON~1\U30Z\BLK1_30Z.FTZ
BLK-1, u30z-16, montario, 03/02/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 16.40 0.20
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.050E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.68
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	8.342E+05	10	4.254E+06	51	18	549.16	190.1	190.3
2	1.314E+06	14	3.472E+06	37	16	284.58	89.4	89.5
3	1.001E+06	8	3.629E+06	29	12	390.33	156.0	156.1
4	9.384E+05	10	2.158E+06	23	16	247.66	93.9	94.0
5	8.342E+05	10	1.835E+06	22	18	236.89	90.4	90.5
6	8.133E+05	13	3.566E+06	57	24	472.13	145.3	145.4
7	2.503E+05	4	1.126E+06	18	24	484.55	268.0	268.0
8	2.169E+06	13	8.175E+06	49	9	405.86	126.8	126.9
9	1.595E+06	17	4.411E+06	47	16	297.70	84.4	84.5
10	1.001E+06	16	3.566E+06	57	24	383.60	108.7	108.8
11	1.609E+06	30	4.451E+06	83	28	297.91	63.7	63.8
12	1.408E+06	15	4.692E+06	50	16	358.93	105.8	105.9
13	1.351E+06	27	3.554E+06	71	30	283.15	64.2	64.3
14	1.502E+06	12	4.630E+06	37	12	332.01	110.4	110.5
15	1.783E+06	19	6.475E+06	69	16	391.04	101.5	101.6
POOLED	1.173E+06	218	3.767E+06	700	279	345.75	27.4	27.8
MEAN ZETA (using grain ratios)						340.82	22.3	22.7

CHI-SQUARED PROBABILITY (%): 90.4

MEAN (RhoS/RhoI) +/- 1 SE: 0.316 +/- 0.0200

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:06:43 FILENAME:
F:\FISSIO~1\ZIRCON~1\U30Z\PST1_30Z.FTZ
PST-1, u30z-17, montario, 3/02/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 18.51 0.10
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.040E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.66
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	3.566E+06	(57)	1.176E+07	(188)	24	402.23	61.2	61.2
2	1.627E+06	(13)	7.132E+06	(57)	12	534.71	164.6	164.6
3	2.022E+06	(66)	5.179E+06	(169)	49	312.27	45.6	45.7
4	2.127E+06	(34)	4.880E+06	(78)	24	279.77	57.7	57.7
5	1.502E+06	(12)	4.254E+06	(34)	12	345.53	116.2	116.2
6	3.066E+06	(49)	8.446E+06	(135)	24	335.99	56.3	56.3
7	3.228E+06	(43)	7.357E+06	(98)	20	277.94	51.0	51.1
8	3.453E+06	(23)	8.859E+06	(59)	10	312.83	77.1	77.1
9	1.314E+06	(14)	3.003E+06	(32)	16	278.75	89.4	89.5
10	2.815E+06	(45)	6.882E+06	(110)	24	298.10	53.0	53.0
11	1.971E+06	(21)	4.974E+06	(53)	16	307.78	79.5	79.5
12	1.823E+06	(17)	5.470E+06	(51)	14	365.85	102.6	102.7
13	1.823E+06	(17)	6.971E+06	(65)	14	466.28	127.3	127.3
14	2.252E+06	(18)	7.257E+06	(58)	12	392.95	106.2	106.2
15	2.102E+06	(14)	6.456E+06	(43)	10	374.56	115.4	115.4
POOLED	2.367E+06	(443)	6.572E+06	(1230)	281	338.60	19.6	19.7
MEAN ZETA (using grain ratios)						340.28	16.8	16.9

CHI-SQUARED PROBABILITY (%): 83.7

MEAN (RhoS/RhoI) +/- 1 SE: 0.358 +/- 0.0167

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:08:15 FILENAME:
F:\FISSIO~1\ZIRCON~1\U26Z\BLK1_26Z.FTZ
BLK-1, u26z-30, montario, 03/03/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 16.40 0.20
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.850E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.65
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.030E+06	(48)	2.874E+06	(134)	70	321.70	54.4	54.5
2	1.126E+06	(18)	4.004E+06	(64)	24	409.72	109.5	109.6
3	1.051E+06	(21)	4.054E+06	(81)	30	444.47	109.1	109.2
4	8.044E+05	(30)	2.949E+06	(110)	56	422.53	87.3	87.5
5	7.722E+05	(18)	2.703E+06	(63)	35	403.32	108.0	108.1
6	7.038E+05	(30)	2.815E+06	(120)	64	460.94	94.4	94.6
7	5.005E+05	(28)	2.038E+06	(114)	84	469.17	99.3	99.4
8	9.921E+05	(37)	3.834E+06	(143)	56	445.36	82.5	82.7
9	1.051E+06	(28)	2.477E+06	(66)	40	271.62	61.4	61.5
10	9.653E+05	(36)	2.386E+06	(89)	56	284.88	56.5	56.6
11	9.593E+05	(23)	2.669E+06	(64)	36	320.65	78.1	78.2
12	9.384E+05	(30)	2.534E+06	(81)	48	311.13	66.7	66.8
13	1.073E+06	(10)	3.754E+06	(35)	14	403.32	144.8	144.9
14	1.051E+06	(35)	3.544E+06	(118)	50	388.50	75.1	75.2
15	9.009E+05	(15)	3.243E+06	(54)	25	414.84	121.3	121.4
POOLED	8.882E+05	(407)	2.916E+06	(1336)	688	378.26	22.3	22.8
MEAN ZETA (using grain ratios)						373.32	19.3	19.8

CHI-SQUARED PROBABILITY (%): 74.2

MEAN (RhoS/RhoI) +/- 1 SE: 0.309 +/- 0.0151

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 05-01-2005/16:08:27 FILENAME:
F:\FISSIO~1\ZIRCON~1\U26Z\FCT1_26Z.FTZ
FCT-1, U26Z-2, montario, 04/07/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.101E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 2.16
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	6.006E+06	(24)	1.176E+07	(47)	6	353.15	88.9	89.2
2	9.009E+06	(36)	1.326E+07	(53)	6	265.49	57.6	57.8
3	9.009E+06	(30)	1.441E+07	(48)	5	288.53	67.4	67.6
4	6.194E+06	(33)	1.577E+07	(84)	8	459.03	94.8	95.2
5	5.443E+06	(29)	1.201E+07	(64)	8	397.97	89.5	89.8
6	5.756E+06	(23)	1.101E+07	(44)	6	344.98	89.1	89.3
7	6.757E+06	(27)	1.702E+07	(68)	6	454.17	103.8	104.1
8	4.129E+06	(22)	1.051E+07	(56)	8	459.03	115.9	116.2
9	2.836E+06	(17)	6.840E+06	(41)	9	434.92	125.8	126.1
10	6.006E+06	(24)	1.351E+07	(54)	6	405.75	99.9	100.2
POOLED	5.851E+06	(265)	1.234E+07	(559)	68	380.40	29.5	30.3
MEAN ZETA (using grain ratios)						373.16	25.9	26.8

CHI-SQUARED PROBABILITY (%): 65.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.483 +/- 0.0319

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 05-01-2005/16:09:31 FILENAME:
F:\FISSIO~1\ZIRCON~1\U21Z\FCT1_21Z.FTZ
FCT-1, U21Z-2, Montario, 04/04/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.014E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 2.19
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	4.379E+06	(35)	9.259E+06	(74)	12	392.28	80.9	81.2
2	4.354E+06	(29)	1.036E+07	(69)	10	441.45	98.2	98.5
3	4.880E+06	(26)	1.351E+07	(72)	8	513.80	118.1	118.5
4	6.006E+06	(24)	1.026E+07	(41)	6	316.96	81.8	82.0
5	6.569E+06	(35)	1.182E+07	(63)	8	333.97	70.8	71.0
6	4.880E+06	(26)	1.164E+07	(62)	8	442.43	103.8	104.1
7	2.669E+06	(16)	5.339E+06	(32)	9	371.07	113.9	114.1
8	4.505E+06	(27)	1.084E+07	(65)	9	446.66	102.7	103.0
9	6.006E+06	(32)	1.502E+07	(80)	8	463.84	97.6	97.9
10	5.506E+06	(22)	1.226E+07	(49)	6	413.24	106.4	106.7
POOLED	4.862E+06	(272)	1.085E+07	(607)	84	414.05	31.5	32.4
MEAN ZETA (using grain ratios)						405.19	21.7	22.9

CHI-SQUARED PROBABILITY (%): 92.5

MEAN (RhoS/RhoI) +/- 1 SE: 0.458 +/- 0.0224

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 05-01-2005/16:09:41 FILENAME:
F:\FISSIO~1\ZIRCON~1\U21Z\FCT3_21Z.FTZ
FCT-3, U21Z-51, Montario, 04/06/05

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.696E+05
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 2.31
SIZE OF COUNTING SQUARE (CM^2): 6.660E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	8.509E+06	(34)	1.101E+07	(44)	6	268.43	61.6	61.8
2	7.508E+06	(40)	1.520E+07	(81)	8	420.03	81.7	82.1
3	5.443E+06	(29)	1.182E+07	(63)	8	450.61	101.7	102.0
4	5.068E+06	(27)	1.145E+07	(61)	8	468.62	108.9	109.2
5	2.252E+06	(15)	4.054E+06	(27)	10	373.36	120.5	120.7
6	6.507E+06	(26)	1.176E+07	(47)	6	374.95	92.1	92.3
7	5.631E+06	(30)	9.197E+06	(49)	8	338.79	78.9	79.2
8	4.317E+06	(23)	6.757E+06	(36)	8	324.66	87.0	87.2
9	5.631E+06	(30)	9.760E+06	(52)	8	359.53	82.8	83.1
10	6.507E+06	(26)	1.101E+07	(44)	6	351.02	87.2	87.4
POOLED	5.532E+06	(280)	9.957E+06	(504)	76	373.36	29.1	29.9
MEAN ZETA (using grain ratios)						364.08	21.1	22.1

CHI-SQUARED PROBABILITY (%): 86.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.570 +/- 0.0303

Zeta Summary

==========ZetaMean Program v. 1.0 (Brandon 4/18/01)==========
Date/Time: 05-01-2005/16:17:59

Zeta 5-1-05

Number	Zeta	Grain-only SE	Total SE	2*grain-only SE
1)	319.31	23.70	24.00	47.40
2)	338.60	19.60	19.70	39.20
3)	345.75	27.40	27.80	54.80
4)	378.26	22.30	22.80	44.60
5)	380.40	29.50	30.30	59.00
6)	414.05	31.50	32.40	63.00
7)	373.36	29.10	29.90	58.20
8)	363.89	23.50	23.90	47.00
9)	333.61	23.30	23.60	46.60
10)	386.97	28.80	29.60	57.60
11)	389.25	31.70	32.50	63.40

WEIGHTED MEAN
360.20 8.04
(2 SE = 16.08)

APPENDIX B

Zircon Age Data

1. 4-01
2. 4-02
3. 4-03
4. 4-04
5. 4-05
6. 4-06
7. 4-07
8. 4-08
9. 4-10
10. 4-12
11. 4-13
12. 4-14
13. 4-15
14. 4-16
15. 4-17
16. 4-18
17. 4-19
18. 4-21
19. 4-22
20. 4-23
21. 4-24

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:29:58 FILENAME: F:\FISSIO~1\U33Z\04_01A.FTZ
04-01A, U33Z-31,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.703E+05
                                    RELATIVE ERROR (%):      1.69
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   7.01E+06 (  42)  5.51E+06 (  33)    9    251  87   61.6   38.2  100.2
   2   6.34E+06 (  38)  5.84E+06 (  35)    9    266  90   52.6   32.4   85.7
   3   4.22E+06 (  45)  2.63E+06 (  28)   16    120  45   77.6   47.5  129.1
   4   5.34E+06 (  32)  3.84E+06 (  23)    9    175  72   67.2   38.3  120.2
   5   2.34E+06 (  39)  2.16E+06 (  36)   25     98  33   52.5   32.5   84.9
   6   4.22E+06 (  45)  2.53E+06 (  27)   16    115  44   80.4   49.0  134.7
   7   3.57E+06 (  38)  2.25E+06 (  24)   16    102  42   76.4   44.8  133.1
   8   3.67E+06 (  22)  2.34E+06 (  14)    9    106  56   75.7   37.3  159.8
   9   7.51E+06 (  40)  5.82E+06 (  31)    8    265  95   62.4   38.2  103.2
  10   5.63E+06 (  60)  4.50E+06 (  48)   16    205  59   60.5   40.7   90.4
  11   6.19E+06 (  66)  5.44E+06 (  58)   16    248  65   55.1   38.2   79.9
  12   3.75E+06 (  40)  3.28E+06 (  35)   16    149  50   55.4   34.3   89.7
  13   2.72E+06 (  29)  2.63E+06 (  28)   16    120  45   50.2   28.9   87.5
  14   2.82E+06 (  30)  2.35E+06 (  25)   16    107  42   58.1   33.1  102.9
  15   4.40E+06 (  44)  3.60E+06 (  36)   15    164  55   59.2   37.3   94.6

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:29:58 FILENAME: F:\FISSIO~1\U33Z\04_01A.FTZ
04-01A, U33Z-31,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 13  2.72E+06 (  29) 2.63E+06 (  28)  50.2  28.9  87.5 100.0   50.2  28.9  87.5
  5  2.34E+06 (  39) 2.16E+06 (  36)  52.5  32.5  84.9  89.8   51.5  36.1  73.6
  2  6.34E+06 (  38) 5.84E+06 (  35)  52.6  32.4  85.7  98.9   51.9  39.3  68.5
 11  6.19E+06 (  66) 5.44E+06 (  58)  55.1  38.2  79.9  99.3   53.1  42.5  66.3
 12  3.75E+06 (  40) 3.28E+06 (  35)  55.4  34.3  89.7  99.8   53.5  43.7  65.5
 14  2.82E+06 (  30) 2.35E+06 (  25)  58.1  33.1 102.9  99.9   54.0  44.7  65.4
 15  4.40E+06 (  44) 3.60E+06 (  36)  59.2  37.3  94.6  99.9   54.8  45.9  65.4
 10  5.63E+06 (  60) 4.50E+06 (  48)  60.5  40.7  90.4  99.9   55.7  47.3  65.6
  1  7.01E+06 (  42) 5.51E+06 (  33)  61.6  38.2 100.2  99.9   56.3  48.2  65.8
  9  7.51E+06 (  40) 5.82E+06 (  31)  62.4  38.2 103.2 100.0   56.8  48.9  66.0
  4  5.34E+06 (  32) 3.84E+06 (  23)  67.2  38.3 120.2  99.9   57.4  49.7  66.4
  8  3.67E+06 (  22) 2.34E+06 (  14)  75.7  37.3 159.8  99.9   58.1  50.4  67.0
  7  3.57E+06 (  38) 2.25E+06 (  24)  76.4  44.8 133.1  99.5   59.1  51.5  67.9
  3  4.22E+06 (  45) 2.63E+06 (  28)  77.6  47.5 129.1  98.8   60.3  52.7  69.0
  6  4.22E+06 (  45) 2.53E+06 (  27)  80.4  49.0 134.7  97.5   61.4  53.9  70.0
POOL 4.32E+06(  610) 3.41E+06(  481)                    97.5   61.4  53.9  70.0

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  155.0,  15.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   61.4,  57.5 --  65.7 (  -4.0   +4.2)
                95% CONF. INTERVAL(Ma):          53.9 --  70.0 (  -7.5   +8.6)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.4011,   14
                     CHI^2 PROBABILITY:   97.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   61.4,  57.5 --  65.7 (  -4.0   +4.2)
                95% CONF. INTERVAL(Ma):          53.9 --  70.0 (  -7.5   +8.6)
                    AGE DISPERSION (%):    0.1
```

```
 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   61.4,  57.5 --  65.7 (  -4.0   +4.2)
               95% CONF. INTERVAL (Ma):         53.9 --  70.0 (  -7.5   +8.6)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:29:58 FILENAME: F:\FISSIO~1\U33Z\04_01A.FTZ
04-01A, U33Z-31,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    50.19 to    80.05 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       58.37            2.957                 18.14

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       56.81            2.924                 17.94
       81.32            1.223                  7.50

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:29:58 FILENAME: F:\FISSIO~1\U33Z\04_01A.FTZ
04-01A, U33Z-31,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

                PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
            0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  30.5 -   0 :o
  33.7 -   0 :o
  37.3 -   0 :o
  41.2 -   0 :    o
  45.5 -   0 :             o
  50.3 -  20 :****************************o***************
  55.5 -  20 :******************************************o**
  61.3 -  27 :*********************************************o****************
  67.8 -   7 :***************                    o
  74.8 -  20 :************************o********************
  82.7 -   7 :*************** o
  91.3 -   0 :        o
 100.8 -   0 :   o
 111.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:05 FILENAME: F:\FISSIO~1\U33Z\04_02A.FTZ
04-02A, U33Z-32,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.692E+05
                                    RELATIVE ERROR (%):      1.71
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                               SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   2.06E+06 (  11)  4.13E+06 (  22)    8    189  80   24.4   10.6   52.0
   2   2.72E+06 (  29)  4.13E+06 (  44)   16    189  57   31.9   19.2   52.1
   3   3.50E+06 (  28)  7.63E+06 (  61)   12    349  90   22.3   13.7   35.3
   4   5.71E+06 (  38)  6.01E+06 (  40)   10    274  87   45.9   28.7   73.4
   5   3.57E+06 (  38)  4.04E+06 (  43)   16    184  56   42.7   26.9   67.6
   6   5.11E+06 (  34)  7.66E+06 (  51)   10    350  98   32.3   20.3   50.7
   7   3.20E+06 (  32)  5.01E+06 (  50)   15    229  65   31.0   19.2   49.2
   8   2.50E+06 (  20)  4.50E+06 (  36)   12    206  68   27.0   14.7   47.7
   9   6.01E+06 (  24)  8.01E+06 (  32)    6    366 129   36.3   20.4   63.5
  10   5.71E+06 (  57)  6.31E+06 (  63)   15    288  73   43.7   30.0   63.6
  11   5.76E+06 (  46)  7.88E+06 (  63)   12    360  91   35.3   23.6   52.5
  12   4.34E+06 (  26)  6.51E+06 (  39)    9    297  95   32.3   18.8   54.3
  13   5.82E+06 (  31)  9.95E+06 (  53)    8    455 125   28.4   17.6   44.9
  14   4.84E+06 (  29)  5.51E+06 (  33)    9    252  87   42.5   24.9   72.1
  15   3.80E+06 (  38)  4.90E+06 (  49)   15    224  64   37.5   23.9   58.5

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:05 FILENAME: F:\FISSIO~1\U33Z\04_02A.FTZ
04-02A, U33Z-32,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  3  3.50E+06 (  28) 7.63E+06 (  61)  22.3  13.7  35.3 100.0   22.3  13.7  35.3
  1  2.06E+06 (  11) 4.13E+06 (  22)  24.4  10.6  52.0  84.4   22.8  15.1  33.7
  8  2.50E+06 (  20) 4.50E+06 (  36)  27.0  14.7  47.7  86.9   24.0  17.2  33.1
 13  5.82E+06 (  31) 9.95E+06 (  53)  28.4  17.6  44.9  88.9   25.4  19.6  32.9
  7  3.20E+06 (  32) 5.01E+06 (  50)  31.0  19.2  49.2  87.5   26.6  21.2  33.4
  2  2.72E+06 (  29) 4.13E+06 (  44)  31.9  19.2  52.1  89.1   27.5  22.4  33.8
  6  5.11E+06 (  34) 7.66E+06 (  51)  32.3  20.3  50.7  91.0   28.3  23.4  34.1
 12  4.34E+06 (  26) 6.51E+06 (  39)  32.3  18.8  54.3  93.9   28.7  24.0  34.3
 11  5.76E+06 (  46) 7.88E+06 (  63)  35.3  23.6  52.5  91.5   29.7  25.2  35.0
  9  6.01E+06 (  24) 8.01E+06 (  32)  36.3  20.4  63.5  92.5   30.2  25.7  35.3
 15  3.80E+06 (  38) 4.90E+06 (  49)  37.5  23.9  58.5  91.1   30.9  26.6  35.9
 14  4.84E+06 (  29) 5.51E+06 (  33)  42.5  24.9  72.1  86.4   31.6  27.3  36.5
  5  3.57E+06 (  38) 4.04E+06 (  43)  42.7  26.9  67.6  80.1   32.4  28.2  37.3
 10  5.71E+06 (  57) 6.31E+06 (  63)  43.7  30.0  63.6  68.2   33.5  29.4  38.3
  4  5.71E+06 (  38) 6.01E+06 (  40)  45.9  28.7  73.4  61.2   34.3  30.1  39.0
POOL 4.17E+06(  481) 5.89E+06(  679)                      61.2   34.3  30.1  39.0

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  269.3,  22.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   34.3,  32.1 --  36.6 (  -2.2   +2.3)
                95% CONF. INTERVAL(Ma):          30.1 --  39.0 (  -4.1   +4.7)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.8517,   14
                     CHI^2 PROBABILITY:   61.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   34.3,  32.1 --  36.6 (  -2.2   +2.3)
                95% CONF. INTERVAL(Ma):          30.1 --  39.0 (  -4.1   +4.7)
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```
                    AGE DISPERSION (%):    1.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   34.3,  32.1 --  36.6 (  -2.2   +2.3)
                95% CONF. INTERVAL (Ma):         30.1 --  39.0 (  -4.1   +4.7)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:05 FILENAME: F:\FISSIO~1\U33Z\04_02A.FTZ
04-02A, U33Z-32,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    22.43 to    45.92 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       33.95            2.298                 13.94

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       21.48            0.570                  3.46
       32.67            2.267                 13.76
       43.85            1.642                  9.97

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:05 FILENAME: F:\FISSIO~1\U33Z\04_02A.FTZ
04-02A, U33Z-32,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  13.7 -   0 :o
  15.2 -   0 :o
  16.8 -   0 :o
  18.5 -   0 :   o
  20.5 -   0 :        o
  22.6 -   7 :************o******
  25.0 -   7 :*******************o
  27.6 -  13 :******************************o*********
  30.5 -  13 :****************************************o
  33.7 -  20 :*********************************************o**************
  37.3 -  13 :*****************************************  o
  41.2 -  13 :************************************o**
  45.5 -  13 :****************************o***********
  50.3 -   0 :              o
  55.5 -   0 :    o
  61.3 -   0 :o
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-03-2005/16:09:14 FILENAME: F:\FISSIO~1\U33Z\04_03A.FTZ
04-03A, U33Z-33,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.681E+05
RELATIVE ERROR (%): 1.73
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 360.20 8.04
SIZE OF COUNTER SQUARE (cm^2): 6.660E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s	Grain Age	Age (Ma) --95% CI--	
1	9.76E+06	(39)	1.23E+07	(49)	6	563 161	38.4	24.5	59.6
2	9.26E+06	(37)	1.40E+07	(56)	6	643 173	31.9	20.4	49.1
3	1.03E+07	(41)	1.43E+07	(57)	6	654 174	34.7	22.6	52.7
4	1.03E+07	(41)	1.18E+07	(47)	6	540 158	42.0	26.9	65.2
5	8.26E+06	(33)	1.03E+07	(41)	6	471 147	38.8	23.7	62.8
6	7.51E+06	(20)	1.43E+07	(38)	4	654 212	25.5	14.0	44.7
7	7.51E+06	(30)	9.26E+06	(37)	6	425 140	39.1	23.3	64.9
8	6.51E+06	(26)	1.28E+07	(51)	6	586 164	24.6	14.7	40.2
9	5.17E+06	(31)	7.67E+06	(46)	9	352 104	32.5	19.9	52.3
10	6.26E+06	(25)	1.45E+07	(58)	6	666 176	20.9	12.4	33.8
11	1.80E+07	(48)	1.54E+07	(41)	4	706 221	56.3	36.3	87.5
12	4.69E+06	(25)	7.32E+06	(39)	8	336 107	31.0	17.9	52.3
13	6.76E+06	(18)	1.13E+07	(30)	4	517 188	29.0	15.2	53.5
14	8.01E+06	(32)	1.05E+07	(42)	6	482 149	36.7	22.4	59.5
15	7.51E+06	(30)	1.33E+07	(53)	6	608 168	27.3	16.8	43.5

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-03-2005/16:09:14 FILENAME: F:\FISSIO~1\U33Z\04_03A.FTZ
04-03A, U33Z-33,
Number of grains = 15

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
10	6.26E+06	(25)	1.45E+07	(58)	20.9	12.4	33.8	100.0	20.9	12.4	33.8
8	6.51E+06	(26)	1.28E+07	(51)	24.6	14.7	40.2	62.1	22.6	15.8	31.8
6	7.51E+06	(20)	1.43E+07	(38)	25.5	14.0	44.7	83.0	23.4	17.5	31.1
15	7.51E+06	(30)	1.33E+07	(53)	27.3	16.8	43.5	87.0	24.4	19.1	31.2
13	6.76E+06	(18)	1.13E+07	(30)	29.0	15.2	53.5	91.1	25.0	19.9	31.4
12	4.69E+06	(25)	7.32E+06	(39)	31.0	17.9	52.3	90.5	25.8	21.0	31.8
2	9.26E+06	(37)	1.40E+07	(56)	31.9	20.4	49.1	88.5	26.9	22.2	32.5
9	5.17E+06	(31)	7.67E+06	(46)	32.5	19.9	52.3	89.3	27.6	23.1	32.9
3	1.03E+07	(41)	1.43E+07	(57)	34.7	22.6	52.7	86.0	28.5	24.2	33.6
14	8.01E+06	(32)	1.05E+07	(42)	36.7	22.4	59.5	83.5	29.2	25.0	34.2
1	9.76E+06	(39)	1.23E+07	(49)	38.4	24.5	59.6	78.1	30.1	25.9	34.9
5	8.26E+06	(33)	1.03E+07	(41)	38.8	23.7	62.8	76.1	30.7	26.6	35.5
7	7.51E+06	(30)	9.26E+06	(37)	39.1	23.3	64.9	76.0	31.2	27.2	35.9
4	1.03E+07	(41)	1.18E+07	(47)	42.0	26.9	65.2	68.9	32.0	28.0	36.6
11	1.80E+07	(48)	1.54E+07	(41)	56.3	36.3	87.5	27.6	33.5	29.4	38.1
POOL	8.03E+06	(476)	1.16E+07	(685)				27.6	33.5	29.4	38.1

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 530.2, 44.5

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 33.5, 31.3 -- 35.8 (-2.1 +2.3)
95% CONF. INTERVAL(Ma): 29.4 -- 38.1 (-4.1 +4.6)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.1882, 14
CHI^2 PROBABILITY: 27.6%

```
CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   33.4,  31.1 --  35.9 (  -2.3   +2.4)
                 95% CONF. INTERVAL(Ma):         29.1 --  38.4 (  -4.3   +5.0)
                     AGE DISPERSION (%):    9.8

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   33.5,  31.3 --  35.8 (  -2.1   +2.3)
                95% CONF. INTERVAL (Ma):         29.4 --  38.1 (  -4.1   +4.6)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-03-2005/16:09:14 FILENAME: F:\FISSIO~1\U33Z\04_03A.FTZ
04-03A, U33Z-33,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    21.01 to    56.18 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       34.86            2.301                 13.60

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.40            1.152                  6.80
       36.43            2.254                 13.31
       58.31            0.326                  1.93
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-03-2005/16:09:14 FILENAME: F:\FISSIO~1\U33Z\04_03A.FTZ
04-03A, U33Z-33,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  12.4 -   0 :o
  13.7 -   0 :o
  15.2 -   0 :o
  16.8 -   0 :o
  18.5 -   0 :   o
  20.5 -   7 :*******o*******
  22.6 -   0 :            o
  25.0 -  13 :******************o***********
  27.6 -   7 :***************       o
  30.5 -  20 :*****************************o***************
  33.7 -  13 :*****************************   o
  37.3 -  27 :********************************o**************************
  41.2 -   7 :***************         o
  45.5 -   0 :             o
  50.3 -   0 :       o
  55.5 -   7 :*****o*********
  61.3 -   0 :   o
  67.8 -   0 : o
  74.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-05-2005/13:53:01 FILENAME: F:\FISSIO~1\U33Z\04_04A.FTZ
04-04A, U33Z-34,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.670E+05
                                    RELATIVE ERROR (%):      1.75
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   2.63E+06 (  21)  6.63E+06 (  53)   12    306  84   19.1   10.9   32.1
   2   8.76E+06 (  35)  1.20E+07 (  48)    6    553 160   35.0   21.9   55.2
   3   9.76E+06 (  39)  6.26E+06 (  25)    6    288 115   74.4   44.1  128.2
   4   5.76E+06 (  23)  9.76E+06 (  39)    6    450 144   28.4   16.1   48.6
   5   5.01E+06 (  20)  6.26E+06 (  25)    6    288 115   38.4   20.2   71.8
   6   7.01E+06 (  28)  1.20E+07 (  48)    6    553 160   28.1   16.9   45.5
   7   8.76E+06 (  35)  9.51E+06 (  38)    6    438 142   44.2   27.1   71.7
   8   1.08E+07 (  43)  1.55E+07 (  62)    6    715 183   33.3   22.0   49.9
   9   9.76E+06 (  39)  1.13E+07 (  45)    6    519 155   41.6   26.3   65.2
  10   1.08E+07 (  43)  1.40E+07 (  56)    6    646 173   36.9   24.1   55.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-05-2005/13:53:01 FILENAME: F:\FISSIO~1\U33Z\04_04A.FTZ
04-04A, U33Z-34,
Number of grains =  10
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  1  2.63E+06 (  21) 6.63E+06 (  53)  19.1  10.9  32.1 100.0   19.1  10.9  32.1
  6  7.01E+06 (  28) 1.20E+07 (  48)  28.1  16.9  45.5  26.9   23.3  16.2  33.1
  4  5.76E+06 (  23) 9.76E+06 (  39)  28.4  16.1  48.6  45.4   24.8  18.6  33.0
  8  1.08E+07 (  43) 1.55E+07 (  62)  33.3  22.0  49.9  38.9   27.4  21.6  34.6
  2  8.76E+06 (  35) 1.20E+07 (  48)  35.0  21.9  55.2  41.3   28.8  23.4  35.5
 10  1.08E+07 (  43) 1.40E+07 (  56)  36.9  24.1  55.8  40.6   30.3  25.1  36.5
  5  5.01E+06 (  20) 6.26E+06 (  25)  38.4  20.2  71.8  46.5   30.9  25.8  37.0
  9  9.76E+06 (  39) 1.13E+07 (  45)  41.6  26.3  65.2  40.9   32.2  27.2  38.1
  7  8.76E+06 (  35) 9.51E+06 (  38)  44.2  27.1  71.7  36.0   33.3  28.3  39.0
  3  9.76E+06 (  39) 6.26E+06 (  25)  74.4  44.1 128.2   3.2   35.6  30.6  41.5
POOL 7.42E+06(  326) 9.99E+06(  439)                      3.2   35.6  30.6  41.5

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  460.1,  46.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   35.6,  32.9 --  38.5 (  -2.7   +2.9)
                 95% CONF. INTERVAL(Ma):         30.6 --  41.5 (  -5.1   +5.9)
      REDUCED CHI^2, DEGREES OF FREEDOM:    2.0321,    9
                      CHI^2 PROBABILITY:    3.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   35.8,  32.3 --  39.6 (  -3.5   +3.9)
                 95% CONF. INTERVAL(Ma):         29.2 --  43.7 (  -6.5   +8.0)
                     AGE DISPERSION (%):   21.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   35.6,  32.9 --  38.5 (  -2.7   +2.9)
                95% CONF. INTERVAL (Ma):         30.6 --  41.5 (  -5.1   +5.9)
        NUMBER AND PERCENTAGE OF GRAINS:   10,   100%
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-05-2005/13:53:01 FILENAME: F:\FISSIO~1\U33Z\04_04A.FTZ
04-04A, U33Z-34,
Kernel factor = .6 (Ratio of kernel window size to standard error)
Number of grains = 10
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages = 19.30 to 74.06 Ma

First Search: peaks with zero first derivatives.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
35.97	1.510	9.04
73.98	0.262	1.57

Second search: find minima in the second derivative of the Gaussian
probability density function.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
18.67	0.265	1.59
35.65	1.508	9.04
74.25	0.262	1.57

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-05-2005/13:53:01 FILENAME: F:\FISSIO~1\U33Z\04_04A.FTZ
04-04A, U33Z-34,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  10    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  11.3 -   0 :o
  12.4 -   0 :o
  13.7 -   0 :o
  15.2 -   0 : o
  16.8 -   0 :    o
  18.5 -  10 :*******o**********************
  20.5 -   0 :        o
  22.6 -   0 :         o
  25.0 -   0 :             o
  27.6 -  20 :**********************o************************************
  30.5 -   0 :                                  o
  33.7 -  20 :*****************************************o****************
  37.3 -  20 :*********************************************o**************
  41.2 -  10 :******************************      o
  45.5 -  10 :************************o******
  50.3 -   0 :           o
  55.5 -   0 :    o
  61.3 -   0 :   o
  67.8 -   0 :      o
  74.8 -  10 :*******o**********************
  82.7 -   0 :     o
  91.3 -   0 :  o
 100.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:16 FILENAME: F:\FISSIO~1\U33Z\04_05A.FTZ
04-05A, U33Z-35,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.658E+05
                                    RELATIVE ERROR (%):      1.78
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                               SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   8.26E+06 (  33)  1.40E+07 (  56)    6    649 174   28.2   17.7   44.1
   2   6.91E+06 (  46)  8.41E+06 (  56)   10    389 104   39.2   25.9   59.0
   3   7.51E+06 (  45)  1.03E+07 (  62)    9    479 122   34.7   23.1   51.7
   4   1.08E+07 (  43)  1.35E+07 (  54)    6    625 171   38.0   24.8   57.8
   5   8.17E+06 (  49)  9.51E+06 (  57)    9    440 117   41.0   27.4   61.2
   6   7.51E+06 (  45)  1.05E+07 (  63)    9    486 123   34.1   22.7   50.8
   7   8.26E+06 (  44)  1.14E+07 (  61)    8    530 136   34.5   22.8   51.6
   8   8.51E+06 (  34)  1.33E+07 (  53)    6    614 169   30.7   19.3   48.0
   9   5.63E+06 (  45)  5.51E+06 (  44)   12    255  77   48.8   31.5   75.6
  10   8.45E+06 (  45)  1.03E+07 (  55)    8    478 129   39.1   25.7   59.0
  11   5.51E+06 (  44)  7.13E+06 (  57)   12    330  88   36.9   24.3   55.6
  12   7.17E+06 (  43)  9.84E+06 (  59)    9    455 119   34.8   22.9   52.5
  13   2.53E+06 (  27)  3.28E+06 (  35)   16    152  51   36.9   21.4   62.6
  14   4.63E+06 (  37)  6.51E+06 (  52)   12    301  84   34.0   21.7   52.8
  15   1.28E+07 (  77)  1.08E+07 (  65)    9    502 125   56.4   40.0   79.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:16 FILENAME: F:\FISSIO~1\U33Z\04_05A.FTZ
04-05A, U33Z-35,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  1  8.26E+06 (  33) 1.40E+07 (  56)  28.2  17.7  44.1 100.0   28.2  17.7  44.1
  8  8.51E+06 (  34) 1.33E+07 (  53)  30.7  19.3  48.0  78.5   29.4  21.3  40.2
 14  4.63E+06 (  37) 6.51E+06 (  52)  34.0  21.7  52.8  82.8   30.9  24.0  39.7
  6  7.51E+06 (  45) 1.05E+07 (  63)  34.1  22.7  50.8  90.5   31.8  25.7  39.4
  7  8.26E+06 (  44) 1.14E+07 (  61)  34.5  22.8  51.6  95.2   32.4  26.8  39.1
  3  7.51E+06 (  45) 1.03E+07 (  62)  34.7  23.1  51.7  97.7   32.8  27.5  39.0
 12  7.17E+06 (  43) 9.84E+06 (  59)  34.8  22.9  52.5  99.0   33.1  28.1  38.9
 13  2.53E+06 (  27) 3.28E+06 (  35)  36.9  21.4  62.6  99.4   33.4  28.6  39.0
 11  5.51E+06 (  44) 7.13E+06 (  57)  36.9  24.3  55.6  99.6   33.8  29.1  39.1
  4  1.08E+07 (  43) 1.35E+07 (  54)  38.0  24.8  57.8  99.7   34.2  29.7  39.3
 10  8.45E+06 (  45) 1.03E+07 (  55)  39.1  25.7  59.0  99.7   34.6  30.3  39.6
  2  6.91E+06 (  46) 8.41E+06 (  56)  39.2  25.9  59.0  99.7   35.0  30.8  39.8
  5  8.17E+06 (  49) 9.51E+06 (  57)  41.0  27.4  61.2  99.6   35.5  31.3  40.2
  9  5.63E+06 (  45) 5.51E+06 (  44)  48.8  31.5  75.6  97.4   36.2  32.1  40.9
 15  1.28E+07 (  77) 1.08E+07 (  65)  56.4  40.0  79.8  65.5   37.8  33.7  42.5
POOL 7.00E+06(  657) 8.83E+06(  829)                    65.5   37.8  33.7  42.5

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  408.5,  31.9

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   37.8,  35.7 --  40.1 (  -2.2   +2.3)
                95% CONF. INTERVAL(Ma):          33.7 --  42.5 (  -4.2   +4.7)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.8136,   14
                     CHI^2 PROBABILITY:   65.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   37.8,  35.6 --  40.1 (  -2.2   +2.3)
                95% CONF. INTERVAL(Ma):          33.7 --  42.5 (  -4.2   +4.7)
```

```
                    AGE DISPERSION (%):    1.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   37.8,  35.7 --  40.1 (  -2.2   +2.3)
               95% CONF. INTERVAL (Ma):         33.7 --  42.5 (  -4.2   +4.7)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:16 FILENAME: F:\FISSIO~1\U33Z\04_05A.FTZ
04-05A, U33Z-35,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    28.32 to    56.39 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       36.15            3.358                 17.25

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       36.04            3.358                 17.25
       56.61            0.573                  2.94

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:16 FILENAME: F:\FISSIO~1\U33Z\04_05A.FTZ
04-05A, U33Z-35,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  16.8 -   0 :o
  18.5 -   0 :o
  20.5 -   0 :o
  22.6 -   0 :o
  25.0 -   0 :   o
  27.6 -   7 :**********o*
  30.5 -   7 :************          o
  33.7 -  33 :************************************o**********************
  37.3 -  27 :*************************************o*********
  41.2 -  13 :************************   o
  45.5 -   0 :              o
  50.3 -   7 :********o***
  55.5 -   7 :******o*****
  61.3 -   0 :   o
  67.8 -   0 :o
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:30:32 FILENAME: F:\FISSIO~1\U33Z\04_06A.FTZ
04-06A, U33Z-36,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.647E+05
RELATIVE ERROR (%): 1.80
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 360.20 8.04
SIZE OF COUNTER SQUARE (cm^2): 6.660E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s	Grain Age	Age (Ma) --95% CI--	
1	1.03E+07	(41)	1.05E+07	(42)	6	488 151	46.4	29.4	73.0
2	7.17E+06	(43)	1.07E+07	(64)	9	496 125	32.0	21.2	47.8
3	3.63E+06	(29)	6.13E+06	(49)	12	285 82	28.2	17.1	45.5
4	9.01E+06	(36)	9.76E+06	(39)	6	454 145	43.9	27.1	70.8
5	7.01E+06	(28)	6.51E+06	(26)	6	302 118	51.1	28.9	90.6
6	7.26E+06	(29)	1.05E+07	(42)	6	488 151	32.9	19.7	54.0
7	8.41E+06	(28)	1.47E+07	(49)	5	684 196	27.3	16.4	44.1
8	8.26E+06	(55)	1.17E+07	(78)	10	544 124	33.6	23.3	48.0
9	8.01E+06	(32)	7.26E+06	(29)	6	337 125	52.4	30.7	89.6
10	8.76E+06	(35)	9.51E+06	(38)	6	442 143	43.8	26.8	71.1
11	7.51E+06	(30)	1.43E+07	(57)	6	663 176	25.1	15.5	39.6
12	1.30E+07	(52)	1.65E+07	(66)	6	767 190	37.5	25.5	54.7
13	8.34E+06	(50)	1.18E+07	(71)	9	550 132	33.5	22.8	48.8
14	9.18E+06	(55)	1.20E+07	(72)	9	558 133	36.3	25.1	52.3
15	7.01E+06	(42)	1.08E+07	(65)	9	504 126	30.8	20.3	46.0

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:30:32 FILENAME: F:\FISSIO~1\U33Z\04_06A.FTZ
04-06A, U33Z-36,
Number of grains = 15

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
11	7.51E+06	(30)	1.43E+07	(57)	25.1	15.5	39.6	100.0	25.1	15.5	39.6
7	8.41E+06	(28)	1.47E+07	(49)	27.3	16.4	44.1	80.1	26.1	18.5	36.2
3	3.63E+06	(29)	6.13E+06	(49)	28.2	17.1	45.5	93.3	26.8	20.5	35.0
15	7.01E+06	(42)	1.08E+07	(65)	30.8	20.3	46.0	92.2	27.9	22.3	34.9
2	7.17E+06	(43)	1.07E+07	(64)	32.0	21.2	47.8	93.3	28.8	23.7	35.1
6	7.26E+06	(29)	1.05E+07	(42)	32.9	19.7	54.0	95.5	29.4	24.4	35.3
13	8.34E+06	(50)	1.18E+07	(71)	33.5	22.8	48.8	95.9	30.1	25.5	35.6
8	8.26E+06	(55)	1.17E+07	(78)	33.6	23.3	48.0	96.9	30.7	26.3	35.8
14	9.18E+06	(55)	1.20E+07	(72)	36.3	25.1	52.3	95.8	31.4	27.2	36.3
12	1.30E+07	(52)	1.65E+07	(66)	37.5	25.5	54.7	94.7	32.1	28.0	36.7
10	8.76E+06	(35)	9.51E+06	(38)	43.8	26.8	71.1	88.9	32.7	28.7	37.4
4	9.01E+06	(36)	9.76E+06	(39)	43.9	27.1	70.8	83.5	33.4	29.3	37.9
1	1.03E+07	(41)	1.05E+07	(42)	46.4	29.4	73.0	73.3	34.1	30.1	38.7
5	7.01E+06	(28)	6.51E+06	(26)	51.1	28.9	90.6	63.0	34.7	30.7	39.2
9	8.01E+06	(32)	7.26E+06	(29)	52.4	30.7	89.6	50.6	35.3	31.3	39.9
POOL	7.91E+06	(585)	1.06E+07	(787)				50.6	35.3	31.3	39.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 494.7, 39.5

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 35.3, 33.2 -- 37.6 (-2.1 +2.2)
95% CONF. INTERVAL(Ma): 31.3 -- 39.9 (-4.0 +4.5)
REDUCED CHI^2, DEGREES OF FREEDOM: 0.9474, 14
CHI^2 PROBABILITY: 50.6%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 35.3, 33.2 -- 37.6 (-2.1 +2.2)
95% CONF. INTERVAL(Ma): 31.3 -- 39.9 (-4.0 +4.5)

```
                    AGE DISPERSION (%):    0.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   35.3,  33.2 --  37.6 (  -2.1   +2.2)
                95% CONF. INTERVAL (Ma):         31.3 --  39.9 (  -4.0   +4.5)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:32 FILENAME: F:\FISSIO~1\U33Z\04_06A.FTZ
04-06A, U33Z-36,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    25.24 to    52.31 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       33.66            2.471                 13.54

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.88            0.857                  4.70
       33.54            2.471                 13.54
       48.57            1.235                  6.77

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:32 FILENAME: F:\FISSIO~1\U33Z\04_06A.FTZ
04-06A, U33Z-36,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  15.2 -   0 :o
  16.8 -   0 :o
  18.5 -   0 :o
  20.5 -   0 :  o
  22.6 -   0 :        o
  25.0 -   7 :*****************o**
  27.6 -  13 :****************************o***********
  30.5 -  13 :*****************************************  o
  33.7 -  20 :************************************************o***********
  37.3 -  13 :***************************************** o
  41.2 -   0 :                                    o
  45.5 -  20 :***************************o********************************
  50.3 -  13 :**********************o*****************
  55.5 -   0 :             o
  61.3 -   0 :      o
  67.8 -   0 : o
  74.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/13:26:22 FILENAME: E:\FISSIO~1\U33Z\04_07A.FTZ
04-07A, U33Z-37,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.636E+05
                                    RELATIVE ERROR (%):      1.83
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.13E+07 (  45)  1.45E+07 (  58)    6    677 179   36.8   24.3   55.2
   2   9.51E+06 (  38)  1.28E+07 (  51)    6    596 167   35.3   22.5   54.8
   3   6.26E+06 (  25)  1.10E+07 (  44)    6    514 155   27.0   15.8   45.0
   4   9.01E+06 (  36)  1.25E+07 (  50)    6    584 166   34.1   21.6   53.4
   5   1.00E+07 (  40)  1.70E+07 (  68)    6    794 194   27.9   18.4   41.8
   6   7.26E+06 (  29)  1.23E+07 (  49)    6    572 164   28.1   17.1   45.3
   7   8.01E+06 (  32)  1.48E+07 (  59)    6    689 180   25.8   16.2   40.2
   8   7.51E+06 (  30)  1.65E+07 (  66)    6    771 191   21.6   13.5   33.7
   9   1.13E+07 (  45)  9.76E+06 (  39)    6    455 146   54.5   34.7   85.9
  10   9.26E+06 (  37)  1.45E+07 (  58)    6    677 179   30.3   19.4   46.5
  11   1.43E+07 (  57)  1.95E+07 (  78)    6    911 208   34.6   24.1   49.4
  12   6.57E+06 (  35)  1.20E+07 (  64)    8    560 141   26.0   16.6   39.8
  13   9.01E+06 (  36)  1.63E+07 (  65)    6    759 190   26.3   16.9   40.1
  14   1.03E+07 (  41)  1.13E+07 (  45)    6    525 157   43.1   27.5   67.3
  15   6.51E+06 (  26)  1.28E+07 (  51)    6    596 167   24.2   14.5   39.5

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/13:26:22 FILENAME: E:\FISSIO~1\U33Z\04_07A.FTZ
04-07A, U33Z-37,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  8  7.51E+06 (  30) 1.65E+07 (  66)  21.6  13.5  33.7 100.0   21.6  13.5  33.7
 15  6.51E+06 (  26) 1.28E+07 (  51)  24.2  14.5  39.5  72.5   22.7  16.2  31.5
  7  8.01E+06 (  32) 1.48E+07 (  59)  25.8  16.2  40.2  84.7   23.8  18.3  30.8
 12  6.57E+06 (  35) 1.20E+07 (  64)  26.0  16.6  39.8  92.8   24.3  19.5  30.4
 13  9.01E+06 (  36) 1.63E+07 (  65)  26.3  16.9  40.1  96.7   24.7  20.3  30.2
  3  6.26E+06 (  25) 1.10E+07 (  44)  27.0  15.8  45.0  98.5   25.0  20.8  30.1
  5  1.00E+07 (  40) 1.70E+07 (  68)  27.9  18.4  41.8  98.9   25.5  21.5  30.2
  6  7.26E+06 (  29) 1.23E+07 (  49)  28.1  17.1  45.3  99.4   25.7  21.9  30.3
 10  9.26E+06 (  37) 1.45E+07 (  58)  30.3  19.4  46.5  99.1   26.2  22.5  30.6
  4  9.01E+06 (  36) 1.25E+07 (  50)  34.1  21.6  53.4  96.9   26.9  23.2  31.2
 11  1.43E+07 (  57) 1.95E+07 (  78)  34.6  24.1  49.4  91.3   27.8  24.3  32.0
  2  9.51E+06 (  38) 1.28E+07 (  51)  35.3  22.5  54.8  88.8   28.4  24.8  32.4
  1  1.13E+07 (  45) 1.45E+07 (  58)  36.8  24.3  55.2  83.8   29.0  25.5  33.0
 14  1.03E+07 (  41) 1.13E+07 (  45)  43.1  27.5  67.3  65.8   29.8  26.3  33.8
  9  1.13E+07 (  45) 9.76E+06 (  39)  54.5  34.7  85.9  21.9   30.9  27.4  34.9
POOL 9.01E+06(  552) 1.38E+07(  845)                      21.9   30.9  27.4  34.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  643.5,  50.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   30.9,  29.1 --  32.9 (  -1.9   +2.0)
                95% CONF. INTERVAL(Ma):         27.4 --  34.9 (  -3.5   +4.0)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.2671,   14
                     CHI^2 PROBABILITY:   21.9%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   30.9,  29.0 --  33.0 (  -2.0   +2.1)
                95% CONF. INTERVAL(Ma):         27.2 --  35.2 (  -3.7   +4.3)
```

```
                    AGE DISPERSION (%):    8.8

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   30.9,  29.1 --  32.9 (  -1.9   +2.0)
                95% CONF. INTERVAL (Ma):         27.4 --  34.9 (  -3.5   +4.0)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/13:26:22 FILENAME: E:\FISSIO~1\U33Z\04_07A.FTZ
04-07A, U33Z-37,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    21.74 to    54.46 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       27.56            2.404                 12.95

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       26.46            2.353                 12.68
       35.45            1.782                  9.60
       55.65            0.347                  1.87

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/13:26:22 FILENAME: E:\FISSIO~1\U33Z\04_07A.FTZ
04-07A, U33Z-37,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  13.7 -   0 :o
  15.2 -   0 :o
  16.8 -   0 :o
  18.5 -   0 :  o
  20.5 -   0 :         o
  22.6 -   7 :***************    o
  25.0 -  20 :******************************o**************
  27.6 -  27 :***********************************o***********************
  30.5 -   7 :***************                  o
  33.7 -  20 :****************************o***************
  37.3 -   7 :***************       o
  41.2 -   7 :*************o*
  45.5 -   0 :       o
  50.3 -   0 :     o
  55.5 -   7 :****o*********
  61.3 -   0 :  o
  67.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:46 FILENAME: F:\FISSIO~1\U33Z\04_08A.FTZ
04-08A, U33Z-39,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.613E+05
                                    RELATIVE ERROR (%):      1.90
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   6.63E+06 (  53)  7.88E+06 (  63)   12    371  94   39.5   26.8   57.8
   2   3.94E+06 (  21)  6.76E+06 (  36)    8    318 106   27.5   15.2   48.2
   3   3.00E+06 (  24)  6.63E+06 (  53)   12    312  86   21.4   12.6   35.1
   4   6.26E+06 (  25)  1.43E+07 (  57)    6    671 179   20.7   12.3   33.6
   5   2.84E+06 (  17)  6.84E+06 (  41)    9    322 101   19.6   10.4   35.1
   6   6.13E+06 (  49)  1.26E+07 ( 101)   12    595 120   22.8   15.8   32.4
   7   6.76E+06 (  36)  9.20E+06 (  49)    8    433 124   34.5   21.8   54.1
   8   2.72E+06 (  29)  5.91E+06 (  63)   16    278  71   21.7   13.4   34.1
   9   2.06E+06 (  22)  5.72E+06 (  61)   16    269  69   17.0    9.9   28.0
  10   3.88E+06 (  31)  4.75E+06 (  38)   12    224  73   38.3   23.0   63.2
  11   5.84E+06 (  35)  7.51E+06 (  45)    9    353 106   36.5   22.8   58.1
  12   3.63E+06 (  29)  7.38E+06 (  59)   12    348  91   23.2   14.3   36.6
  13   3.88E+06 (  31)  5.26E+06 (  42)   12    247  76   34.7   21.0   56.4
  14   3.50E+06 (  42)  7.01E+06 (  84)   18    330  73   23.5   15.8   34.5
  15   2.00E+06 (  32)  5.26E+06 (  84)   24    247  55   18.0   11.5   27.2

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:46 FILENAME: F:\FISSIO~1\U33Z\04_08A.FTZ
04-08A, U33Z-39,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  9  2.06E+06 (  22) 5.72E+06 (  61)  17.0   9.9  28.0 100.0   17.0   9.9  28.0
 15  2.00E+06 (  32) 5.26E+06 (  84)  18.0  11.5  27.2  86.6   17.5  12.5  24.1
  5  2.84E+06 (  17) 6.84E+06 (  41)  19.6  10.4  35.1  93.5   18.0  13.6  23.8
  4  6.26E+06 (  25) 1.43E+07 (  57)  20.7  12.3  33.6  94.4   18.6  14.6  23.7
  3  3.00E+06 (  24) 6.63E+06 (  53)  21.4  12.6  35.1  96.0   19.1  15.3  23.8
  8  2.72E+06 (  29) 5.91E+06 (  63)  21.7  13.4  34.1  97.2   19.5  16.0  23.8
  6  6.13E+06 (  49) 1.26E+07 ( 101)  22.8  15.8  32.4  96.1   20.3  17.0  24.1
 12  3.63E+06 (  29) 7.38E+06 (  59)  23.2  14.3  36.6  97.1   20.6  17.4  24.3
 14  3.50E+06 (  42) 7.01E+06 (  84)  23.5  15.8  34.5  97.5   21.0  18.0  24.5
  2  3.94E+06 (  21) 6.76E+06 (  36)  27.5  15.2  48.2  96.2   21.3  18.4  24.8
  7  6.76E+06 (  36) 9.20E+06 (  49)  34.5  21.8  54.1  68.3   22.3  19.3  25.7
 13  3.88E+06 (  31) 5.26E+06 (  42)  34.7  21.0  56.4  47.3   23.0  20.0  26.4
 11  5.84E+06 (  35) 7.51E+06 (  45)  36.5  22.8  58.1  27.0   23.8  20.8  27.2
 10  3.88E+06 (  31) 4.75E+06 (  38)  38.3  23.0  63.2  15.4   24.5  21.5  27.9
  1  6.63E+06 (  53) 7.88E+06 (  63)  39.5  26.8  57.8   4.6   25.5  22.5  28.9
POOL 3.84E+06(  476) 7.07E+06(  876)                      4.6   25.5  22.5  28.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  332.9,  25.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   25.5,  24.0 --  27.2 (  -1.6   +1.7)
                95% CONF. INTERVAL(Ma):          22.5 --  28.9 (  -3.0   +3.4)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.7118,   14
                     CHI^2 PROBABILITY:    4.6%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   25.6,  23.7 --  27.7 (  -1.9   +2.1)
                95% CONF. INTERVAL(Ma):          22.0 --  29.9 (  -3.6   +4.2)
```

```
                    AGE DISPERSION (%):   17.3

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   25.5,  24.0 --  27.2 (  -1.6   +1.7)
               95% CONF. INTERVAL (Ma):         22.5 --  28.9 (  -3.0   +3.4)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:46 FILENAME: F:\FISSIO~1\U33Z\04_08A.FTZ
04-08A, U33Z-39,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    17.19 to    39.53 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       22.26            2.192                 12.57
       36.70            1.442                  8.27

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       22.75            2.171                 12.45
       37.51            1.426                  8.18
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:46 FILENAME: F:\FISSIO~1\U33Z\04_08A.FTZ
04-08A, U33Z-39,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  10.2 -   0 :o
  11.3 -   0 :o
  12.4 -   0 :o
  13.7 -   0 : o
  15.2 -   0 :     o
  16.8 -   7 :************o**
  18.5 -   7 :***************      o
  20.5 -  20 :****************************o***************
  22.6 -  27 :*******************************o*************************
  25.0 -   0 :                         o
  27.6 -   7 :**************o
  30.5 -   0 :              o
  33.7 -  13 :******************o***********
  37.3 -  13 :**********************o********
  41.2 -   7 :***************o
  45.5 -   0 :      o
  50.3 -   0 : o
  55.5 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:58 FILENAME: F:\FISSIO~1\U33Z\04_10A.FTZ
04-10A, U33Z-42,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.580E+05
                                    RELATIVE ERROR (%):      2.03
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   4.50E+06 (  24)  1.20E+07 (  64)    8    573 144   17.5   10.4   28.3
   2   6.01E+06 (  32)  9.76E+06 (  52)    8    465 130   28.6   17.8   45.2
   3   1.03E+07 (  55)  1.65E+07 (  88)    8    787 170   29.0   20.3   41.1
   4   7.51E+06 (  30)  1.40E+07 (  56)    6    668 180   24.9   15.4   39.4
   5   4.75E+06 (  19)  6.76E+06 (  27)    6    322 124   32.7   17.1   60.9
   6   2.00E+06 (  16)  7.26E+06 (  58)   12    346  92   12.9    6.9   22.6
   7   7.01E+06 (  28)  1.45E+07 (  58)    6    692 183   22.5   13.7   35.8
   8   9.26E+06 (  37)  1.30E+07 (  52)    6    620 173   33.0   21.0   51.3
   9   1.50E+07 (  40)  1.05E+07 (  28)    4    501 189   65.9   39.8  111.0
  10   4.88E+06 (  26)  1.26E+07 (  67)    8    600 148   18.1   11.0   28.8
  11   3.34E+06 (  20)  4.00E+06 (  24)    9    191  78   38.7   20.2   72.9
  12   3.75E+06 (  30)  7.51E+06 (  60)   12    358  93   23.3   14.4   36.6
  13   3.63E+06 (  29)  8.51E+06 (  68)   12    406  99   19.9   12.3   31.0
  14   7.76E+06 (  31)  1.28E+07 (  51)    6    608 171   28.3   17.4   44.9
  15   5.01E+06 (  20)  8.51E+06 (  34)    6    406 139   27.4   14.9   48.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:58 FILENAME: F:\FISSIO~1\U33Z\04_10A.FTZ
04-10A, U33Z-42,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  6  2.00E+06 (  16) 7.26E+06 (  58)  12.9   6.9  22.6 100.0   12.9   6.9  22.6
  1  4.50E+06 (  24) 1.20E+07 (  64)  17.5  10.4  28.3  40.6   15.3  10.4  22.0
 10  4.88E+06 (  26) 1.26E+07 (  67)  18.1  11.0  28.8  60.7   16.3  12.2  21.7
 13  3.63E+06 (  29) 8.51E+06 (  68)  19.9  12.3  31.0  67.2   17.2  13.5  21.9
  7  7.01E+06 (  28) 1.45E+07 (  58)  22.5  13.7  35.8  63.2   18.2  14.6  22.5
 12  3.75E+06 (  30) 7.51E+06 (  60)  23.3  14.4  36.6  62.0   19.0  15.6  23.1
  4  7.51E+06 (  30) 1.40E+07 (  56)  24.9  15.4  39.4  58.3   19.7  16.4  23.7
 15  5.01E+06 (  20) 8.51E+06 (  34)  27.4  14.9  48.8  55.5   20.3  17.0  24.2
 14  7.76E+06 (  31) 1.28E+07 (  51)  28.3  17.4  44.9  46.7   21.1  17.9  24.8
  2  6.01E+06 (  32) 9.76E+06 (  52)  28.6  17.8  45.2  41.7   21.7  18.6  25.4
  3  1.03E+07 (  55) 1.65E+07 (  88)  29.0  20.3  41.1  32.2   22.7  19.6  26.3
  5  4.75E+06 (  19) 6.76E+06 (  27)  32.7  17.1  60.9  30.6   23.1  20.0  26.6
  8  9.26E+06 (  37) 1.30E+07 (  52)  33.0  21.0  51.3  22.9   23.8  20.8  27.3
 11  3.34E+06 (  20) 4.00E+06 (  24)  38.7  20.2  72.9  17.2   24.3  21.2  27.8
  9  1.50E+07 (  40) 1.05E+07 (  28)  65.9  39.8 111.0   0.2   25.8  22.6  29.4
POOL 5.61E+06(  437) 1.01E+07(  787)                      0.2   25.8  22.6  29.4

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  481.5,  39.5

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   25.8,  24.1 --  27.5 (  -1.7   +1.8)
                95% CONF. INTERVAL(Ma):         22.6 --  29.4 (  -3.2   +3.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    2.4352,   14
                      CHI^2 PROBABILITY:    0.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   26.1,  23.7 --  28.7 (  -2.4   +2.6)
                95% CONF. INTERVAL(Ma):         21.6 --  31.5 (  -4.5   +5.4)
```

```
                    AGE DISPERSION (%):   26.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   24.3,  22.7 --  26.0 (  -1.6   +1.7)
               95% CONF. INTERVAL (Ma):         21.2 --  27.8 (  -3.1   +3.5)
        NUMBER AND PERCENTAGE OF GRAINS:   14,    93%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:30:58 FILENAME: F:\FISSIO~1\U33Z\04_10A.FTZ
04-10A, U33Z-42,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    13.09 to    65.69 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       28.34            1.942                 11.77
       65.47            0.275                   1.67

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       12.09            0.225                   1.36
       18.49            1.039                   6.30
       29.04            1.924                  11.67
       65.99            0.275                   1.66
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:30:58 FILENAME: F:\FISSIO~1\U33Z\04_10A.FTZ
04-10A, U33Z-42,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   8.3 -   0 :o
   9.2 -   0 :o
  10.2 -   0 : o
  11.3 -   0 :  o
  12.4 -   0 :    o
  13.7 -   7 :******o*************
  15.2 -   0 :         o
  16.8 -   7 :**************o*****
  18.5 -   7 :********************o
  20.5 -   7 :********************    o
  22.6 -  13 :****************************o***********
  25.0 -   7 :********************             o
  27.6 -  20 :************************************o********************
  30.5 -   7 :********************               o
  33.7 -  13 :************************o**************
  37.3 -   7 :**************o*****
  41.2 -   0 :       o
  45.5 -   0 :   o
  50.3 -   0 :  o
  55.5 -   0 :  o
  61.3 -   0 :    o
  67.8 -   7 :****o***************
  74.8 -   0 :   o
  82.7 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:31:10 FILENAME: F:\FISSIO~1\U33Z\04_12B.FTZ
04-12B, U33Z-45,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.546E+05
                                    RELATIVE ERROR (%):      2.17
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   9.84E+06 (  59)  4.00E+06 (  24)    9    193  79  111.3   68.6  187.2
   2   1.75E+07 (  70)  5.76E+06 (  23)    6    278 115  137.5   85.3  230.6
   3   6.26E+06 (  25)  3.25E+06 (  13)    6    157  86   87.1   43.2  185.3
   4   1.02E+07 (  61)  6.17E+06 (  37)    9    298  98   75.1   49.2  116.3
   5   9.31E+06 (  62)  5.11E+06 (  34)   10    247  85   82.9   53.8  130.1
   6   1.50E+07 (  60)  4.25E+06 (  17)    6    206  99  158.8   92.4  289.8
   7   7.51E+06 (  45)  4.00E+06 (  24)    9    193  79   85.2   51.0  146.2
   8   8.41E+06 (  56)  4.65E+06 (  31)   10    225  81   82.1   52.2  131.9
   9   7.51E+06 (  45)  4.17E+06 (  25)    9    201  80   81.8   49.3  139.3
  10   6.51E+06 (  39)  4.34E+06 (  26)    9    210  82   68.3   40.6  116.9
  11   8.17E+06 (  49)  4.84E+06 (  29)    9    234  87   76.9   47.7  126.3
  12   1.07E+07 (  64)  4.67E+06 (  28)    9    226  85  103.7   65.8  168.0
  13   7.34E+06 (  44)  3.84E+06 (  23)    9    185  77   86.9   51.5  150.8
  14   1.28E+07 (  51)  5.51E+06 (  22)    6    266 113  105.0   62.9  181.9
  15   9.34E+06 (  56)  4.34E+06 (  26)    9    210  82   97.7   60.6  162.2

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:31:10 FILENAME: F:\FISSIO~1\U33Z\04_12B.FTZ
04-12B, U33Z-45,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 10  6.51E+06 (  39) 4.34E+06 (  26)  68.3  40.6 116.9 100.0   68.3  40.6 116.9
  4  1.02E+07 (  61) 6.17E+06 (  37)  75.1  49.2 116.3  77.3   72.3  52.2 101.0
 11  8.17E+06 (  49) 4.84E+06 (  29)  76.9  47.7 126.3  93.6   73.7  56.5  96.0
  9  7.51E+06 (  45) 4.17E+06 (  25)  81.8  49.3 139.3  96.5   75.5  59.6  95.5
  8  8.41E+06 (  56) 4.65E+06 (  31)  82.1  52.2 131.9  98.3   76.9  62.3  94.9
  5  9.31E+06 (  62) 5.11E+06 (  34)  82.9  53.8 130.1  99.2   78.0  64.4  94.5
  7  7.51E+06 (  45) 4.00E+06 (  24)  85.2  51.0 146.2  99.6   78.9  65.8  94.5
 13  7.34E+06 (  44) 3.84E+06 (  23)  86.9  51.5 150.8  99.8   79.7  67.1  94.7
  3  6.26E+06 (  25) 3.25E+06 (  13)  87.1  43.2 185.3  99.9   80.1  67.7  94.8
 15  9.34E+06 (  56) 4.34E+06 (  26)  97.7  60.6 162.2  99.7   81.9  69.8  96.1
 12  1.07E+07 (  64) 4.67E+06 (  28) 103.7  65.8 168.0  99.1   84.0  72.1  97.8
 14  1.28E+07 (  51) 5.51E+06 (  22) 105.0  62.9 181.9  98.7   85.5  73.7  99.1
  1  9.84E+06 (  59) 4.00E+06 (  24) 111.3  68.6 187.2  97.5   87.3  75.6 100.7
  2  1.75E+07 (  70) 5.76E+06 (  23) 137.5  85.3 230.6  84.7   90.5  78.8 104.0
  6  1.50E+07 (  60) 4.25E+06 (  17) 158.8  92.4 289.8  58.5   93.6  81.7 107.2
POOL 9.44E+06(  786) 4.59E+06(  382)                     58.5   93.6  81.7 107.2

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  221.7,  24.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   93.6,  87.3 -- 100.3 (  -6.3   +6.7)
                95% CONF. INTERVAL(Ma):          81.7 -- 107.2 ( -11.9  +13.6)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.8764,   14
                     CHI^2 PROBABILITY:   58.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   93.7,  87.4 -- 100.4 (  -6.3   +6.7)
                95% CONF. INTERVAL(Ma):          81.8 -- 107.3 ( -11.9  +13.6)
```

```
                    AGE DISPERSION (%):    1.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   93.6,  87.3 -- 100.3 (  -6.3   +6.7)
                95% CONF. INTERVAL (Ma):         81.7 -- 107.2 ( -11.9  +13.6)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:10 FILENAME: F:\FISSIO~1\U33Z\04_12B.FTZ
04-12B, U33Z-45,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    67.99 to   156.60 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       83.39            2.517                 15.58

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       79.83            2.457                 15.21
      153.17            0.477                  2.96

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:10 FILENAME: F:\FISSIO~1\U33Z\04_12B.FTZ
04-12B, U33Z-45,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         6.67      13.33     20        26.67     33.33     40
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  41.2 -   0 :o
  45.5 -   0 :o
  50.3 -   0 :o
  55.5 -   0 : o
  61.3 -   0 :     o
  67.8 -   7 :**********  o
  74.8 -  13 :*******************o
  82.7 -  40 :************************o**********************************
  91.3 -   0 :                      o
 100.8 -  20 :*****************o************
 111.3 -   7 :**********  o
 122.9 -   0 :        o
 135.7 -   7 :******o***
 149.8 -   7 :****o*****
 165.4 -   0 :  o
 182.6 -   0 : o
 201.5 -   0 :o
```

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:31:21 FILENAME: F:\FISSIO~1\U33Z\04_13A.FTZ
04-13A, U33Z-46,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.535E+05
                                    RELATIVE ERROR (%):      2.23
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   1.11E+07 (  74)  4.20E+06 (  28)   10    204  77   119.1   76.5  191.3
   2   7.23E+06 (  77)  4.69E+06 (  50)   16    228  65    69.9   48.3  102.0
   3   1.17E+07 (  39)  8.71E+06 (  29)    5    423 157    61.0   36.8  102.4
   4   9.51E+06 (  95)  5.91E+06 (  59)   15    287  75    73.0   52.2  103.0
   5   1.08E+07 (  72)  5.86E+06 (  39)   10    284  91    83.6   55.9  126.9
   6   9.18E+06 (  55)  6.67E+06 (  40)    9    324 103    62.4   40.8   96.4
   7   1.43E+07 (  57)  8.51E+06 (  34)    6    413 142    76.0   48.9  119.9
   8   1.35E+07 (  54)  8.01E+06 (  32)    6    389 137    76.4   48.6  122.4
   9   9.68E+06 (  58)  5.67E+06 (  34)    9    275  95    77.3   49.8  121.8
  10   8.68E+06 (  52)  5.51E+06 (  33)    9    267  93    71.4   45.4  114.2
  11   7.76E+06 (  31)  3.25E+06 (  13)    6    158  86   107.2   55.0  223.2
  12   1.02E+07 (  61)  4.84E+06 (  29)    9    235  87    95.1   60.3  153.5
  13   7.38E+06 (  59)  6.38E+06 (  51)   12    310  87    52.6   35.5   78.2
  14   1.35E+07 (  81)  8.17E+06 (  49)    9    397 114    75.0   51.9  109.3
  15   1.43E+07 (  86)  6.67E+06 (  40)    9    324 103    97.2   66.2  145.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:31:21 FILENAME: F:\FISSIO~1\U33Z\04_13A.FTZ
04-13A, U33Z-46,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 13  7.38E+06 (  59) 6.38E+06 (  51)  52.6  35.5  78.2 100.0   52.6  35.5  78.2
  3  1.17E+07 (  39) 8.71E+06 (  29)  61.0  36.8 102.4  62.8   55.7  40.9  75.9
  6  9.18E+06 (  55) 6.67E+06 (  40)  62.4  40.8  96.4  80.3   57.9  45.3  74.0
  2  7.23E+06 (  77) 4.69E+06 (  50)  69.9  48.3 102.0  75.6   61.4  50.0  75.5
 10  8.68E+06 (  52) 5.51E+06 (  33)  71.4  45.4 114.2  81.2   63.1  52.2  76.2
  4  9.51E+06 (  95) 5.91E+06 (  59)  73.0  52.2 103.0  82.1   65.3  55.2  77.3
 14  1.35E+07 (  81) 8.17E+06 (  49)  75.0  51.9 109.3  84.6   66.9  57.2  78.1
  7  1.43E+07 (  57) 8.51E+06 (  34)  76.0  48.9 119.9  88.2   67.8  58.4  78.6
  8  1.35E+07 (  54) 8.01E+06 (  32)  76.4  48.6 122.4  91.3   68.5  59.4  79.1
  9  9.68E+06 (  58) 5.67E+06 (  34)  77.3  49.8 121.8  93.5   69.2  60.3  79.5
  5  1.08E+07 (  72) 5.86E+06 (  39)  83.6  55.9 126.9  92.4   70.5  61.7  80.5
 12  1.02E+07 (  61) 4.84E+06 (  29)  95.1  60.3 153.5  86.1   72.0  63.3  81.9
 15  1.43E+07 (  86) 6.67E+06 (  40)  97.2  66.2 145.4  74.2   74.0  65.3  83.8
 11  7.76E+06 (  31) 3.25E+06 (  13) 107.2  55.0 223.2  70.5   74.8  66.1  84.6
  1  1.11E+07 (  74) 4.20E+06 (  28) 119.1  76.5 191.3  43.0   77.0  68.3  86.9
POOL 1.02E+07(  951) 6.01E+06(  560)                     43.0   77.0  68.3  86.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  291.4,  27.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   77.0,  72.4 --  81.9 (  -4.6   +4.9)
                95% CONF. INTERVAL(Ma):         68.3 --  86.9 (  -8.8   +9.9)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.0193,   14
                     CHI^2 PROBABILITY:   43.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   77.1,  72.4 --  82.0 (  -4.6   +4.9)
                95% CONF. INTERVAL(Ma):         68.3 --  87.0 (  -8.8   +9.9)
```

```
                    AGE DISPERSION (%):    2.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   77.0,  72.4 --  81.9 (  -4.6   +4.9)
               95% CONF. INTERVAL (Ma):         68.3 --  86.9 (  -8.8   +9.9)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:21 FILENAME: F:\FISSIO~1\U33Z\04_13A.FTZ
04-13A, U33Z-46,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    52.53 to   118.25 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       73.94            2.815                 15.25

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       51.46            0.615                  3.33
       73.17            2.809                 15.22
      103.61            1.036                  5.61
      123.25            0.515                  2.79
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:21 FILENAME: F:\FISSIO~1\U33Z\04_13A.FTZ
04-13A, U33Z-46,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  30.5 -   0 :o
  33.7 -   0 :o
  37.3 -   0 :o
  41.2 -   0 :o
  45.5 -   0 :  o
  50.3 -   7 :*****o******
  55.5 -   0 :          o
  61.3 -  13 :*****************o******
  67.8 -  13 :***********************    o
  74.8 -  33 :********************************o************************
  82.7 -   7 :************              o
  91.3 -   7 :************      o
 100.8 -  13 :*************o**********
 111.3 -   0 :         o
 122.9 -   7 :*****o******
 135.7 -   0 :  o
 149.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:36 FILENAME: F:\FISSIO~1\U33Z\04_14B.FTZ
04-14B, U33Z-49,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.501E+05
                                    RELATIVE ERROR (%):      2.39
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                               SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   7.26E+06 (  29)  1.25E+07 (  50)    6    615 176   26.1   15.9   42.1
   2   7.88E+06 (  21)  1.28E+07 (  34)    4    628 216   27.9   15.3   49.3
   3   1.10E+07 (  44)  1.73E+07 (  69)    6    849 208   28.7   19.1   42.5
   4   1.18E+07 (  47)  1.23E+07 (  49)    6    603 174   43.1   28.2   65.7
   5   6.26E+06 (  25)  1.15E+07 (  46)    6    566 168   24.5   14.4   40.7
   6   6.76E+06 (  27)  1.20E+07 (  48)    6    591 172   25.4   15.2   41.4
   7   8.63E+06 (  23)  1.31E+07 (  35)    4    646 219   29.6   16.6   51.5
   8   6.01E+06 (  24)  1.10E+07 (  44)    6    542 164   24.6   14.2   41.3
   9   6.26E+06 (  25)  1.10E+07 (  44)    6    542 164   25.6   15.0   42.7
  10   9.76E+06 (  39)  1.48E+07 (  59)    6    726 191   29.8   19.3   45.4
  11   8.26E+06 (  33)  1.35E+07 (  54)    6    665 183   27.5   17.2   43.2
  12   8.01E+06 (  32)  9.51E+06 (  38)    6    468 152   37.9   22.9   62.2
  13   9.76E+06 (  26)  1.95E+07 (  52)    4    960 269   22.6   13.5   36.7
  14   7.76E+06 (  31)  1.60E+07 (  64)    6    788 200   21.9   13.7   34.0
  15   1.05E+07 (  21)  1.40E+07 (  28)    3    689 260   33.8   18.2   61.5

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:36 FILENAME: F:\FISSIO~1\U33Z\04_14B.FTZ
04-14B, U33Z-49,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 14  7.76E+06 (  31) 1.60E+07 (  64)  21.9  13.7  34.0 100.0   21.9  13.7  34.0
 13  9.76E+06 (  26) 1.95E+07 (  52)  22.6  13.5  36.7  92.2   22.1  15.8  30.7
  5  6.26E+06 (  25) 1.15E+07 (  46)  24.5  14.4  40.7  93.9   22.8  17.4  30.0
  8  6.01E+06 (  24) 1.10E+07 (  44)  24.6  14.2  41.3  97.9   23.2  18.2  29.5
  6  6.76E+06 (  27) 1.20E+07 (  48)  25.4  15.2  41.4  99.0   23.6  19.0  29.3
  9  6.26E+06 (  25) 1.10E+07 (  44)  25.6  15.0  42.7  99.6   23.9  19.5  29.2
  1  7.26E+06 (  29) 1.25E+07 (  50)  26.1  15.9  42.1  99.8   24.2  20.0  29.2
 11  8.26E+06 (  33) 1.35E+07 (  54)  27.5  17.2  43.2  99.7   24.6  20.7  29.4
  2  7.88E+06 (  21) 1.28E+07 (  34)  27.9  15.3  49.3  99.8   24.9  21.0  29.5
  3  1.10E+07 (  44) 1.73E+07 (  69)  28.7  19.1  42.5  99.8   25.4  21.7  29.7
  7  8.63E+06 (  23) 1.31E+07 (  35)  29.6  16.6  51.5  99.8   25.7  22.0  29.9
 10  9.76E+06 (  39) 1.48E+07 (  59)  29.8  19.3  45.4  99.8   26.1  22.5  30.2
 15  1.05E+07 (  21) 1.40E+07 (  28)  33.8  18.2  61.5  99.6   26.4  22.9  30.5
 12  8.01E+06 (  32) 9.51E+06 (  38)  37.9  22.9  62.2  97.4   27.1  23.5  31.1
  4  1.18E+07 (  47) 1.23E+07 (  49)  43.1  28.2  65.7  77.5   28.1  24.6  32.2
POOL 8.29E+06(  447) 1.32E+07(  714)                      77.5   28.1  24.6  32.2

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  650.9,  57.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   28.1,  26.3 --  30.1 (  -1.9   +2.0)
                95% CONF. INTERVAL(Ma):          24.6 --  32.2 (  -3.5   +4.0)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.7019,   14
                     CHI^2 PROBABILITY:   77.5%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   28.1,  26.3 --  30.1 (  -1.9   +2.0)
                95% CONF. INTERVAL(Ma):          24.6 --  32.2 (  -3.5   +4.0)
```

```
                    AGE DISPERSION (%):    0.5

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   28.1,  26.3 --  30.1 (  -1.9   +2.0)
               95% CONF. INTERVAL (Ma):         24.6 --  32.2 (  -3.5   +4.0)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:36 FILENAME: F:\FISSIO~1\U33Z\04_14B.FTZ
04-14B, U33Z-49,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    21.96 to    43.08 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       26.95            2.844                 17.01

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       27.42            2.833                 16.94
       42.86            0.645                  3.86

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:31:36 FILENAME: F:\FISSIO~1\U33Z\04_14B.FTZ
04-14B, U33Z-49,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  13.7 -   0 :o
  15.2 -   0 :o
  16.8 -   0 :o
  18.5 -   0 :    o
  20.5 -   0 :           o
  22.6 -  13 :**********************o*
  25.0 -  33 :******************************o**************************
  27.6 -  20 :********************************o**
  30.5 -  13 :************************  o
  33.7 -   7 :************    o
  37.3 -   7 :**********o*
  41.2 -   7 :********o***
  45.5 -   0 :     o
  50.3 -   0 : o
  55.5 -   0 :o
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:24:12 FILENAME: F:\FISSIO~1\U33Y\04_15C.FTZ
04-15A U33Y-2, 04-15B U33Y-3

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.897E+05
RELATIVE ERROR (%): 2.19
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 360.20 8.04
SIZE OF COUNTER SQUARE (cm^2): 6.660E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s	Grain Age	Age (Ma) --95% CI--
1	2.25E+06	(9)	2.10E+07	(84)	6	893 198	5.7	2.5 11.1
2	2.00E+06	(8)	1.45E+07	(58)	6	616 163	7.3	3.0 15.2
3	1.25E+06	(10)	7.13E+06	(57)	12	303 81	9.3	4.2 18.1
4	1.31E+06	(7)	6.94E+06	(37)	8	295 97	10.1	3.7 22.4
5	4.50E+05	(6)	7.21E+06	(96)	20	306 64	3.3	1.2 7.4
6	1.38E+06	(11)	1.38E+07	(110)	12	584 114	5.3	2.5 9.7
7	9.61E+05	(16)	9.55E+06	(159)	25	405 67	5.3	2.9 8.8
8	1.88E+06	(10)	9.95E+06	(53)	8	422 117	10.0	4.5 19.6
9	1.88E+06	(10)	1.14E+07	(61)	8	486 126	8.7	3.9 16.8

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.884E+05
RELATIVE ERROR (%): 2.12
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 360.20 8.04
SIZE OF COUNTER SQUARE (cm^2): 6.660E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s	Grain Age	Age (Ma) --95% CI--
10	9.38E+05	(10)	7.32E+06	(78)	16	312 72	6.8	3.1 12.9
11	3.75E+05	(3)	3.75E+06	(30)	12	160 58	5.4	1.0 16.7
12	2.75E+06	(11)	1.55E+07	(62)	6	662 170	9.3	4.4 17.7
13	8.45E+05	(9)	5.91E+06	(63)	16	252 64	7.5	3.2 15.0
14	5.63E+05	(6)	3.19E+06	(34)	16	136 47	9.4	3.1 22.1
15	4.69E+05	(5)	3.57E+06	(38)	16	152 49	7.0	2.1 17.4

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:24:12 FILENAME: F:\FISSIO~1\U33Y\04_15C.FTZ
04-15A U33Y-2, 04-15B U33Y-3
Number of grains = 15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--	P(X2) (%)	Sum age (Ma) Age	--95% CI--
5	4.50E+05	(6)	7.21E+06	(96)	3.3	1.2 7.4	100.0	3.3	1.2 7.4
6	1.38E+06	(11)	1.38E+07	(110)	5.3	2.5 9.7	36.8	4.3	2.5 7.1
7	9.61E+05	(16)	9.55E+06	(159)	5.3	2.9 8.8	59.2	4.7	3.2 6.8
11	3.75E+05	(3)	3.75E+06	(30)	5.4	1.0 16.7	78.6	4.8	3.3 6.7
1	2.25E+06	(9)	2.10E+07	(84)	5.7	2.5 11.1	87.7	4.9	3.5 6.7
10	9.38E+05	(10)	7.32E+06	(78)	6.8	3.1 12.9	86.9	5.2	3.9 6.9
15	4.69E+05	(5)	3.57E+06	(38)	7.0	2.1 17.4	90.6	5.3	4.0 6.9
2	2.00E+06	(8)	1.45E+07	(58)	7.3	3.0 15.2	91.0	5.5	4.2 7.1
13	8.45E+05	(9)	5.91E+06	(63)	7.5	3.2 15.0	91.2	5.6	4.4 7.2
9	1.88E+06	(10)	1.14E+07	(61)	8.7	3.9 16.8	86.7	5.9	4.7 7.4
3	1.25E+06	(10)	7.13E+06	(57)	9.3	4.2 18.1	81.1	6.1	4.9 7.6
12	2.75E+06	(11)	1.55E+07	(62)	9.3	4.4 17.7	76.7	6.3	5.1 7.8
14	5.63E+05	(6)	3.19E+06	(34)	9.4	3.1 22.1	78.6	6.4	5.2 7.9
8	1.88E+06	(10)	9.95E+06	(53)	10.0	4.5 19.6	75.1	6.6	5.4 8.0
4	1.31E+06	(7)	6.94E+06	(37)	10.1	3.7 22.4	75.5	6.7	5.5 8.1
POOL	1.05E+06	(131)	8.20E+06	(1021)			75.5	6.7	5.5 8.1

```
MEAN URANIUM CONCENTRATION +/-2SE (ppm):  348.2,  26.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):    6.7,   6.1 --   7.4 (  -0.6   +0.7)
                95% CONF. INTERVAL(Ma):           5.5 --   8.1 (  -1.2   +1.4)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.7213,   14
                     CHI^2 PROBABILITY:   75.5%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):    6.7,   6.1 --   7.4 (  -0.6   +0.7)
                95% CONF. INTERVAL(Ma):           5.5 --   8.1 (  -1.2   +1.4)
                    AGE DISPERSION (%):    0.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    6.7,   6.1 --   7.4 (  -0.6   +0.7)
               95% CONF. INTERVAL (Ma):           5.5 --   8.1 (  -1.2   +1.4)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:24:12 FILENAME: F:\FISSIO~1\U33Y\04_15C.FTZ
04-15A U33Y-2, 04-15B U33Y-3
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     3.51 to    10.43 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        8.60           1.617                 15.23

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        3.06           0.161                  1.51
        5.49           1.127                 10.61
        9.30           1.563                 14.72
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:12 FILENAME: F:\FISSIO~1\U33Y\04_15C.FTZ
04-15A U33Y-2, 04-15B U33Y-3
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   2.1 -   0 :o
   2.3 -   0 :o
   2.5 -   0 :o
   2.8 -   0 : o
   3.1 -   0 :  o
   3.4 -   7 :***o***************
   3.7 -   0 :     o
   4.1 -   0 :       o
   4.6 -   0 :             o
   5.1 -   0 :                 o
   5.6 -  20 :**********************o************************************
   6.2 -   7 :********************     o
   6.8 -   7 :********************       o
   7.5 -  20 :******************************o******************************
   8.3 -   0 :                                o
   9.2 -  20 :******************************o******************************
  10.2 -  20 :*************************o*********************************
  11.3 -   0 :                   o
  12.4 -   0 :             o
  13.7 -   0 :      o
  15.2 -   0 :  o
  16.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:26 FILENAME: F:\FISSIO~1\U33Y\04_16A.FTZ
04-16A, U33Y-4,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.870E+05
                                    RELATIVE ERROR (%):      2.04
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   4.69E+05 (  10)  3.57E+06 (  76)   32    153  35    6.9    3.1   13.2
   2   1.13E+05 (   3)  3.00E+06 (  80)   40    129  29    2.0    0.4    5.9
   3   8.45E+05 (   9)  9.10E+06 (  97)   16    390  81    4.9    2.1    9.5
   4   2.50E+05 (   2)  3.25E+06 (  26)   12    139  54    4.3    0.5   15.9
   5   5.01E+05 (   4)  5.38E+06 (  43)   12    231  71    5.0    1.3   13.2
   6   1.50E+06 (   6)  1.13E+07 (  45)    6    483 144    7.1    2.4   16.2
   7   1.33E+06 (   8)  1.13E+07 (  68)    9    486 119    6.2    2.5   12.7
   8   6.26E+05 (   5)  5.26E+06 (  42)   12    225  70    6.3    1.9   15.5
   9   9.01E+05 (  12)  8.93E+06 ( 119)   20    383  72    5.3    2.6    9.5
  10   1.13E+06 (  12)  1.36E+07 ( 145)   16    583 100    4.3    2.2    7.7
  11   6.57E+05 (   7)  4.69E+06 (  50)   16    201  57    7.4    2.8   16.0
  12   1.33E+06 (   8)  1.20E+07 (  72)    9    515 123    5.8    2.4   11.9
  13   1.03E+06 (  11)  8.16E+06 (  87)   16    350  76    6.6    3.1   12.3
  14   5.26E+05 (   7)  6.61E+06 (  88)   20    283  61    4.2    1.6    8.8
  15   1.00E+06 (   8)  7.88E+06 (  63)   12    338  86    6.7    2.7   13.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:26 FILENAME: F:\FISSIO~1\U33Y\04_16A.FTZ
04-16A, U33Y-4,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  2  1.13E+05 (   3) 3.00E+06 (  80)   2.0   0.4   5.9 100.0    2.0   0.4   5.9
 14  5.26E+05 (   7) 6.61E+06 (  88)   4.2   1.6   8.8  27.8    3.1   1.4   5.8
  4  2.50E+05 (   2) 3.25E+06 (  26)   4.3   0.5  15.9  53.8    3.2   1.6   5.7
 10  1.13E+06 (  12) 1.36E+07 ( 145)   4.3   2.2   7.7  66.4    3.7   2.3   5.6
  3  8.45E+05 (   9) 9.10E+06 (  97)   4.9   2.1   9.5  74.8    3.9   2.7   5.6
  5  5.01E+05 (   4) 5.38E+06 (  43)   5.0   1.3  13.2  84.4    4.0   2.8   5.6
  9  9.01E+05 (  12) 8.93E+06 ( 119)   5.3   2.6   9.5  86.5    4.2   3.1   5.7
 12  1.33E+06 (   8) 1.20E+07 (  72)   5.8   2.4  11.9  88.2    4.4   3.4   5.8
  7  1.33E+06 (   8) 1.13E+07 (  68)   6.2   2.5  12.7  89.0    4.6   3.5   5.9
  8  6.26E+05 (   5) 5.26E+06 (  42)   6.3   1.9  15.5  91.6    4.7   3.6   6.0
 13  1.03E+06 (  11) 8.16E+06 (  87)   6.6   3.1  12.3  90.3    4.9   3.8   6.1
 15  1.00E+06 (   8) 7.88E+06 (  63)   6.7   2.7  13.8  91.4    5.0   4.0   6.2
  1  4.69E+05 (  10) 3.57E+06 (  76)   6.9   3.1  13.2  91.5    5.1   4.1   6.3
  6  1.50E+06 (   6) 1.13E+07 (  45)   7.1   2.4  16.2  93.0    5.2   4.2   6.4
 11  6.57E+05 (   7) 4.69E+06 (  50)   7.4   2.8  16.0  93.5    5.3   4.3   6.5
POOL 6.78E+05(  112) 6.67E+06( 1101)                     93.5    5.3   4.3   6.5

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  285.7,  20.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):    5.3,   4.8 --   5.9 (  -0.5   +0.6)
                95% CONF. INTERVAL(Ma):          4.3 --   6.5 (  -1.0   +1.2)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.4988,   14
                     CHI^2 PROBABILITY:   93.5%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):    5.3,   4.7 --   5.8 (  -0.5   +0.6)
```

```
                95% CONF. INTERVAL(Ma):          4.3 --   6.4 (  -1.0   +1.2)
                    AGE DISPERSION (%):    0.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    5.3,   4.8 --   5.9 (  -0.5   +0.6)
                95% CONF. INTERVAL (Ma):          4.3 --   6.5 (  -1.0   +1.2)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:24:26 FILENAME: F:\FISSIO~1\U33Y\04_16A.FTZ
04-16A, U33Y-4,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     2.25 to     7.67 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        6.19            1.829                 18.92

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        2.03            0.126                  1.30
        6.63            1.784                 18.45
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:26 FILENAME: F:\FISSIO~1\U33Y\04_16A.FTZ
04-16A, U33Y-4,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   1.4 -   0 :o
   1.5 -   0 :o
   1.7 -   0 :o
   1.9 -   0 : o
   2.1 -   0 : o
   2.3 -   7 :*o*************
   2.5 -   0 : o
   2.8 -   0 :  o
   3.1 -   0 :   o
   3.4 -   0 :     o
   3.7 -   0 :        o
   4.1 -   0 :             o
   4.6 -  13 :******************o**********
   5.1 -  13 :**********************o*******
   5.6 -  13 :**************************o****
   6.2 -  13 :***************************o***
   6.8 -  27 :************************o*********************************
   7.5 -  13 :**********************o********
   8.3 -   0 :               o
   9.2 -   0 :         o
  10.2 -   0 :    o
  11.3 -   0 :  o
  12.4 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:38 FILENAME: F:\FISSIO~1\U33Y\04_17A.FTZ
04-17A, U33Y-6,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.844E+05
                                    RELATIVE ERROR (%):      1.91
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   7.51E+05 (   3)  8.01E+06 (  32)    6    346 122    5.0    0.9   15.3
   2   1.25E+06 (  10)  1.00E+07 (  80)   12    433  98    6.5    3.0   12.4
   3   7.51E+05 (   9)  9.01E+06 ( 108)   18    390  76    4.3    1.9    8.4
   4   1.88E+05 (   3)  1.88E+06 (  30)   24     81  30    5.4    1.0   16.5
   5   1.13E+06 (   9)  5.63E+06 (  45)   12    244  73   10.4    4.4   21.2
   6   4.80E+05 (   8)  2.82E+06 (  47)   25    122  36    8.9    3.6   18.6
   7   2.13E+06 (  17)  1.25E+07 ( 100)   12    541 110    8.8    4.9   14.7
   8   1.00E+06 (   6)  3.84E+06 (  23)    9    166  69   13.6    4.4   33.7
   9   1.17E+06 (   7)  8.68E+06 (  52)    9    375 105    7.0    2.6   15.2
  10   1.63E+06 (  13)  7.01E+06 (  56)   12    303  81   12.0    6.0   22.0
  11   1.38E+06 (  11)  1.10E+07 (  88)   12    476 103    6.5    3.1   12.0
  12   1.00E+06 (   6)  6.17E+06 (  37)    9    267  88    8.5    2.9   19.8
  13   8.76E+05 (   7)  8.51E+06 (  68)   12    368  90    5.4    2.0   11.5
  14   8.76E+05 (   7)  7.01E+06 (  56)   12    303  81    6.5    2.5   14.1
  15   6.67E+05 (   4)  6.51E+06 (  39)    9    281  90    5.4    1.4   14.6

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:38 FILENAME: F:\FISSIO~1\U33Y\04_17A.FTZ
04-17A, U33Y-6,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  3  7.51E+05 (   9) 9.01E+06 ( 108)   4.3   1.9   8.4 100.0    4.3   1.9   8.4
  1  7.51E+05 (   3) 8.01E+06 (  32)   5.0   0.9  15.3  86.6    4.4   2.2   7.9
  4  1.88E+05 (   3) 1.88E+06 (  30)   5.4   1.0  16.5  96.1    4.6   2.5   7.7
 13  8.76E+05 (   7) 8.51E+06 (  68)   5.4   2.0  11.5  98.1    4.8   2.9   7.3
 15  6.67E+05 (   4) 6.51E+06 (  39)   5.4   1.4  14.6  99.5    4.8   3.1   7.2
 11  1.38E+06 (  11) 1.10E+07 (  88)   6.5   3.1  12.0  97.9    5.2   3.6   7.3
  2  1.25E+06 (  10) 1.00E+07 (  80)   6.5   3.0  12.4  98.3    5.4   3.9   7.3
 14  8.76E+05 (   7) 7.01E+06 (  56)   6.5   2.5  14.1  99.1    5.6   4.2   7.4
  9  1.17E+06 (   7) 8.68E+06 (  52)   7.0   2.6  15.2  99.4    5.7   4.3   7.4
 12  1.00E+06 (   6) 6.17E+06 (  37)   8.5   2.9  19.8  98.9    5.9   4.5   7.6
  7  2.13E+06 (  17) 1.25E+07 ( 100)   8.8   4.9  14.7  95.0    6.3   5.0   7.9
  6  4.80E+05 (   8) 2.82E+06 (  47)   8.9   3.6  18.6  95.0    6.4   5.1   8.0
  5  1.13E+06 (   9) 5.63E+06 (  45)  10.4   4.4  21.2  91.6    6.6   5.4   8.2
 10  1.63E+06 (  13) 7.01E+06 (  56)  12.0   6.0  22.0  76.6    7.0   5.7   8.6
  8  1.00E+06 (   6) 3.84E+06 (  23)  13.6   4.4  33.7  69.3    7.2   5.9   8.7
POOL 9.34E+05(  120) 6.70E+06(  861)                     69.3    7.2   5.9   8.7

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  289.7,  22.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):    7.2,   6.5 --   7.9 (  -0.7   +0.8)
                95% CONF. INTERVAL(Ma):          5.9 --   8.7 (  -1.3   +1.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.7797,   14
                     CHI^2 PROBABILITY:   69.3%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):    7.1,   6.4 --   7.9 (  -0.7   +0.8)
```

```
                95% CONF. INTERVAL(Ma):          5.8 --   8.7 (  -1.3   +1.6)
                    AGE DISPERSION (%):    0.7

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    7.2,   6.5 --   7.9 (  -0.7   +0.8)
                95% CONF. INTERVAL (Ma):          5.9 --   8.7 (  -1.3   +1.6)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:38 FILENAME: F:\FISSIO~1\U33Y\04_17A.FTZ
04-17A, U33Y-6,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     4.48 to    14.15 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        7.18            1.471                 14.92

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        6.49            1.425                 14.45
```

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:38 FILENAME: F:\FISSIO~1\U33Y\04_17A.FTZ
04-17A, U33Y-6,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   2.8 -   0 :o
   3.1 -   0 :o
   3.4 -   0 :  o
   3.7 -   0 :    o
   4.1 -   0 :       o
   4.6 -   7 :**********o****
   5.1 -   0 :             o
   5.6 -  27 :*****************o****************************************
   6.2 -   0 :                   o
   6.8 -  20 :********************o***********************
   7.5 -   7 :***************      o
   8.3 -   0 :                    o
   9.2 -  20 :******************o*************************
  10.2 -   7 :***************o
  11.3 -   0 :            o
  12.4 -   7 :**********o****
  13.7 -   7 :*******o*******
  15.2 -   0 :    o
  16.8 -   0 :  o
  18.5 -   0 : o
  20.5 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/21:20:54 FILENAME: E:\FISSIO~1\U33Y\04_18B.FTZ
04-18B, U33Y-6,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.738E+05
                                    RELATIVE ERROR (%):      1.65
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   1.84E+07 (  49)  1.88E+06 (   5)    4     84  72  453.3  190.6 1393.1
   2   2.38E+07 (  95)  2.75E+06 (  11)    6    124  73  407.2  223.4  827.2
   3   8.01E+06 (  48)  4.50E+06 (  27)    9    202  77   86.9   53.3  144.7
   4   2.95E+07 ( 118)  1.25E+06 (   5)    6     56  48 1040.2  467.1 2893.7
   5   4.88E+06 (  13)  2.25E+06 (   6)    4    101  79  104.5   37.8  334.2
   6   3.15E+07 (  84)  3.00E+06 (   8)    4    135  93  489.3  246.1 1133.6
   7   2.03E+07 (  81)  2.75E+06 (  11)    6    124  73  348.9  189.5  715.5
   8   2.33E+07 (  62)  3.00E+06 (   8)    4    135  93  365.0  179.7  864.3
   9   6.84E+06 (  41)  6.67E+05 (   4)    9     30  28  470.2  180.4 1698.9

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/21:20:54 FILENAME: E:\FISSIO~1\U33Y\04_18B.FTZ
04-18B, U33Y-6,
Number of grains =  9
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  3  8.01E+06 (  48) 4.50E+06 (  27)  86.9  53.3 144.7 100.0   86.9  53.3 144.7
  5  4.88E+06 (  13) 2.25E+06 (   6) 104.5  37.8 334.2  71.8   90.3  58.4 142.4
  7  2.03E+07 (  81) 2.75E+06 (  11) 348.9 189.5 715.5   0.1  156.8 111.6 225.0
  8  2.33E+07 (  62) 3.00E+06 (   8) 365.0 179.7 864.3   0.0  190.2 140.2 262.7
  2  2.38E+07 (  95) 2.75E+06 (  11) 407.2 223.4 827.2   0.0  228.5 174.1 299.5
  1  1.84E+07 (  49) 1.88E+06 (   5) 453.3 190.6 %1393.1   0.0  246.1 189.7
318.9
  9  6.84E+06 (  41) 6.67E+05 (   4) 470.2 180.4 %1698.9   0.0  259.6 201.8
333.6
  6  3.15E+07 (  84) 3.00E+06 (   8) 489.3 246.1 %1133.6   0.0  283.7 223.7
359.4
  4  2.95E+07 ( 118) 1.25E+06 (   5)1040.2 467.1 %2893.7   0.0  332.4 264.7
417.0
POOL 1.71E+07(  591) 2.45E+06(   85)                     0.0  332.4 264.7 417.0

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  110.3,  24.2

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):  332.4, 296.0 -- 373.2 ( -36.4  +40.8)
                 95% CONF. INTERVAL(Ma):         264.7 -- 417.0 ( -67.7  +84.5)
      REDUCED CHI^2, DEGREES OF FREEDOM:    6.8400,    8
                      CHI^2 PROBABILITY:    0.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):  294.7, 224.6 -- 386.1 ( -70.1  +91.4)
                 95% CONF. INTERVAL(Ma):         172.8 -- 499.4 (-121.9 +204.7)
                     AGE DISPERSION (%):   74.7

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   90.3,  71.5 -- 114.8 ( -18.8  +24.5)
                95% CONF. INTERVAL (Ma):          58.4 -- 142.4 ( -31.9  +52.0)
        NUMBER AND PERCENTAGE OF GRAINS:    2,    22%
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 07-11-2005/21:20:54 FILENAME: E:\FISSIO~1\U33Y\04_18B.FTZ
04-18B, U33Y-6,
Kernel factor = .6 (Ratio of kernel window size to standard error)
Number of grains = 9
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages = 86.39 to 983.45 Ma

First Search: peaks with zero first derivatives.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
87.80	0.399	3.92
390.50	0.918	9.02
965.50	0.156	1.53

Second search: find minima in the second derivative of the Gaussian
probability density function.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
379.93	0.912	8.97
1007.51	0.154	1.52

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 07-11-2005/21:20:54 FILENAME: E:\FISSIO~1\U33Y\04_18B.FTZ
04-18B, U33Y-6,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  9    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.7       7.41      11.11     14.81     18.52     22.2
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  50.3 -   0 :o
  55.5 -   0 :o
  61.3 -   0 :o
  67.8 -   0 :  o
  74.8 -   0 :      o
  82.7 -  11 :**********o******************
  91.3 -   0 :           o
 100.8 -  11 :********o********************
 111.3 -   0 :     o
 122.9 -   0 :   o
 135.7 -   0 :  o
 149.8 -   0 : o
 165.4 -   0 :o
 182.6 -   0 :o
 201.5 -   0 :o
 222.3 -   0 : o
 245.2 -   0 :   o
 270.5 -   0 :       o
 298.3 -   0 :             o
 328.9 -  11 :********************o*********
 362.5 -  11 :************************o****
 399.5 -  11 :**************************o***
 440.1 -  22 :************************o************************************
 484.7 -  11 :******************o**********
 533.6 -   0 :            o
 587.2 -   0 :        o
 646.0 -   0 :     o
 710.3 -   0 :   o
 780.6 -   0 :   o
 857.5 -   0 :   o
 941.4 -  11 :****o************************
1032.9 -   0 :    o
1132.5 -   0 :   o
1240.8 -   0 :  o
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:24:56 FILENAME: F:\FISSIO~1\U33Y\04_19C.FTZ
04-19C, U33Y-6,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 2.699E+05
RELATIVE ERROR (%): 1.72
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 12.30
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 360.20 8.04
SIZE OF COUNTER SQUARE (cm^2): 6.660E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s	Grain Age	Age (Ma) --95% CI--
1	3.00E+05	(3)	2.20E+06	(22)	15	100 42	6.9	1.3 22.0
2	3.00E+05	(2)	4.50E+06	(30)	10	205 75	3.5	0.4 12.8
3	1.50E+06	(6)	6.26E+06	(25)	6	285 113	11.9	3.9 29.1
4	1.17E+06	(7)	4.84E+06	(29)	9	220 82	11.9	4.3 27.3
5	1.13E+06	(6)	4.32E+06	(23)	8	197 81	12.9	4.2 32.0
6	1.00E+06	(6)	8.51E+06	(51)	9	388 109	5.9	2.0 13.3
7	1.25E+06	(5)	2.50E+06	(10)	6	114 70	24.6	6.5 77.6
8	8.34E+05	(10)	2.67E+06	(32)	18	122 43	15.3	6.7 31.6
9	5.01E+05	(6)	3.84E+06	(46)	18	175 52	6.5	2.2 14.9
10	1.50E+06	(9)	4.84E+06	(29)	9	220 82	15.3	6.3 32.7
11	3.75E+05	(2)	5.26E+06	(28)	8	239 90	3.7	0.4 13.8
12	7.51E+05	(3)	5.26E+06	(21)	6	239 104	7.3	1.3 23.2
13	1.13E+06	(6)	4.32E+06	(23)	8	197 81	12.9	4.2 32.0
14	1.31E+06	(7)	6.38E+06	(34)	8	291 100	10.2	3.7 22.9
15	1.20E+06	(8)	2.85E+06	(19)	10	130 59	20.7	7.7 48.8

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 05-01-2005/16:24:56 FILENAME: F:\FISSIO~1\U33Y\04_19C.FTZ
04-19C, U33Y-6,
Number of grains = 15

------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--	P(X2) (%)	Sum age (Ma) Age	--95% CI--
2	3.00E+05	(2)	4.50E+06	(30)	3.5	0.4 12.8	100.0	3.5	0.4 12.8
11	3.75E+05	(2)	5.26E+06	(28)	3.7	0.4 13.8	94.7	3.5	0.9 9.1
6	1.00E+06	(6)	8.51E+06	(51)	5.9	2.0 13.3	72.5	4.5	2.1 8.5
9	5.01E+05	(6)	3.84E+06	(46)	6.5	2.2 14.9	80.0	5.1	2.8 8.4
1	3.00E+05	(3)	2.20E+06	(22)	6.9	1.3 22.0	88.7	5.3	3.1 8.4
12	7.51E+05	(3)	5.26E+06	(21)	7.3	1.3 23.2	93.5	5.4	3.3 8.4
14	1.31E+06	(7)	6.38E+06	(34)	10.2	3.7 22.9	81.7	6.1	4.0 9.0
3	1.50E+06	(6)	6.26E+06	(25)	11.9	3.9 29.1	71.6	6.6	4.5 9.5
4	1.17E+06	(7)	4.84E+06	(29)	11.9	4.3 27.3	66.0	7.2	5.0 9.9
13	1.13E+06	(6)	4.32E+06	(23)	12.9	4.2 32.0	63.0	7.6	5.4 10.3
5	1.13E+06	(6)	4.32E+06	(23)	12.9	4.2 32.0	62.8	8.0	5.9 10.7
10	1.50E+06	(9)	4.84E+06	(29)	15.3	6.3 32.7	51.4	8.5	6.5 11.2
8	8.34E+05	(10)	2.67E+06	(32)	15.3	6.7 31.6	44.0	9.1	7.0 11.7
15	1.20E+06	(8)	2.85E+06	(19)	20.7	7.7 48.8	29.3	9.6	7.5 12.2
7	1.25E+06	(5)	2.50E+06	(10)	24.6	6.5 77.6	21.4	9.9	7.8 12.6
POOL	8.72E+05	(86)	4.28E+06	(422)			21.4	9.9	7.8 12.6

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 195.1, 20.1

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 9.9, 8.8 -- 11.2 (-1.1 +1.3)
95% CONF. INTERVAL(Ma): 7.8 -- 12.6 (-2.1 +2.7)
REDUCED CHI^2, DEGREES OF FREEDOM: 1.2739, 14
CHI^2 PROBABILITY: 21.4%
>>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 10.0, 8.8 -- 11.4 (-1.2 +1.4)

```
                95% CONF. INTERVAL(Ma):          7.7 --  12.9 (  -2.2   +2.9)
                    AGE DISPERSION (%):   17.5

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    9.9,   8.8 --  11.2 (  -1.1   +1.3)
               95% CONF. INTERVAL (Ma):          7.8 --  12.6 (  -2.1   +2.7)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:24:56 FILENAME: F:\FISSIO~1\U33Y\04_19C.FTZ
04-19C, U33Y-6,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     3.98 to    25.41 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       13.58            1.101                 13.34

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        2.88            0.139                  1.69
        6.15            0.637                  7.72
       14.24            1.091                 13.22
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:24:56 FILENAME: F:\FISSIO~1\U33Y\04_19C.FTZ
04-19C, U33Y-6,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         2.22      4.44      6.67      8.89      11.11     13.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   2.5 -   0 :  o
   2.8 -   0 :   o
   3.1 -   0 :    o
   3.4 -   0 :     o
   3.7 -   0 :       o
   4.1 -  13 :********o**************************************************
   4.6 -   0 :           o
   5.1 -   0 :              o
   5.6 -   0 :                o
   6.2 -   7 :******************o***********
   6.8 -   7 :******************o**********
   7.5 -  13 :********************o****************************************
   8.3 -   0 :                     o
   9.2 -   0 :                      o
  10.2 -   7 :************************o****
  11.3 -   0 :                           o
  12.4 -  13 :*******************************o****************************
  13.7 -  13 :*******************************o****************************
  15.2 -  13 :*******************************o****************************
  16.8 -   0 :                          o
  18.5 -   0 :                        o
  20.5 -   7 :****************o*************
  22.6 -   0 :            o
  25.0 -   7 :*********o*******************
  27.6 -   0 :      o
  30.5 -   0 :    o
  33.7 -   0 :  o
  37.3 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:26 FILENAME: F:\FISSIO~1\U33Y\04_21B.FTZ
04-21B, U33Y-19,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.672E+05
                                    RELATIVE ERROR (%):      1.81
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   1.45E+07 (  58)  2.75E+06 (  11)    6    127  75  245.9  130.4  515.5
   2   2.00E+07 (  80)  2.75E+06 (  11)    6    127  75  336.6  182.6  691.4
   3   9.01E+06 (  48)  1.13E+06 (   6)    8     52  41  365.5  162.3 1016.9
   4   1.58E+07 (  63)  2.50E+06 (  10)    6    115  71  292.3  152.5  631.4
   5   2.10E+07 (  84)  3.75E+06 (  15)    6    173  88  261.7  152.4  484.6
   6   1.53E+07 (  61)  1.25E+06 (   5)    6     58  49  546.3  233.8 1644.7
   7   1.23E+07 (  49)  1.75E+06 (   7)    6     81  59  322.1  149.8  826.8
   8   8.63E+06 (  46)  3.00E+06 (  16)    8    138  68  136.0   76.3  256.9
   9   1.25E+07 (  50)  3.50E+06 (  14)    6    161  85  168.2   92.7  328.5
  10   8.26E+06 (  33)  1.75E+06 (   7)    6     81  59  219.0   97.8  581.1
  11   1.40E+07 (  56)  2.50E+06 (  10)    6    115  71  260.6  134.6  567.3
  12   1.28E+07 (  51)  1.75E+06 (   7)    6     81  59  334.8  156.3  856.8
  13   2.28E+07 (  91)  4.25E+06 (  17)    6    196  94  250.6  150.4  446.1
  14   1.48E+07 (  59)  3.25E+06 (  13)    6    150  82  212.7  117.2  420.5
  15   1.03E+07 (  55)  3.19E+06 (  17)    8    147  70  152.8   88.3  280.3

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:26 FILENAME: F:\FISSIO~1\U33Y\04_21B.FTZ
04-21B, U33Y-19,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)          Age   --95% CI--  (%)    Age   --95% CI--
  8  8.63E+06 (  46) 3.00E+06 (  16) 136.0  76.3 256.9 100.0  136.0  76.3 256.9
 15  1.03E+07 (  55) 3.19E+06 (  17) 152.8  88.3 280.3  76.9  145.1  97.6 221.8
  9  1.25E+07 (  50) 3.50E+06 (  14) 168.2  92.7 328.5  87.4  152.4 109.6 216.1
 14  1.48E+07 (  59) 3.25E+06 (  13) 212.7 117.2 420.5  73.7  165.3 123.9 220.3
 10  8.26E+06 (  33) 1.75E+06 (   7) 219.0  97.8 581.1  78.1  171.3 130.5 224.7
  1  1.45E+07 (  58) 2.75E+06 (  11) 245.9 130.4 515.5  71.1  182.2 141.7 234.1
 13  2.28E+07 (  91) 4.25E+06 (  17) 250.6 150.4 446.1  63.6  194.8 155.2 244.4
 11  1.40E+07 (  56) 2.50E+06 (  10) 260.6 134.6 567.3  64.7  201.4 162.2 249.9
  5  2.10E+07 (  84) 3.75E+06 (  15) 261.7 152.4 484.6  64.1  209.2 170.9 256.0
  4  1.58E+07 (  63) 2.50E+06 (  10) 292.3 152.5 631.4  62.0  215.9 177.7 262.2
  7  1.23E+07 (  49) 1.75E+06 (   7) 322.1 149.8 826.8  59.5  221.7 183.4 267.8
 12  1.28E+07 (  51) 1.75E+06 (   7) 334.8 156.3 856.8  56.4  227.6 189.2 273.6
  2  2.00E+07 (  80) 2.75E+06 (  11) 336.6 182.6 691.4  49.6  235.6 197.2 281.4
  3  9.01E+06 (  48) 1.13E+06 (   6) 365.5 162.3 %1016.9  47.1  240.8 202.2
286.7
  6  1.53E+07 (  61) 1.25E+06 (   5) 546.3 233.8 %1644.7  27.5  250.7 211.1
297.5
POOL 1.38E+07(  884) 2.60E+06(  166)                    27.5  250.7 211.1 297.5

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  119.5,  19.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):  250.7, 229.7 -- 273.6 ( -21.0  +22.9)
                95% CONF. INTERVAL(Ma):         211.1 -- 297.5 ( -39.6  +46.8)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.1893,   14
                        CHI^2 PROBABILITY:   27.5%
```

```
CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):  251.2, 229.3 -- 275.1 ( -21.9  +23.9)
                 95% CONF. INTERVAL(Ma):         210.1 -- 300.1 ( -41.1  +48.9)
                     AGE DISPERSION (%):    9.3

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):  250.7, 229.7 -- 273.6 ( -21.0  +22.9)
                95% CONF. INTERVAL (Ma):         211.1 -- 297.5 ( -39.6  +46.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:26 FILENAME: F:\FISSIO~1\U33Y\04_21B.FTZ
04-21B, U33Y-19,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =   134.21 to   516.82 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      259.49            1.683                 14.41

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      144.87            0.700                  6.00
      254.45            1.678                 14.37
      629.32            0.123                  1.05
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:26 FILENAME: F:\FISSIO~1\U33Y\04_21B.FTZ
04-21B, U33Y-19,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  82.7 -   0 :o
  91.3 -   0 :o
 100.8 -   0 :o
 111.3 -   0 :  o
 122.9 -   0 :     o
 135.7 -   7 :********o******
 149.8 -   7 :**********o****
 165.4 -   7 :***********o***
 182.6 -   0 :            o
 201.5 -  13 :***************o**************
 222.3 -   0 :                    o
 245.2 -  27 :************************o***********************************
 270.5 -   0 :                       o
 298.3 -  13 :*********************o********
 328.9 -  13 :*****************o************
 362.5 -   7 :************o**
 399.5 -   0 :        o
 440.1 -   0 :     o
 484.7 -   0 :   o
 533.6 -   7 :**o***********
 587.2 -   0 : o
 646.0 -   0 : o
 710.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-05-2005/15:46:44 FILENAME: F:\FISSIO~1\U33Y\04_22.FTZ
04-22A, U33Y-20, 04-22B, U33Y-21

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.659E+05
                                    RELATIVE ERROR (%):      1.88
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   2.10E+07 (  56)  4.13E+06 (  11)    4    191 113  236.5  125.0  497.0
   2   2.40E+07 (  64)  2.63E+06 (   7)    4    122  89  415.3  197.4 1044.2
   3   3.04E+07 (  81)  4.13E+06 (  11)    4    191 113  339.1  184.1  696.1
   4   1.43E+07 (  38)  2.25E+06 (   6)    4    104  82  289.9  125.8  823.6
   5   1.35E+07 (  36)  2.25E+06 (   6)    4    104  82  275.1  118.7  785.1

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.646E+05
                                    RELATIVE ERROR (%):      1.95
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   6   1.88E+07 (  50)  3.75E+06 (  10)    4    174 108  231.0  118.2  507.1
   7   1.58E+07 (  42)  1.50E+06 (   4)    4     70  66  465.7  178.9 1682.8
   8   2.10E+07 (  56)  1.88E+06 (   5)    4     87  74  498.7  211.9 1515.9
   9   1.76E+07 (  47)  3.00E+06 (   8)    4    140  96  269.6  129.6  652.6
  10   1.76E+07 (  47)  1.50E+06 (   4)    4     70  66  518.8  201.4 1849.2

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-05-2005/15:46:44 FILENAME: F:\FISSIO~1\U33Y\04_22.FTZ
04-22A, U33Y-20, 04-22B, U33Y-21
Number of grains =  10
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  6  1.88E+07 (  50) 3.75E+06 (  10) 231.0 118.2 507.1 100.0  232.1 118.8 509.4
  1  2.10E+07 (  56) 4.13E+06 (  11) 236.5 125.0 497.0  96.2  235.8 148.3 394.8
  9  1.76E+07 (  47) 3.00E+06 (   8) 269.6 129.6 652.6  94.5  246.7 166.5 379.2
  5  1.35E+07 (  36) 2.25E+06 (   6) 275.1 118.7 785.1  98.0  252.6 176.7 372.1
  4  1.43E+07 (  38) 2.25E+06 (   6) 289.9 125.8 823.6  98.9  259.0 186.3 369.4
  3  3.04E+07 (  81) 4.13E+06 (  11) 339.1 184.1 696.1  96.6  276.9 207.0 377.9
  2  2.40E+07 (  64) 2.63E+06 (   7) 415.3 197.4 %1044.2  91.4  292.6 222.5
384.2
  7  1.58E+07 (  42) 1.50E+06 (   4) 465.7 178.9 %1682.8  88.3  304.7 233.9
396.4
  8  2.10E+07 (  56) 1.88E+06 (   5) 498.7 211.9 %1515.9  82.4  320.2 248.4
412.2
 10  1.76E+07 (  47) 1.50E+06 (   4) 518.8 201.4 %1849.2  79.2  332.4 259.8
424.6
POOL 1.94E+07(  517) 2.71E+06(   72)                    79.2  332.4 259.8 424.6

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  125.3,  29.9

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):  332.4, 293.2 -- 376.7 ( -39.2  +44.3)
                95% CONF. INTERVAL(Ma):         259.8 -- 424.6 ( -72.6  +92.2)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.6077,    9
```

```
                    CHI^2 PROBABILITY:   79.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):  334.3, 294.8 -- 379.0 ( -39.6  +44.7)
                 95% CONF. INTERVAL(Ma):         261.1 -- 427.4 ( -73.2  +93.1)
                     AGE DISPERSION (%):    0.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):  332.4, 293.2 -- 376.7 ( -39.2  +44.3)
                95% CONF. INTERVAL (Ma):         259.8 -- 424.6 ( -72.6  +92.2)
       NUMBER AND PERCENTAGE OF GRAINS:   10,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-05-2005/15:46:44 FILENAME: F:\FISSIO~1\U33Y\04_22.FTZ
04-22A, U33Y-20, 04-22B, U33Y-21
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  10
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =   225.21 to   484.36 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      273.71            0.985                 10.05

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      236.51            0.904                  9.22
      339.53            0.906                  9.24
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-05-2005/15:46:44 FILENAME: F:\FISSIO~1\U33Y\04_22.FTZ
04-22A, U33Y-20, 04-22B, U33Y-21
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  10    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5         10        15        20        25        30
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
 135.7 -   0 :o
 149.8 -   0 :o
 165.4 -   0 :  o
 182.6 -   0 :      o
 201.5 -   0 :           o
 222.3 -  20 :***************o************************
 245.2 -   0 :                  o
 270.5 -  30 :******************o*****************************************
 298.3 -   0 :                  o
 328.9 -  10 :******************o*
 362.5 -   0 :                 o
 399.5 -  10 :***************o****
 440.1 -  10 :*************o******
 484.7 -  20 :**********o***************************
 533.6 -   0 :        o
 587.2 -   0 :      o
 646.0 -   0 :   o
 710.3 -   0 :  o
 780.6 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:06 FILENAME: F:\FISSIO~1\U33Y\04_23A.FTZ
04-23A, U33Y-22,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.633E+05
                                    RELATIVE ERROR (%):      2.03
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                              SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   5.26E+05 (   7)  3.23E+06 (  43)   20    151  46    7.9    2.9   17.3
   2   1.06E+06 (  17)  4.69E+06 (  75)   24    219  51   10.8    5.9   18.4
   3   1.41E+06 (  15)  6.01E+06 (  64)   16    281  71   11.2    5.9   19.7
   4   2.44E+06 (  26)  6.48E+06 (  69)   16    302  74   17.9   10.9   28.4
   5   7.51E+05 (   9)  4.42E+06 (  53)   18    207  57    8.2    3.5   16.5
   6   7.51E+05 (  18)  3.96E+06 (  95)   36    185  39    9.0    5.1   15.0
   7   1.50E+06 (  16)  4.88E+06 (  52)   16    228  64   14.7    7.8   26.0
   8   2.34E+06 (  14)  5.01E+06 (  30)    9    234  85   22.2   10.8   43.0
   9   1.22E+06 (  13)  5.44E+06 (  58)   16    254  67   10.7    5.3   19.6
  10   1.50E+06 (  16)  5.26E+06 (  56)   16    245  66   13.6    7.2   24.0
  11   1.20E+06 (  16)  5.63E+06 (  75)   20    263  61   10.2    5.5   17.5
  12   4.50E+05 (   9)  3.20E+06 (  64)   30    150  38    6.8    2.9   13.5
  13   9.38E+05 (  15)  4.63E+06 (  74)   24    216  51    9.7    5.1   16.9
  14   1.06E+06 (  17)  4.75E+06 (  76)   24    222  52   10.7    5.9   18.1
  15   7.51E+05 (  10)  3.38E+06 (  45)   20    158  47   10.7    4.7   21.2

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:06 FILENAME: F:\FISSIO~1\U33Y\04_23A.FTZ
04-23A, U33Y-22,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 12  4.50E+05 (   9) 3.20E+06 (  64)   6.8   2.9  13.5 100.0    6.8   2.9  13.5
  1  5.26E+05 (   7) 3.23E+06 (  43)   7.9   2.9  17.3  78.7    7.2   3.9  12.1
  5  7.51E+05 (   9) 4.42E+06 (  53)   8.2   3.5  16.5  92.7    7.4   4.6  11.4
  6  7.51E+05 (  18) 3.96E+06 (  95)   9.0   5.1  15.0  92.4    8.0   5.6  11.1
 13  9.38E+05 (  15) 4.63E+06 (  74)   9.7   5.1  16.9  94.2    8.4   6.3  11.2
 11  1.20E+06 (  16) 5.63E+06 (  75)  10.2   5.5  17.5  95.1    8.7   6.8  11.3
 15  7.51E+05 (  10) 3.38E+06 (  45)  10.7   4.7  21.2  96.6    8.9   7.0  11.3
 14  1.06E+06 (  17) 4.75E+06 (  76)  10.7   5.9  18.1  97.3    9.2   7.3  11.4
  9  1.22E+06 (  13) 5.44E+06 (  58)  10.7   5.3  19.6  98.3    9.3   7.5  11.5
  2  1.06E+06 (  17) 4.69E+06 (  75)  10.8   5.9  18.4  98.8    9.5   7.8  11.5
  3  1.41E+06 (  15) 6.01E+06 (  64)  11.2   5.9  19.7  99.2    9.6   8.0  11.6
 10  1.50E+06 (  16) 5.26E+06 (  56)  13.6   7.2  24.0  97.6    9.9   8.3  11.8
  7  1.50E+06 (  16) 4.88E+06 (  52)  14.7   7.8  26.0  94.3   10.2   8.6  12.1
  4  2.44E+06 (  26) 6.48E+06 (  69)  17.9  10.9  28.4  64.0   10.8   9.2  12.7
  8  2.34E+06 (  14) 5.01E+06 (  30)  22.2  10.8  43.0  35.7   11.1   9.5  13.1
POOL 1.07E+06(  218) 4.57E+06(  929)                     35.7   11.1   9.5  13.1

MEAN URANIUM CONCENTRATION +/-2SE (ppm):  213.6,  16.5

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   11.1,  10.3 --  12.1 (  -0.9   +0.9)
                95% CONF. INTERVAL(Ma):           9.5 --  13.1 (  -1.6   +1.9)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.0938,   14
                     CHI^2 PROBABILITY:   35.7%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   11.1,  10.3 --  12.1 (  -0.9   +0.9)
                95% CONF. INTERVAL(Ma):           9.5 --  13.0 (  -1.6   +1.9)
```

```
                    AGE DISPERSION (%):    2.7

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   11.1,  10.3 --  12.1 (  -0.9   +0.9)
                95% CONF. INTERVAL (Ma):           9.5 --  13.1 (  -1.6   +1.9)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:25:06 FILENAME: F:\FISSIO~1\U33Y\04_23A.FTZ
04-23A, U33Y-22,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     6.98 to    22.50 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       10.47            2.068                 15.60

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       10.41            2.068                 15.59
       18.34            0.595                  4.49
       26.11            0.163                  1.23
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:06 FILENAME: F:\FISSIO~1\U33Y\04_23A.FTZ
04-23A, U33Y-22,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   4.1 -   0 :o
   4.6 -   0 :o
   5.1 -   0 :o
   5.6 -   0 : o
   6.2 -   0 :   o
   6.8 -   7 :*****o******
   7.5 -   0 :         o
   8.3 -  13 :**************o*********
   9.2 -   7 :************        o
  10.2 -  13 :************************o
  11.3 -  33 :***********************o************************************
  12.4 -   0 :                  o
  13.7 -   7 :************ o
  15.2 -   7 :*********o**
  16.8 -   0 :       o
  18.5 -   7 :******o*****
  20.5 -   0 :    o
  22.6 -   7 :***o********
  25.0 -   0 : o
  27.6 -   0 :o
  30.5 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:25:39 FILENAME: F:\FISSIO~1\U33Y\04_24A.FTZ
04-24A, U33Y-24,

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      2.606E+05
                                    RELATIVE ERROR (%):      2.21
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     12.30
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    360.20     8.04
                            SIZE OF COUNTER SQUARE (cm^2):      6.660E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   6.34E+06 (  38)  8.34E+05 (   5)    9     39  34  337.9  138.5 1068.4
   2   2.00E+07 (  80)  1.50E+06 (   6)    6     71  56  583.2  269.0 1554.3
   3   1.68E+07 (  67)  2.00E+06 (   8)    6     94  65  375.0  185.4  885.1
   4   7.51E+06 (  30)  1.25E+06 (   5)    6     59  50  268.5  107.1  869.1
   5   7.26E+06 (  29)  1.00E+06 (   4)    6     47  45  320.8  118.2 1211.7
   6   1.03E+07 (  41)  7.51E+05 (   3)    6     35  38  584.1  201.2 2625.0
   7   1.30E+07 (  52)  1.50E+06 (   6)    6     71  56  385.5  172.2 1066.7
   8   2.38E+07 (  95)  3.00E+06 (  12)    6    142  80  357.1  199.5  705.4
   9   7.01E+06 (  28)  1.00E+06 (   4)    6     47  45  310.1  113.8 1175.9
  10   1.63E+07 (  65)  1.75E+06 (   7)    6     83  60  413.4  196.6 1039.4
  11   9.51E+06 (  38)  7.51E+05 (   3)    6     35  38  543.3  185.7 2471.6
  12   1.10E+07 (  44)  2.00E+06 (   8)    6     94  65  249.0  118.9  606.2
  13   1.65E+07 (  66)  3.00E+06 (  12)    6    142  80  250.3  136.6  505.1
  14   8.51E+06 (  34)  5.01E+05 (   2)    6     24  30  703.8  201.1 4670.9
  15   1.54E+07 (  41)  2.63E+06 (   7)    4    124  91  264.2  120.8  688.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:25:39 FILENAME: F:\FISSIO~1\U33Y\04_24A.FTZ
04-24A, U33Y-24,
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 12  1.10E+07 (  44) 2.00E+06 (   8) 249.0 118.9 606.2 100.0  249.0 118.9 606.2
 13  1.65E+07 (  66) 3.00E+06 (  12) 250.3 136.6 505.1 100.0  251.4 157.0 425.5
 15  1.54E+07 (  41) 2.63E+06 (   7) 264.2 120.8 688.8  99.1  256.0 170.7 399.6
  4  7.51E+06 (  30) 1.25E+06 (   5) 268.5 107.1 869.1  99.8  259.0 178.5 388.7
  9  7.01E+06 (  28) 1.00E+06 (   4) 310.1 113.8 %1175.9  99.6  265.9 187.3
388.8
  5  7.26E+06 (  29) 1.00E+06 (   4) 320.8 118.2 %1211.7  99.7  272.4 195.5
389.9
  1  6.34E+06 (  38) 8.34E+05 (   5) 337.9 138.5 %1068.4  99.7  280.7 205.4
392.8
  8  2.38E+07 (  95) 3.00E+06 (  12) 357.1 199.5 705.4  99.2  296.3 224.2 390.9
  3  1.68E+07 (  67) 2.00E+06 (   8) 375.0 185.4 885.1  99.1  306.8 236.2 397.8
  7  1.30E+07 (  52) 1.50E+06 (   6) 385.5 172.2 %1066.7  99.3  314.2 244.6
402.9
 10  1.63E+07 (  65) 1.75E+06 (   7) 413.4 196.6 %1039.4  99.1  323.9 255.0
410.6
 11  9.51E+06 (  38) 7.51E+05 (   3) 543.3 185.7 %2471.6  98.4  333.0 263.5
420.3
  2  2.00E+07 (  80) 1.50E+06 (   6) 583.2 269.0 %1554.3  93.9  351.5 280.5
439.8
  6  1.03E+07 (  41) 7.51E+05 (   3) 584.1 201.2 %2625.0  92.6  360.3 288.7
449.1
 14  8.51E+06 (  34) 5.01E+05 (   2) 703.8 201.1 %4670.9  90.2  369.0 296.5
458.7
POOL 1.23E+07(  748) 1.52E+06(   92)                    90.2  369.0 296.5 458.7
```

```
MEAN URANIUM CONCENTRATION +/-2SE (ppm):   71.6,  15.3

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):  369.0, 330.1 -- 412.4 ( -39.0  +43.4)
                95% CONF. INTERVAL(Ma):         296.5 -- 458.7 ( -72.6  +89.7)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.5539,   14
                      CHI^2 PROBABILITY:   90.2%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):  370.7, 331.5 -- 414.4 ( -39.2  +43.7)
                95% CONF. INTERVAL(Ma):         297.7 -- 461.1 ( -73.0  +90.3)
                    AGE DISPERSION (%):    0.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):  369.0, 330.1 -- 412.4 ( -39.0  +43.4)
               95% CONF. INTERVAL (Ma):         296.5 -- 458.7 ( -72.6  +89.7)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 05-01-2005/16:25:39 FILENAME: F:\FISSIO~1\U33Y\04_24A.FTZ
04-24A, U33Y-24,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =   241.15 to   617.18 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      331.44            1.468                16.70

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
      354.69            1.443                16.41
      634.35            0.485                 5.51
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 05-01-2005/16:25:39 FILENAME: F:\FISSIO~1\U33Y\04_24A.FTZ
04-24A, U33Y-24,
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
 149.8 -   0 :o
 165.4 -   0 :  o
 182.6 -   0 :    o
 201.5 -   0 :        o
 222.3 -   0 :             o
 245.2 -  27 :****************o*****************************************
 270.5 -   0 :                   o
 298.3 -  13 :*******************o*********
 328.9 -   7 :***************      o
 362.5 -  20 :*******************o************************
 399.5 -   7 :***************   o
 440.1 -   0 :              o
 484.7 -   7 :************o**
 533.6 -  13 :**********o******************
 587.2 -   0 :        o
 646.0 -   7 :******o********
 710.3 -   0 :    o
 780.6 -   0 :   o
 857.5 -   0 : o
 941.4 -   0 : o
1032.9 -   0 :o
```

APPENDIX C

Apatite Calibration

1. Fluence Calculations

2. Age Standards

3. Zeta Summary

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 01-14-2005/15:36:03

U32A Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
FIRST MONITOR:	1	0.0	4130	3.950E+05	1.56
	2	2.7	4106	3.927E+05	1.52
	3	5.4	4082	3.905E+05	1.49
	4	8.1	4059	3.882E+05	1.46
	5	10.8	4035	3.859E+05	1.43
	6	13.5	4011	3.836E+05	1.40
	7	16.2	3987	3.814E+05	1.37
	8	18.9	3964	3.791E+05	1.34
	9	21.6	3940	3.768E+05	1.32
	10	24.3	3916	3.746E+05	1.29
	11	27.0	3892	3.723E+05	1.27
	12	29.7	3868	3.700E+05	1.25
	13	32.4	3845	3.678E+05	1.23
	14	35.1	3821	3.655E+05	1.21
	15	37.8	3797	3.632E+05	1.20
	16	40.5	3773	3.609E+05	1.18
	17	43.2	3749	3.587E+05	1.17
	18	45.9	3726	3.564E+05	1.17
	19	48.6	3702	3.541E+05	1.16
	20	51.4	3678	3.519E+05	1.16
	21	54.1	3654	3.496E+05	1.17
	22	56.8	3631	3.473E+05	1.17
	23	59.5	3607	3.451E+05	1.19
	24	62.2	3583	3.428E+05	1.20
	25	64.9	3559	3.405E+05	1.22
	26	67.6	3535	3.382E+05	1.24
	27	70.3	3512	3.360E+05	1.26
	28	73.0	3488	3.337E+05	1.29
	29	75.7	3464	3.314E+05	1.32
	30	78.4	3440	3.292E+05	1.36
	31	81.1	3416	3.269E+05	1.40
	32	83.8	3393	3.246E+05	1.44
	33	86.5	3369	3.224E+05	1.49
	34	89.2	3345	3.201E+05	1.53
	35	91.9	3321	3.178E+05	1.59
	36	94.6	3298	3.155E+05	1.64
	37	97.3	3274	3.133E+05	1.70
SECOND MONITOR:	38	100.0	3250	3.110E+05	1.75

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 01-24-2004/11:47:59

U31A Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	3258	4.150E+05	1.75
	2	2.0	3261	4.124E+05	1.73
	3	4.1	3263	4.098E+05	1.70
	4	6.1	3266	4.072E+05	1.68
	5	8.2	3268	4.046E+05	1.65
	6	10.2	3271	4.019E+05	1.63
	7	12.2	3273	3.993E+05	1.60
	8	14.3	3276	3.967E+05	1.58
	9	16.3	3279	3.941E+05	1.56
	10	18.4	3281	3.915E+05	1.53
	11	20.4	3284	3.889E+05	1.51
	12	22.4	3286	3.863E+05	1.49
	13	24.5	3289	3.837E+05	1.47
	14	26.5	3291	3.810E+05	1.44
	15	28.6	3294	3.784E+05	1.42
	16	30.6	3297	3.758E+05	1.40
	17	32.7	3299	3.732E+05	1.38
	18	34.7	3302	3.706E+05	1.36
	19	36.7	3304	3.680E+05	1.34
	20	38.8	3307	3.654E+05	1.33
	21	40.8	3309	3.628E+05	1.31
	22	42.9	3312	3.601E+05	1.29
	23	44.9	3315	3.575E+05	1.28
	24	46.9	3317	3.549E+05	1.27
	25	49.0	3320	3.523E+05	1.26
	26	51.0	3322	3.497E+05	1.25
	27	53.1	3325	3.471E+05	1.24
	28	55.1	3327	3.445E+05	1.23
	29	57.1	3330	3.419E+05	1.23
	30	59.2	3333	3.392E+05	1.23
	31	61.2	3335	3.366E+05	1.23
	32	63.3	3338	3.340E+05	1.23
	33	65.3	3340	3.314E+05	1.23
	34	67.3	3343	3.288E+05	1.24
	35	69.4	3345	3.262E+05	1.25
	36	71.4	3348	3.236E+05	1.26
	37	73.5	3351	3.210E+05	1.28
	38	75.5	3353	3.183E+05	1.30
	39	77.6	3356	3.157E+05	1.32
	40	79.6	3358	3.131E+05	1.34
	41	81.6	3361	3.105E+05	1.37
	42	83.7	3363	3.079E+05	1.40
	43	85.7	3366	3.053E+05	1.43
	44	87.8	3369	3.027E+05	1.46
	45	89.8	3371	3.001E+05	1.50
	46	91.8	3374	2.974E+05	1.54
	47	93.9	3376	2.948E+05	1.58
	48	95.9	3379	2.922E+05	1.62
	49	98.0	3381	2.896E+05	1.67
SECOND MONITOR:	50	100.0	3384	2.870E+05	1.72

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 01-31-2001/14:15:50

U17A Fluence

=========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS=========

----------POSITION IN PACKAGE--------			----EFFECTIVE VALUES AT POSITION----		
Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	2274	3.480E+06	2.10
	2	4.8	2262	3.461E+06	2.01
	3	9.5	2250	3.443E+06	1.93
	4	14.3	2238	3.424E+06	1.85
	5	19.0	2226	3.406E+06	1.78
	6	23.8	2214	3.387E+06	1.71
	7	28.6	2203	3.369E+06	1.65
	8	33.3	2191	3.350E+06	1.61
	9	38.1	2179	3.331E+06	1.57
	10	42.9	2167	3.313E+06	1.54
	11	47.6	2155	3.294E+06	1.53
	12	52.4	2143	3.276E+06	1.53
	13	57.1	2131	3.257E+06	1.54
	14	61.9	2119	3.239E+06	1.57
	15	66.7	2107	3.220E+06	1.61
	16	71.4	2095	3.201E+06	1.67
	17	76.2	2084	3.183E+06	1.73
	18	81.0	2072	3.164E+06	1.81
	19	85.7	2060	3.146E+06	1.90
	20	90.5	2048	3.127E+06	2.00
	21	95.2	2036	3.109E+06	2.11
SECOND MONITOR:	22	100.0	2024	3.090E+06	2.22

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 01-31-2001/14:09:07

U10B Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	1	0.0	4174	3.550E+06	1.55
	2	6.3	4123	3.506E+06	1.47
	3	12.5	4072	3.463E+06	1.40
	4	18.8	4021	3.419E+06	1.33
	5	25.0	3970	3.375E+06	1.27
	6	31.3	3919	3.331E+06	1.22
	7	37.5	3868	3.288E+06	1.19
	8	43.8	3817	3.244E+06	1.16
	9	50.0	3766	3.200E+06	1.15
	10	56.3	3714	3.156E+06	1.16
	11	62.5	3663	3.113E+06	1.19
	12	68.8	3612	3.069E+06	1.24
	13	75.0	3561	3.025E+06	1.30
	14	81.3	3510	2.981E+06	1.38
	15	87.5	3459	2.938E+06	1.48
	16	93.8	3408	2.894E+06	1.60
SECOND MONITOR:	17	100.0	3357	2.850E+06	1.73

Fluence Calculations

==========Fluence Program v. 1.1 (Brandon 7/6/97)==========
DATE/TIME: 01-31-2001/14:14:49

U9A Fluence

==========INTERPOLATED TRACK DENSITY USING A PAIR OF GLASS STANDARDS==========

Monitor Label	Position	Distance(%)	Nd	RhoD (t/cm^2)	RE[RhoD](%)
FIRST MONITOR:	37	0.0	2848	2.420E+06	1.87
	36	2.8	2890	2.456E+06	1.80
	35	5.6	2932	2.491E+06	1.72
	34	8.3	2973	2.527E+06	1.66
	33	11.1	3015	2.562E+06	1.59
	32	13.9	3057	2.598E+06	1.53
	31	16.7	3099	2.633E+06	1.48
	30	19.4	3140	2.669E+06	1.43
	29	22.2	3182	2.704E+06	1.38
	28	25.0	3224	2.740E+06	1.34
	27	27.8	3266	2.776E+06	1.31
	26	30.6	3307	2.811E+06	1.28
	25	33.3	3349	2.847E+06	1.25
	24	36.1	3391	2.882E+06	1.23
	23	38.9	3433	2.918E+06	1.21
	22	41.7	3474	2.953E+06	1.20
	21	44.4	3516	2.989E+06	1.19
	20	47.2	3558	3.024E+06	1.18
	19	50.0	3600	3.060E+06	1.18
	18	52.8	3641	3.096E+06	1.18
	17	55.6	3683	3.131E+06	1.19
	16	58.3	3725	3.167E+06	1.19
	15	61.1	3767	3.202E+06	1.20
	14	63.9	3808	3.238E+06	1.22
	13	66.7	3850	3.273E+06	1.23
	12	69.4	3892	3.309E+06	1.25
	11	72.2	3934	3.344E+06	1.27
	10	75.0	3975	3.380E+06	1.29
	9	77.8	4017	3.416E+06	1.31
	8	80.6	4059	3.451E+06	1.33
	7	83.3	4101	3.487E+06	1.36
	6	86.1	4142	3.522E+06	1.38
	5	88.9	4184	3.558E+06	1.41
	4	91.7	4226	3.593E+06	1.43
	3	94.4	4268	3.629E+06	1.46
	2	97.2	4309	3.664E+06	1.49
SECOND MONITOR:	1	100.0	4351	3.700E+06	1.52

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 02-21-2005/14:49:25 FILENAME: F:\FISSIO~1\U32A\D1_32A.FTA
Durango age standard D1 U32A-21

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.496E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.17
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.911E+05	(10)	9.365E+05	(49)	80	88.24	30.6	30.7
2	9.557E+04	(5)	8.410E+05	(44)	80	158.46	74.8	74.9
3	1.529E+05	(8)	7.454E+05	(39)	80	87.79	34.1	34.1
4	1.338E+05	(7)	9.365E+05	(49)	80	126.05	51.0	51.0
5	1.147E+05	(6)	5.925E+05	(31)	80	93.04	41.5	41.5
6	1.147E+05	(6)	5.161E+05	(27)	80	81.03	36.6	36.6
7	1.147E+05	(6)	1.147E+06	(60)	80	180.07	77.1	77.2
8	1.433E+05	(6)	7.645E+05	(32)	64	96.04	42.7	42.8
9	1.672E+05	(7)	6.929E+05	(29)	64	74.60	31.4	31.5
10	1.147E+05	(6)	6.307E+05	(33)	80	99.04	44.0	44.0
11	1.195E+05	(5)	8.362E+05	(35)	64	126.05	60.3	60.3
12	1.560E+05	(5)	7.177E+05	(23)	49	82.83	40.9	40.9
13	1.593E+05	(5)	6.052E+05	(19)	48	68.43	34.4	34.4
14	1.911E+05	(10)	7.836E+05	(41)	80	73.83	26.1	26.1
15	1.529E+05	(8)	7.454E+05	(39)	80	87.79	34.1	34.1
POOLED	1.404E+05	(100)	7.722E+05	(550)	1089	99.04	10.8	10.9
MEAN ZETA (using grain ratios)						94.29	6.2	6.4

CHI-SQUARED PROBABILITY (%): 95.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.191 +/- 0.0123

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-17-2005/17:05:34 FILENAME: F:\FISSIO~1\U32A\D5_32A.FTA
Durango age standard D5 U32A-20

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.519E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.16
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	Ns	RhoI (cm^-2)	Ni	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.529E+05	8	7.263E+05	38	80	84.98	33.1	33.1
2	1.720E+05	9	8.601E+05	45	80	89.45	32.7	32.7
3	1.529E+05	8	7.263E+05	38	80	84.98	33.1	33.1
4	1.338E+05	7	6.690E+05	35	80	89.45	37.0	37.1
5	1.529E+05	8	8.219E+05	43	80	96.16	37.0	37.1
6	1.529E+05	8	6.498E+05	34	80	76.03	29.9	29.9
7	1.338E+05	7	8.601E+05	45	80	115.00	46.7	46.8
8	2.485E+05	13	1.300E+06	68	80	93.58	28.3	28.4
9	1.338E+05	7	7.836E+05	41	80	104.78	42.9	42.9
10	1.720E+05	9	1.089E+06	57	80	113.30	40.7	40.7
11	1.147E+05	6	6.881E+05	36	80	107.34	47.3	47.4
12	1.720E+05	9	7.645E+05	40	80	79.51	29.3	29.4
13	1.338E+05	7	9.939E+05	52	80	132.89	53.5	53.6
14	1.338E+05	7	8.601E+05	45	80	115.00	46.7	46.8
15	1.720E+05	9	7.645E+05	40	80	79.51	29.3	29.4
POOLED	1.555E+05	122	8.372E+05	657	1200	96.34	9.6	9.7
MEAN ZETA (using grain ratios)						95.00	4.1	4.4

CHI-SQUARED PROBABILITY (%): 100.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.188 +/- 0.0078

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-18-2005/12:47:54 FILENAME: F:\FISSIO~1\U32A\FCT1_32A.FTA
FCT1 age standard U32A-18

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.564E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.17
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.294E+05	(6)	1.758E+06	(46)	40	120.29	52.2	52.3
2	3.823E+04	(1)	4.587E+05	(12)	40	188.29	196.0	196.0
3	3.398E+05	(8)	1.572E+06	(37)	36	72.57	28.3	28.3
4	1.911E+05	(5)	1.261E+06	(33)	40	103.56	49.7	49.7
5	1.699E+05	(4)	1.487E+06	(35)	36	137.29	72.5	72.5
6	2.676E+05	(7)	2.141E+06	(56)	40	125.52	50.3	50.4
7	2.548E+05	(8)	1.274E+06	(40)	48	78.45	30.4	30.4
8	1.911E+05	(5)	1.720E+06	(45)	40	141.21	66.6	66.6
9	8.495E+04	(2)	5.946E+05	(14)	36	109.83	83.0	83.1
10	2.548E+05	(8)	1.625E+06	(51)	48	100.03	38.1	38.1
11	3.568E+05	(7)	1.478E+06	(29)	30	65.00	27.4	27.4
12	1.699E+05	(4)	1.019E+06	(24)	36	94.14	50.9	50.9
13	3.277E+05	(9)	1.638E+06	(45)	42	78.45	28.7	28.7
14	2.294E+05	(9)	1.070E+06	(42)	60	73.22	26.9	26.9
15	1.529E+05	(4)	1.109E+06	(29)	40	113.76	60.7	60.7
POOLED	2.174E+05	(87)	1.344E+06	(538)	612	97.03	11.3	11.4
MEAN ZETA (using grain ratios)						98.40	7.4	7.6

CHI-SQUARED PROBABILITY (%): 96.5

MEAN (RhoS/RhoI) +/- 1 SE: 0.159 +/- 0.0118

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-17-2005/16:58:40 FILENAME: F:\FISSIO~1\U32A\FCT2_32A.FTA
FCT2 age standard U32A-17

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.587E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.17
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.184E+05	(7)	1.623E+06	(52)	49	115.81	46.6	46.7
2	1.529E+05	(3)	7.136E+05	(14)	30	72.75	46.3	46.3
3	2.548E+05	(6)	1.699E+06	(40)	36	103.93	45.5	45.6
4	7.645E+04	(2)	1.032E+06	(27)	40	210.46	154.3	154.3
5	1.911E+05	(3)	1.019E+06	(16)	24	83.15	52.3	52.3
6	2.676E+05	(7)	1.147E+06	(30)	40	66.81	28.1	28.1
7	2.548E+05	(8)	1.561E+06	(49)	48	95.49	36.4	36.5
8	1.019E+05	(4)	4.842E+05	(19)	60	74.05	40.7	40.8
9	2.446E+05	(4)	1.651E+06	(27)	25	105.23	56.4	56.4
10	1.529E+05	(2)	1.147E+06	(15)	20	116.92	88.0	88.1
11	2.124E+05	(5)	1.444E+06	(34)	36	106.01	50.8	50.8
12	7.281E+04	(2)	8.373E+05	(23)	42	179.28	132.2	132.2
13	1.274E+05	(3)	1.189E+06	(28)	36	145.51	88.4	88.4
14	2.124E+05	(5)	1.444E+06	(34)	36	106.01	50.8	50.8
15	2.294E+05	(6)	1.261E+06	(33)	40	85.74	38.1	38.1
POOLED	1.823E+05	(67)	1.200E+06	(441)	562	102.61	13.5	13.6
MEAN ZETA (using grain ratios)						100.84	7.8	8.0

CHI-SQUARED PROBABILITY (%): 97.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.155 +/- 0.0118

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-17-2005/16:35:36 FILENAME: F:\FISSIO~1\U32A\FCT3_32A.FTA
FCT3 age standard U32A-16

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.609E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.18
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.446E+05	(4)	1.346E+06	(22)	25	85.22	46.3	46.4
2	2.294E+05	(9)	1.427E+06	(56)	60	96.41	34.6	34.7
3	1.638E+05	(6)	1.283E+06	(47)	56	121.38	52.6	52.7
4	2.124E+05	(5)	1.317E+06	(31)	36	96.07	46.3	46.3
5	1.529E+05	(4)	1.223E+06	(32)	40	123.96	65.8	65.8
6	1.699E+05	(6)	7.928E+05	(28)	54	72.31	32.5	32.6
7	3.058E+05	(5)	1.651E+06	(27)	25	83.67	40.7	40.8
8	2.940E+05	(5)	1.411E+06	(24)	26	74.38	36.6	36.6
9	1.311E+05	(6)	1.136E+06	(52)	70	134.29	57.9	58.0
10	1.092E+05	(3)	5.461E+05	(15)	42	77.47	49.0	49.0
11	1.784E+05	(7)	1.070E+06	(42)	60	92.97	38.0	38.0
12	3.823E+05	(10)	1.797E+06	(47)	40	72.83	25.4	25.4
13	2.352E+05	(6)	1.529E+06	(39)	39	100.72	44.2	44.2
14	1.274E+05	(5)	1.172E+06	(46)	60	142.55	67.1	67.2
15	2.548E+05	(8)	1.497E+06	(47)	48	91.03	34.8	34.9
POOLED	1.998E+05	(89)	1.246E+06	(555)	681	96.63	11.1	11.2
MEAN ZETA (using grain ratios)						93.27	5.2	5.5

CHI-SQUARED PROBABILITY (%): 98.3

MEAN (RhoS/RhoI) +/- 1 SE: 0.166 +/- 0.0091

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-17-2005/16:15:47 FILENAME: F:\FISSIO~1\U32A\FCT5_32A.FTA
FCT5 age standard U32A-15

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.632E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.20
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.389E+05	(10)	1.457E+06	(61)	64	93.92	32.1	32.1
2	1.274E+05	(4)	9.557E+05	(30)	48	115.48	61.5	61.5
3	1.019E+05	(4)	1.351E+06	(53)	60	204.01	105.8	105.9
4	2.265E+05	(8)	1.189E+06	(42)	54	80.83	31.2	31.2
5	4.778E+04	(2)	8.840E+05	(37)	64	284.84	206.8	206.9
6	2.912E+05	(8)	1.529E+06	(42)	42	80.83	31.2	31.2
7	3.440E+05	(9)	2.446E+06	(64)	40	109.49	39.0	39.0
8	2.102E+05	(11)	1.510E+06	(79)	80	110.58	35.6	35.7
9	2.730E+05	(5)	9.830E+05	(18)	28	55.43	28.0	28.0
10	2.230E+05	(7)	1.338E+06	(42)	48	92.38	37.7	37.8
11	3.568E+05	(7)	1.733E+06	(34)	30	74.78	31.1	31.1
12	1.911E+05	(10)	1.070E+06	(56)	80	86.22	29.6	29.7
13	1.911E+05	(6)	1.179E+06	(37)	48	94.95	41.8	41.8
14	1.529E+05	(5)	8.257E+05	(27)	50	83.14	40.5	40.5
15	2.548E+05	(7)	1.420E+06	(39)	42	85.78	35.2	35.3
POOLED	2.024E+05	(103)	1.299E+06	(661)	778	98.81	10.5	10.7
MEAN ZETA (using grain ratios)						94.52	8.0	8.2

CHI-SQUARED PROBABILITY (%): 85.2

MEAN (RhoS/RhoI) +/- 1 SE: 0.163 +/- 0.0136

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 02-10-2004/16:27:36 FILENAME: E:\FISSIO~1\MONTARIO\D1_31A.FTA
Durango age standard D1 U31A-31

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.341E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.21
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	7.645E+04	(5)	3.670E+05	(24)	100	90.44	44.5	44.5
2	1.529E+05	(8)	8.792E+05	(46)	80	108.35	41.5	41.6
3	1.682E+05	(11)	8.104E+05	(53)	100	90.79	30.1	30.1
4	1.070E+05	(7)	5.046E+05	(33)	100	88.83	37.0	37.0
5	1.338E+05	(7)	6.881E+05	(36)	80	96.90	40.0	40.1
6	1.529E+05	(8)	8.219E+05	(43)	80	101.28	39.0	39.0
7	1.911E+05	(10)	8.983E+05	(47)	80	88.56	30.9	30.9
8	1.529E+05	(8)	6.498E+05	(34)	80	80.08	31.5	31.5
9	1.529E+05	(6)	8.155E+05	(32)	60	100.49	44.7	44.8
10	1.529E+05	(9)	8.665E+05	(51)	90	106.77	38.6	38.7
11	1.699E+05	(10)	8.495E+05	(50)	90	94.21	32.7	32.7
12	1.529E+05	(10)	9.021E+05	(59)	100	111.17	38.0	38.1
13	1.338E+05	(7)	7.645E+05	(40)	80	107.67	44.1	44.2
14	1.147E+05	(6)	9.939E+05	(52)	80	163.30	70.4	70.5
15	9.174E+04	(6)	5.963E+05	(39)	100	122.48	53.7	53.8
POOLED	1.388E+05	(118)	7.516E+05	(639)	1300	102.04	10.3	10.4
MEAN ZETA (using grain ratios)						100.65	4.2	4.5

CHI-SQUARED PROBABILITY (%): 99.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.187 +/- 0.0075

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 02-10-2004/16:27:50 FILENAME: E:\FISSIO~1\MONTARIO\D3_31A.FTA
Durango age standard D3 U31A-28

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.395E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.21
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.338E+05	(7)	7.836E+05	(41)	80	108.61	44.4	44.5
2	1.147E+05	(6)	7.836E+05	(41)	80	126.71	55.4	55.4
3	1.888E+05	(10)	8.117E+05	(43)	81	79.73	28.0	28.0
4	1.338E+05	(7)	6.307E+05	(33)	80	87.42	36.4	36.4
5	1.147E+05	(6)	6.881E+05	(36)	80	111.26	49.1	49.1
6	1.311E+05	(6)	8.082E+05	(37)	70	114.35	50.3	50.4
7	1.338E+05	(7)	7.072E+05	(37)	80	98.01	40.4	40.4
8	7.645E+04	(4)	4.014E+05	(21)	80	97.35	53.1	53.1
9	1.529E+05	(8)	7.645E+05	(40)	80	92.71	35.9	36.0
10	1.019E+05	(4)	5.352E+05	(21)	60	97.35	53.1	53.1
11	1.672E+05	(7)	7.645E+05	(32)	64	84.77	35.4	35.4
12	2.102E+05	(11)	9.557E+05	(50)	80	84.29	28.1	28.1
13	1.911E+05	(8)	1.027E+06	(43)	64	99.67	38.4	38.4
14	1.147E+05	(6)	6.498E+05	(34)	80	105.08	46.5	46.6
15	1.720E+05	(9)	8.028E+05	(42)	80	86.53	31.8	31.8
POOLED	1.423E+05	(106)	7.397E+05	(551)	1139	96.39	10.3	10.4
MEAN ZETA (using grain ratios)						96.70	3.4	3.7

CHI-SQUARED PROBABILITY (%): 100.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.192 +/- 0.0063

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 02-10-2004/16:28:05 FILENAME: E:\FISSIO~1\MONTARIO\D5_31A.FTA
Durango age standard D5 U31A-31

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.413E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.22
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.682E+05	(11)	9.786E+05	(64)	100	107.32	35.1	35.1
2	2.294E+05	(12)	9.939E+05	(52)	80	79.93	25.6	25.6
3	2.676E+05	(7)	1.032E+06	(27)	40	71.15	30.2	30.2
4	1.529E+05	(6)	7.900E+05	(31)	60	95.30	42.5	42.5
5	1.070E+05	(7)	7.798E+05	(51)	100	134.39	54.2	54.2
6	1.529E+05	(6)	5.861E+05	(23)	60	70.71	32.4	32.4
7	1.720E+05	(9)	8.219E+05	(43)	80	88.13	32.3	32.4
8	4.587E+04	(3)	3.364E+05	(22)	100	135.26	83.3	83.3
9	2.184E+05	(8)	1.092E+06	(40)	56	92.23	35.7	35.8
10	2.446E+05	(4)	1.040E+06	(17)	25	78.39	43.6	43.6
11	1.019E+05	(6)	6.456E+05	(38)	90	116.82	51.3	51.4
12	1.720E+05	(9)	7.454E+05	(39)	80	79.93	29.6	29.6
13	2.076E+05	(11)	7.551E+05	(40)	81	67.07	22.9	22.9
14	9.557E+04	(5)	9.557E+05	(50)	80	184.45	86.5	86.6
15	2.676E+05	(7)	1.300E+06	(34)	40	89.59	37.2	37.2
POOLED	1.583E+05	(111)	8.144E+05	(571)	1072	94.88	9.9	10.0
MEAN ZETA (using grain ratios)						92.10	6.2	6.4

CHI-SQUARED PROBABILITY (%): 90.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.200 +/- 0.0132

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 02-10-2004/16:28:21 FILENAME: E:\FISSIO~1\MONTARIO\FCT4_31A.FTA
FCT4 age standard U31A-22

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.503E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.26
SIZE OF COUNTING SQUARE (CM^2): 6.540E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.124E+05	(5)	9.344E+05	(22)	36	70.24	34.8	34.8
2	1.274E+05	(2)	1.274E+06	(20)	24	159.64	118.4	118.4
3	1.529E+05	(7)	1.376E+06	(63)	70	143.67	57.3	57.3
4	3.504E+05	(11)	1.911E+06	(60)	48	87.07	28.6	28.6
5	1.720E+05	(9)	1.338E+06	(70)	80	124.16	44.0	44.1
6	1.529E+05	(6)	1.147E+06	(45)	60	119.73	52.1	52.1
7	2.294E+05	(12)	1.472E+06	(77)	80	102.43	31.8	31.9
8	2.294E+05	(6)	1.223E+06	(32)	40	85.14	37.9	37.9
9	2.548E+05	(10)	1.351E+06	(53)	60	84.61	29.2	29.2
10	1.529E+05	(7)	1.070E+06	(49)	70	111.75	45.2	45.2
11	9.557E+04	(5)	7.645E+05	(40)	80	127.71	60.6	60.6
12	1.720E+05	(9)	1.070E+06	(56)	80	99.33	35.7	35.7
13	1.433E+05	(6)	8.123E+05	(34)	64	90.46	40.1	40.1
14	2.548E+05	(6)	1.699E+06	(40)	36	106.42	46.6	46.7
15	1.720E+05	(9)	1.013E+06	(53)	80	94.01	33.9	34.0
POOLED	1.852E+05	(110)	1.202E+06	(714)	908	103.62	10.7	10.9
MEAN ZETA (using grain ratios)						102.31	5.9	6.2

CHI-SQUARED PROBABILITY (%): 99.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.156 +/- 0.0088

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:25:54 FILENAME: D:\MONTARI\DR1_17A.TXT
DRA-1 U17A Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.424E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.85
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	7.257E+04	(4)	5.443E+05	(30)	80	137.89	73.4	73.5
2	1.451E+05	(8)	7.620E+05	(42)	80	96.53	37.3	37.3
3	1.814E+05	(8)	7.937E+05	(35)	64	80.44	31.6	31.6
4	2.358E+05	(13)	1.143E+06	(63)	80	89.10	27.2	27.2
5	9.071E+04	(5)	7.075E+05	(39)	80	143.41	68.2	68.2
6	1.089E+05	(6)	8.527E+05	(47)	80	144.02	62.5	62.5
7	4.536E+04	(2)	8.618E+05	(38)	64	349.33	253.5	253.6
8	1.814E+05	(10)	9.434E+05	(52)	80	95.61	33.1	33.1
9	1.814E+05	(10)	1.070E+06	(59)	80	108.48	37.2	37.2
10	1.270E+05	(7)	7.438E+05	(41)	80	107.69	44.1	44.1
11	1.587E+05	(7)	8.844E+05	(39)	64	102.44	42.1	42.1
12	1.587E+05	(7)	4.989E+05	(22)	64	57.78	25.1	25.1
13	1.814E+05	(10)	9.797E+05	(54)	80	99.28	34.2	34.3
POOLED	1.442E+05	(97)	8.342E+05	(561)	976	106.33	11.9	12.0
MEAN ZETA (using grain ratios)						104.71	10.4	10.6

CHI-SQUARED PROBABILITY (%): 86.7

MEAN (RhoS/RhoI) +/- 1 SE: 0.176 +/- 0.0172

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:26:04 FILENAME: D:\MONTARI\DR2_17A.TXT
DRA-2 U17A Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.146E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.90
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.996E+05	(11)	1.052E+06	(58)	80	105.51	34.8	34.8
2	1.361E+05	(6)	6.350E+05	(28)	64	93.38	42.0	42.1
3	1.270E+05	(7)	6.531E+05	(36)	80	102.91	42.6	42.6
4	1.270E+05	(7)	6.168E+05	(34)	80	97.19	40.4	40.4
5	1.814E+05	(8)	8.844E+05	(39)	64	97.55	37.9	37.9
6	9.676E+04	(4)	4.596E+05	(19)	60	95.05	52.3	52.3
7	2.217E+05	(11)	9.877E+05	(49)	72	89.14	29.8	29.8
8	1.361E+05	(6)	7.030E+05	(31)	64	103.39	46.2	46.2
9	1.451E+05	(8)	6.168E+05	(34)	80	85.04	33.5	33.5
10	1.134E+05	(5)	4.762E+05	(21)	64	84.04	41.9	41.9
11	1.587E+05	(7)	9.751E+05	(43)	64	122.92	50.2	50.2
12	9.071E+04	(4)	4.762E+05	(21)	64	105.06	57.3	57.4
13	1.433E+05	(8)	6.271E+05	(35)	81	87.55	34.3	34.4
14	1.089E+05	(6)	6.168E+05	(34)	80	113.39	50.3	50.3
15	1.451E+05	(6)	6.773E+05	(28)	60	93.38	42.0	42.1
POOLED	1.428E+05	(104)	7.003E+05	(510)	1057	98.13	10.7	10.8
MEAN ZETA (using grain ratios)						97.33	3.2	3.6

CHI-SQUARED PROBABILITY (%): 100.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.206 +/- 0.0055

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:36:31 FILENAME: D:\MONTARI\DRA_10B.TXT
DRA-B U10B Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.276E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 2.02
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.512E+05	(5)	9.071E+05	(30)	48	115.30	55.7	55.8
2	8.959E+04	(5)	6.271E+05	(35)	81	134.52	64.4	64.4
3	2.177E+05	(12)	1.197E+06	(66)	80	105.69	33.2	33.3
4	2.329E+05	(13)	1.021E+06	(57)	81	84.26	26.0	26.0
5	1.451E+05	(8)	9.071E+05	(50)	80	120.10	45.8	45.8
6	1.996E+05	(11)	1.089E+06	(60)	80	104.82	34.4	34.5
7	7.257E+04	(4)	6.531E+05	(36)	80	172.95	91.2	91.3
8	1.433E+05	(8)	1.236E+06	(69)	81	165.74	62.0	62.0
9	9.071E+04	(5)	6.713E+05	(37)	80	142.20	67.8	67.9
10	1.089E+05	(6)	7.620E+05	(42)	80	134.52	58.8	58.8
11	1.361E+05	(6)	1.089E+06	(48)	64	153.73	66.6	66.7
12	1.814E+05	(8)	1.293E+06	(57)	64	136.92	51.8	51.8
13	1.814E+05	(8)	1.225E+06	(54)	64	129.71	49.2	49.3
14	1.587E+05	(7)	9.071E+05	(40)	64	109.81	45.0	45.1
15	1.270E+05	(7)	9.978E+05	(55)	80	150.99	60.7	60.7
POOLED	1.482E+05	(113)	9.650E+05	(736)	1107	125.16	12.9	13.0
MEAN ZETA (using grain ratios)						126.23	7.1	7.4

CHI-SQUARED PROBABILITY (%): 99.2

MEAN (RhoS/RhoI) +/- 1 SE: 0.152 +/- 0.0080

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:35:16 FILENAME: D:\MONTARI\FCT_10B.TXT
FCT-B U10B Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.311E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.88
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	4.515E+05	(14)	1.967E+06	(61)	45	73.59	21.9	21.9
2	2.903E+05	(5)	1.219E+06	(21)	25	70.94	35.3	35.3
3	1.866E+05	(9)	7.464E+05	(36)	70	67.56	25.2	25.2
4	1.659E+05	(4)	8.294E+05	(20)	35	84.45	46.3	46.3
5	1.296E+05	(5)	6.998E+05	(27)	56	91.20	44.4	44.5
6	1.244E+05	(3)	9.952E+05	(24)	35	135.12	82.8	82.8
7	2.419E+05	(3)	1.451E+06	(18)	18	101.34	63.2	63.2
8	1.382E+05	(2)	1.313E+06	(19)	21	160.45	119.3	119.3
9	2.419E+05	(5)	1.500E+06	(31)	30	104.71	50.5	50.5
10	5.183E+04	(2)	4.924E+05	(19)	56	160.45	119.3	119.3
11	1.209E+05	(4)	9.676E+05	(32)	48	135.12	71.7	71.7
12	1.344E+05	(5)	9.676E+05	(36)	54	121.60	58.1	58.1
POOLED	1.796E+05	(61)	1.013E+06	(344)	493	95.25	13.4	13.5
MEAN ZETA (using grain ratios)						99.83	9.0	9.2

CHI-SQUARED PROBABILITY (%): 70.6

MEAN (RhoS/RhoI) +/- 1 SE: 0.169 +/- 0.0149

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:37:10 FILENAME: D:\MONTARI\DRA_9A2.TXT
DRA-2 U9A Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 2.456E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.80
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.358E+05	(13)	7.801E+05	(43)	80	84.78	26.9	26.9
2	1.089E+05	(6)	7.257E+05	(40)	80	170.88	74.9	74.9
3	2.358E+05	(13)	9.978E+05	(55)	80	108.44	33.5	33.5
4	1.633E+05	(9)	6.168E+05	(34)	80	96.83	36.3	36.4
5	1.089E+05	(6)	5.987E+05	(33)	80	140.98	62.6	62.7
6	1.633E+05	(9)	5.080E+05	(28)	80	79.75	30.6	30.6
7	1.089E+05	(6)	7.438E+05	(41)	80	175.15	76.6	76.7
8	1.633E+05	(9)	9.797E+05	(54)	80	153.79	55.4	55.5
9	1.451E+05	(8)	5.261E+05	(29)	80	92.92	37.1	37.2
10	1.089E+05	(6)	6.168E+05	(34)	80	145.25	64.4	64.4
11	1.451E+05	(8)	8.345E+05	(46)	80	147.39	56.5	56.6
12	1.633E+05	(9)	5.624E+05	(31)	80	88.29	33.5	33.5
13	1.089E+05	(6)	5.806E+05	(32)	80	136.71	60.9	60.9
POOLED	1.507E+05	(108)	6.978E+05	(500)	1040	118.67	12.8	12.9
MEAN ZETA (using grain ratios)						115.95	9.3	9.5

CHI-SQUARED PROBABILITY (%): 89.4

MEAN (RhoS/RhoI) +/- 1 SE: 0.221 +/- 0.0174

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:36:16 FILENAME: D:\MONTARI\DRA_9A3.TXT
DRA-3 U9A Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 31.40 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.629E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.46
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	1.451E+05	(8)	1.052E+06	(58)	80	125.77	47.5	47.5
2	1.814E+05	(10)	1.270E+06	(70)	80	121.43	41.1	41.1
3	2.540E+05	(14)	9.071E+05	(50)	80	61.95	18.8	18.8
4	1.814E+05	(10)	1.125E+06	(62)	80	107.55	36.7	36.7
5	1.633E+05	(9)	1.107E+06	(61)	80	117.58	42.0	42.1
6	1.996E+05	(11)	9.434E+05	(52)	80	82.01	27.2	27.3
7	2.358E+05	(13)	8.345E+05	(46)	80	61.38	19.3	19.3
8	1.089E+05	(6)	8.890E+05	(49)	80	141.67	61.3	61.4
9	2.177E+05	(12)	9.797E+05	(54)	80	78.06	24.9	25.0
10	1.451E+05	(8)	7.075E+05	(39)	80	84.57	32.8	32.9
11	1.633E+05	(9)	9.797E+05	(54)	80	104.08	37.5	37.5
12	1.270E+05	(7)	1.179E+06	(65)	80	161.08	64.1	64.2
POOLED	1.769E+05	(117)	9.978E+05	(660)	960	97.86	9.9	10.0
MEAN ZETA (using grain ratios)						95.14	8.9	9.0

CHI-SQUARED PROBABILITY (%): 61.6

MEAN (RhoS/RhoI) +/- 1 SE: 0.182 +/- 0.0168

Age Standards

==========Zfactor Program v. 1.2 (Brandon 3/18/95)==========
DATE/TIME: 01-31-2001/13:35:47 FILENAME: D:\MONTARI\FCT_9A2.TXT
FCT-2 U9A Age Standard

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.664E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.49
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.419E+05	(7)	2.108E+06	(61)	42	133.00	53.1	53.2
2	1.209E+05	(4)	1.058E+06	(35)	48	133.54	70.5	70.6
3	1.633E+05	(9)	1.742E+06	(96)	80	162.80	56.8	56.9
4	1.451E+05	(7)	1.306E+06	(63)	70	137.36	54.8	54.8
5	1.659E+05	(8)	1.037E+06	(50)	70	95.39	36.4	36.4
6	1.996E+05	(11)	1.306E+06	(72)	80	99.90	32.4	32.4
7	1.152E+05	(5)	1.866E+06	(81)	63	247.25	114.0	114.1
8	1.935E+05	(8)	1.113E+06	(46)	60	87.76	33.6	33.7
9	2.903E+05	(12)	1.838E+06	(76)	60	96.66	30.1	30.1
10	3.024E+05	(15)	1.492E+06	(74)	72	75.29	21.3	21.4
11	1.814E+05	(9)	1.250E+06	(62)	72	105.14	37.5	37.6
12	2.765E+05	(12)	1.359E+06	(59)	63	75.04	23.8	23.8
13	2.073E+05	(8)	1.477E+06	(57)	56	108.74	41.1	41.1
14	1.411E+05	(7)	9.474E+05	(47)	72	102.48	41.5	41.6
15	3.175E+05	(14)	1.089E+06	(48)	64	52.33	15.9	15.9
POOLED	2.031E+05	(136)	1.384E+06	(927)	972	104.03	9.7	9.9
MEAN ZETA (using grain ratios)						100.74	9.5	9.6

CHI-SQUARED PROBABILITY (%): 33.9

MEAN (RhoS/RhoI) +/- 1 SE: 0.151 +/- 0.0141

Age Standards

=================Zfactor Program v. 1.2 (Brandon 3/18/95)=================
DATE/TIME: 01-31-2001/13:34:51 FILENAME: D:\MONTARI\FCT_9A4.TXT
FCT-4 U9A Age Standard (mica underetched)

AGE (MA) AND STANDARD ERROR (MY) OF AGE STANDARD: 27.90 0.50
TRACK DENSITY FOR GLASS STANDARD (TRACKS/CM^2): 3.273E+06
RELATIVE STANDARD ERROR FOR GLASS DENSITY (%): 1.23
SIZE OF COUNTING SQUARE (CM^2): 6.890E-07

------ ZETA FOR GRAINS OF AGE STANDARD ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	Zeta (yr cm^2)	Grain-only SE	Total SE
1	2.358E+05	(13)	1.270E+06	(70)	80	92.00	27.8	27.9
2	1.270E+05	(7)	1.234E+06	(68)	80	165.97	65.9	66.0
3	1.633E+05	(9)	1.288E+06	(71)	80	134.79	47.7	47.8
4	1.996E+05	(11)	1.560E+06	(86)	80	133.58	42.8	42.9
5	1.728E+05	(5)	1.140E+06	(33)	42	112.76	54.1	54.2
POOLED	1.804E+05	(45)	1.315E+06	(328)	362	124.53	19.9	20.0
MEAN ZETA (using grain ratios)						122.95	12.5	12.7

CHI-SQUARED PROBABILITY (%): 66.0

MEAN (RhoS/RhoI) +/- 1 SE: 0.139 +/- 0.0140

Zeta Summary

==========ZetaMean Program v. 1.0 (Brandon 4/18/01)==========
Date/Time: 02-21-2005/15:13:17

Montario Zeta

Number	Zeta	Grain-only SE	Total SE	2*grain-only SE
1)	106.33	11.90	12.00	23.80
2)	98.13	10.70	10.80	21.40
3)	125.16	12.90	13.00	25.80
4)	95.25	13.40	13.50	26.80
5)	118.67	12.80	12.80	25.60
6)	97.86	9.90	10.00	19.80
7)	104.03	9.70	9.90	19.40
8)	124.53	19.90	20.00	39.80
9)	102.04	10.30	10.40	20.60
10)	94.88	9.90	10.00	19.80
11)	103.62	10.70	10.90	21.40
12)	96.39	10.30	10.40	20.60
13)	102.61	13.50	13.60	27.00
14)	98.81	10.50	10.70	21.00
15)	97.03	11.30	11.40	22.60
16)	96.63	11.10	11.20	22.20
17)	96.34	9.60	9.70	19.20
18)	99.04	10.80	10.90	21.60
WEIGHTED MEAN				
	101.52		2.70	
		(2 SE =	5.41)	

APPENDIX D

Apatite Age Data

1. 4-01
2. 4-02
3. 4-03
4. 4-04
5. 4-05
6. 4-06
7. 4-07
8. 4-08
9. 4-10
10. 4-12
11. 4-13
12. 4-14
13. 4-15
14. 4-16
15. 3-101
16. 3-102
17. 3-103
18. 3-104
19. 3-105
20. 3-106

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:48:47 FILENAME: F:\FISSIO~1\U32A\04_01.FTA
04_01  U32A-02

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.972E+06
                                      RELATIVE ERROR (%):      1.52
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   2.55E+05 (   4)  1.59E+06 (  25)   24     16   6   33.3    8.2   92.8
   2   2.18E+05 (   5)  1.88E+06 (  43)   35     19   6   24.1    7.2   58.8
   3   8.49E+04 (   2)  1.49E+06 (  35)   36     15   5   12.4    1.3   44.7
   4   2.04E+05 (   2)  2.34E+06 (  23)   15     23  10   18.7    2.0   70.6
   5   1.82E+05 (   5)  1.49E+06 (  41)   42     15   5   25.2    7.6   61.9
   6   2.12E+05 (   5)  1.19E+06 (  28)   36     12   4   36.9   10.8   93.8
   7   2.39E+05 (   5)  1.67E+06 (  35)   32     17   6   29.5    8.8   73.5
   8   2.39E+05 (   5)  1.72E+06 (  36)   32     17   6   28.7    8.6   71.3
   9   2.45E+05 (   4)  1.16E+06 (  19)   25     12   5   43.6   10.5  126.6
  10   2.87E+05 (   9)  1.37E+06 (  43)   48     14   4   42.7   18.1   87.3
  11   3.06E+05 (   4)  1.15E+06 (  15)   20     11   6   55.1   13.0  166.7
  12   1.53E+05 (   6)  1.04E+06 (  41)   60     10   3   30.1   10.2   69.6
  13   3.06E+05 (   6)  2.19E+06 (  43)   30     22   7   28.7    9.8   66.1
  14   2.04E+05 (   4)  1.02E+06 (  20)   30     10   5   41.5   10.0  119.3
  15   2.55E+05 (   6)  1.83E+06 (  43)   36     18   6   28.7    9.8   66.1

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:48:47 FILENAME: F:\FISSIO~1\U32A\04_01.FTA
04_01  U32A-02
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)          Age   --95% CI--  (%)    Age   --95% CI--
  3  8.49E+04 (   2) 1.49E+06 (  35)  12.4   1.3  44.7 100.0   12.4   1.3  44.7
  4  2.04E+05 (   2) 2.34E+06 (  23)  18.7   2.0  70.6  68.3   14.4   3.7  37.5
  2  2.18E+05 (   5) 1.88E+06 (  43)  24.1   7.2  58.8  70.5   18.2   8.0  35.4
  5  1.82E+05 (   5) 1.49E+06 (  41)  25.2   7.6  61.9  81.8   20.1  10.6  34.4
  8  2.39E+05 (   5) 1.72E+06 (  36)  28.7   8.6  71.3  86.8   21.7  12.6  34.6
 13  3.06E+05 (   6) 2.19E+06 (  43)  28.7   9.8  66.1  91.4   22.9  14.4  34.5
 15  2.55E+05 (   6) 1.83E+06 (  43)  28.7   9.8  66.1  95.0   23.7  15.7  34.4
  7  2.39E+05 (   5) 1.67E+06 (  35)  29.5   8.8  73.5  97.2   24.3  16.6  34.3
 12  1.53E+05 (   6) 1.04E+06 (  41)  30.1  10.2  69.6  98.4   24.9  17.6  34.4
  1  2.55E+05 (   4) 1.59E+06 (  25)  33.3   8.2  92.8  99.0   25.4  18.2  34.6
  6  2.12E+05 (   5) 1.19E+06 (  28)  36.9  10.8  93.8  99.1   26.2  19.1  35.1
 14  2.04E+05 (   4) 1.02E+06 (  20)  41.5  10.0 119.3  99.0   27.0  20.3  35.9
 10  2.87E+05 (   9) 1.37E+06 (  43)  42.7  18.1  87.3  97.8   28.4  21.8  37.1
  9  2.45E+05 (   4) 1.16E+06 (  19)  43.6  10.5 126.6  98.1   29.0  22.3  37.6
 11  3.06E+05 (   4) 1.15E+06 (  15)  55.1  13.0 166.7  97.1   29.7  23.1  38.3
POOL 2.20E+05(   72) 1.50E+06(  490)                     97.1   29.7  23.1  38.3

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   15.0,   1.4

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   29.7,  26.1 --  33.8 (  -3.6   +4.1)
                95% CONF. INTERVAL(Ma):         23.1 --  38.3 (  -6.7   +8.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.4155,   14
                    CHI^2 PROBABILITY:   97.1%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   29.6,  26.0 --  33.6 (  -3.6   +4.1)
                95% CONF. INTERVAL(Ma):         22.9 --  38.1 (  -6.6   +8.5)
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```
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   29.7,  26.1 --  33.8 (  -3.6   +4.1)
               95% CONF. INTERVAL (Ma):          23.1 --  38.3 (  -6.7   +8.6)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:48:47 FILENAME: F:\FISSIO~1\U32A\04_01.FTA
04_01  U32A-02
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    14.18 to    58.27 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       32.43            1.501                 18.61

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       10.51            0.098                  1.21
       30.60            1.482                 18.38
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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:48:47 FILENAME: F:\FISSIO~1\U32A\04_01.FTA
04_01  U32A-02
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   8.3 -   0 :o
   9.2 -   0 :o
  10.2 -   0 :o
  11.3 -   0 :o
  12.4 -   0 : o
  13.7 -   7 :*o**********
  15.2 -   0 :  o
  16.8 -   0 :   o
  18.5 -   0 :    o
  20.5 -   7 :*******o****
  22.6 -   0 :          o
  25.0 -   7 :************ o
  27.6 -   7 :************   o
  30.5 -  33 :*****************o****************************************
  33.7 -   0 :                 o
  37.3 -  13 :****************o*******
  41.2 -   0 :              o
  45.5 -  20 :***********o************************
  50.3 -   0 :         o
  55.5 -   7 :******o*****
  61.3 -   0 :    o
  67.8 -   0 :  o
  74.8 -   0 : o
  82.7 -   0 :o
  91.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:48:55 FILENAME: F:\FISSIO~1\U32A\04_02.FTA
04_02  U32A-03

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.905E+06
                                    RELATIVE ERROR (%):      1.49
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                              SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.27E+05 (   4)  1.31E+06 (  41)   48     13   4   20.0    5.0   53.2
   2   2.55E+05 (   4)  3.25E+06 (  51)   24     33   9   16.1    4.1   42.2
   3   3.06E+05 (   7)  3.54E+06 (  81)   35     36   8   17.5    6.7   36.9
   4   5.46E+05 (   5)  1.86E+06 (  17)   14     19   9   59.3   16.8  162.7
   5   3.44E+06 (   9)  1.57E+07 (  41)    4    160  50   44.0   18.6   90.3
   6   2.18E+06 (  20)  1.30E+07 ( 119)   14    132  25   33.5   19.6   53.6
   7   2.18E+05 (   2)  1.86E+06 (  17)   14     19   9   24.9    2.6   97.6
   8   5.10E+05 (   6)  6.63E+06 (  78)   18     68  15   15.6    5.4   34.6
   9   3.82E+05 (   4)  1.91E+06 (  20)   16     19   9   40.8    9.8  117.3
  10   1.27E+05 (   1)  1.53E+06 (  12)   12     16   9   18.7    0.4  110.7
  11   3.82E+05 (   4)  2.87E+06 (  30)   16     29  11   27.3    6.8   74.6
  12   3.82E+05 (   4)  2.48E+06 (  26)   16     25  10   31.5    7.7   87.4
  13   3.06E+05 (   2)  3.52E+06 (  23)   10     36  15   18.4    2.0   69.4
  14   2.55E+05 (   2)  2.55E+06 (  20)   12     26  12   21.2    2.2   81.1
  15   4.25E+05 (   5)  1.70E+06 (  20)   18     17   8   50.6   14.5  134.7

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:48:55 FILENAME: F:\FISSIO~1\U32A\04_02.FTA
04_02  U32A-03
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  8  5.10E+05 (   6) 6.63E+06 (  78)  15.6   5.4  34.6 100.0   15.6   5.4  34.6
  2  2.55E+05 (   4) 3.25E+06 (  51)  16.1   4.1  42.2  97.7   15.6   7.2  29.1
  3  3.06E+05 (   7) 3.54E+06 (  81)  17.5   6.7  36.9  97.7   16.2   9.2  26.3
 13  3.06E+05 (   2) 3.52E+06 (  23)  18.4   2.0  69.4  99.7   16.3   9.5  25.8
 10  1.27E+05 (   1) 1.53E+06 (  12)  18.7   0.4 110.7 100.0   16.3   9.7  25.5
  1  1.27E+05 (   4) 1.31E+06 (  41)  20.0   5.0  53.2 100.0   16.7  10.5  25.2
 14  2.55E+05 (   2) 2.55E+06 (  20)  21.2   2.2  81.1 100.0   16.9  10.8  25.1
  7  2.18E+05 (   2) 1.86E+06 (  17)  24.9   2.6  97.6 100.0   17.3  11.2  25.3
 11  3.82E+05 (   4) 2.87E+06 (  30)  27.3   6.8  74.6  99.9   18.0  12.1  25.8
 12  3.82E+05 (   4) 2.48E+06 (  26)  31.5   7.7  87.4  99.4   18.9  13.0  26.5
  6  2.18E+06 (  20) 1.30E+07 ( 119)  33.5  19.6  53.6  87.0   22.4  16.9  29.7
  9  3.82E+05 (   4) 1.91E+06 (  20)  40.8   9.8 117.3  85.6   23.1  17.6  30.3
  5  3.44E+06 (   9) 1.57E+07 (  41)  44.0  18.6  90.3  73.1   24.6  19.0  31.7
 15  4.25E+05 (   5) 1.70E+06 (  20)  50.6  14.5 134.7  66.2   25.4  19.8  32.6
  4  5.46E+05 (   5) 1.86E+06 (  17)  59.3  16.8 162.7  54.5   26.4  20.7  33.5
POOL 4.46E+05(   79) 3.36E+06(  596)                    54.5   26.4  20.7  33.5

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   34.3,   3.0

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   26.4,  23.3 --  29.8 (  -3.1   +3.4)
                95% CONF. INTERVAL(Ma):         20.7 --  33.5 (  -5.6   +7.2)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.9123,   14
                     CHI^2 PROBABILITY:   54.5%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   26.2,  23.1 --  29.7 (  -3.1   +3.5)
```

```
                95% CONF. INTERVAL(Ma):          20.5 --  33.5 (  -5.7   +7.3)
                    AGE DISPERSION (%):    6.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   26.4,  23.3 --  29.8 (  -3.1   +3.4)
               95% CONF. INTERVAL (Ma):          20.7 --  33.5 (  -5.6   +7.2)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:48:55 FILENAME: F:\FISSIO~1\U32A\04_02.FTA
04_02  U32A-03
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    16.39 to    62.00 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       20.17            0.955                 12.87
       33.92            1.076                 14.51

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       17.93            0.913                 12.30
       34.11            1.076                 14.50
       51.52            0.671                  9.05
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:48:55 FILENAME: F:\FISSIO~1\U32A\04_02.FTA
04_02  U32A-03
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         2.22      4.44      6.67      8.89      11.11     13.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  10.2 -   0 :   o
  11.3 -   0 :     o
  12.4 -   0 :         o
  13.7 -   0 :              o
  15.2 -   0 :                   o
  16.8 -  13 :************************o***********************************
  18.5 -   7 :***************************o**
  20.5 -  13 :***************************o*******************************
  22.6 -   7 :***************************o**
  25.0 -   7 :***************************o***
  27.6 -   7 :***************************o**
  30.5 -   7 :********************************o
  33.7 -  13 :********************************o****************************
  37.3 -   0 :                                 o
  41.2 -   0 :                              o
  45.5 -  13 :***********************o***********************************
  50.3 -   0 :                       o
  55.5 -   7 :****************o*************
  61.3 -   7 :*************o****************
  67.8 -   0 :         o
  74.8 -   0 :      o
  82.7 -   0 :    o
  91.3 -   0 :  o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:07 FILENAME: F:\FISSIO~1\U32A\04_03.FTA
04_03  U32A-04

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.882E+06
                                    RELATIVE ERROR (%):      1.46
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                           SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   3.19E+05 (   5)  2.48E+06 (  39)   24     25   8   25.9    7.8   63.9
   2   3.82E+05 (   6)  1.98E+06 (  31)   24     20   7   38.9   13.0   92.2
   3   3.64E+05 (  10)  2.44E+06 (  67)   42     25   6   29.8   13.5   57.3
   4   3.06E+05 (   6)  2.04E+06 (  40)   30     21   7   30.2   10.2   69.8
   5   3.44E+05 (   9)  2.94E+06 (  77)   40     30   7   23.4   10.1   45.9
   6   5.73E+05 (   9)  2.80E+06 (  44)   24     29   9   40.8   17.3   83.2
   7   3.06E+05 (   8)  2.10E+06 (  55)   40     22   6   29.1   11.8   60.3
   8   2.87E+05 (   9)  2.10E+06 (  66)   48     22   5   27.2   11.8   54.0
   9   3.82E+05 (  12)  2.71E+06 (  85)   48     28   6   28.1   13.8   51.0
  10   1.91E+05 (   5)  1.95E+06 (  51)   40     20   6   19.9    6.0   48.0
  11   2.55E+05 (   8)  2.39E+06 (  75)   48     25   6   21.4    8.7   43.5
  12   3.93E+05 (  18)  2.77E+06 ( 127)   70     28   5   28.1   16.0   45.8
  13   3.06E+05 (   9)  2.11E+06 (  62)   45     22   6   29.0   12.5   57.7
  14   4.46E+05 (   7)  2.61E+06 (  41)   24     27   8   34.2   12.7   75.4
  15   2.68E+05 (   7)  2.37E+06 (  62)   40     24   6   22.7    8.6   48.5

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:07 FILENAME: F:\FISSIO~1\U32A\04_03.FTA
04_03  U32A-04
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 10  1.91E+05 (   5) 1.95E+06 (  51)  19.9   6.0  48.0 100.0   19.9   6.0  48.0
 11  2.55E+05 (   8) 2.39E+06 (  75)  21.4   8.7  43.5  88.8   20.5  10.5  36.0
 15  2.68E+05 (   7) 2.37E+06 (  62)  22.7   8.6  48.5  97.4   21.1  12.5  33.3
  5  3.44E+05 (   9) 2.94E+06 (  77)  23.4  10.1  45.9  99.2   21.6  14.1  31.7
  1  3.19E+05 (   5) 2.48E+06 (  39)  25.9   7.8  63.9  99.6   22.1  15.0  31.4
  8  2.87E+05 (   9) 2.10E+06 (  66)  27.2  11.8  54.0  99.4   22.9  16.3  31.4
  9  3.82E+05 (  12) 2.71E+06 (  85)  28.1  13.8  51.0  99.4   24.0  18.0  31.8
 12  3.93E+05 (  18) 2.77E+06 ( 127)  28.1  16.0  45.8  99.5   24.8  19.3  31.8
 13  3.06E+05 (   9) 2.11E+06 (  62)  29.0  12.5  57.7  99.7   25.2  19.9  31.9
  7  3.06E+05 (   8) 2.10E+06 (  55)  29.1  11.8  60.3  99.9   25.4  20.3  31.9
  3  3.64E+05 (  10) 2.44E+06 (  67)  29.8  13.5  57.3  99.9   25.8  20.8  32.0
  4  3.06E+05 (   6) 2.04E+06 (  40)  30.2  10.2  69.8 100.0   26.0  21.0  32.0
 14  4.46E+05 (   7) 2.61E+06 (  41)  34.2  12.7  75.4 100.0   26.3  21.5  32.3
  2  3.82E+05 (   6) 1.98E+06 (  31)  38.9  13.0  92.2  99.9   26.7  21.9  32.7
  6  5.73E+05 (   9) 2.80E+06 (  44)  40.8  17.3  83.2  99.7   27.4  22.6  33.2
POOL 3.33E+05(  128) 2.40E+06(  922)                     99.7   27.4  22.6  33.2

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   24.6,   1.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   27.4,  24.8 --  30.2 (  -2.6   +2.8)
                95% CONF. INTERVAL(Ma):         22.6 --  33.2 (  -4.8   +5.8)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.2623,   14
                     CHI^2 PROBABILITY:   99.7%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   27.3,  24.7 --  30.1 (  -2.6   +2.8)
```

```
                95% CONF. INTERVAL(Ma):          22.5 --  33.1 (  -4.8   +5.8)
                    AGE DISPERSION (%):    0.0

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   27.4,  24.8 --  30.2 (  -2.6   +2.8)
               95% CONF. INTERVAL (Ma):          22.6 --  33.2 (  -4.8   +5.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:07 FILENAME: F:\FISSIO~1\U32A\04_03.FTA
04_03  U32A-04
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    21.01 to    41.93 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       28.62            2.157                 20.21

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       28.49            2.157                 20.21

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:07 FILENAME: F:\FISSIO~1\U32A\04_03.FTA
04_03  U32A-04
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  12.4 -   0 :o
  13.7 -   0 :o
  15.2 -   0 :  o
  16.8 -   0 :    o
  18.5 -   0 :        o
  20.5 -   7 :*************o*
  22.6 -  13 :*******************o*********
  25.0 -   7 :***************           o
  27.6 -  27 :******************************o****************************
  30.5 -  27 :******************************o****************************
  33.7 -   0 :                         o
  37.3 -   7 :***************   o
  41.2 -  13 :*************o***************
  45.5 -   0 :        o
  50.3 -   0 :     o
  55.5 -   0 :  o
  61.3 -   0 : o
  67.8 -   0 :o
```

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 02-24-2005/12:49:15 FILENAME: F:\FISSIO~1\U32A\04_04.FTA
04_04 U32A-05

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2): 3.859E+06
RELATIVE ERROR (%): 1.43
EFFECTIVE URANIUM CONTENT OF MONITOR (ppm): 39.81
ZETA FACTOR AND STANDARD ERROR (yr cm^2): 101.52 2.70
SIZE OF COUNTER SQUARE (cm^2): 6.540E-07

------ GRAIN AGES IN ORIGINAL ORDER ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Squares	U+/-2s		Grain Age	Age (Ma) --95% CI--	
1	6.37E+05	15	4.59E+06	108	36	47	9	27.4	14.7	46.8
2	3.31E+05	13	3.41E+06	134	60	35	6	19.2	9.8	33.6
3	4.78E+05	15	3.85E+06	121	48	40	7	24.5	13.2	41.6
4	3.28E+05	6	3.55E+06	65	28	37	9	18.5	6.4	41.4
5	3.06E+05	12	2.85E+06	112	60	29	6	21.2	10.5	38.1
6	3.19E+05	10	3.31E+06	104	48	34	7	19.1	8.8	36.0
7	2.97E+05	7	3.19E+06	75	36	33	8	18.6	7.1	39.5
8	2.97E+05	7	3.14E+06	74	36	32	8	18.9	7.2	40.0
9	3.67E+05	12	2.51E+06	82	50	26	6	28.9	14.2	52.7
10	2.29E+05	6	3.33E+06	87	40	34	7	13.8	4.8	30.6
11	2.55E+05	8	2.52E+06	79	48	26	6	20.2	8.3	40.9
12	2.18E+05	7	3.15E+06	101	49	33	7	13.9	5.3	29.0
13	5.52E+05	13	5.10E+06	120	36	53	10	21.4	11.0	37.6
14	3.82E+05	10	4.59E+06	120	40	47	9	16.5	7.6	31.0
15	2.75E+05	9	2.08E+06	68	50	21	5	26.3	11.4	52.0

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 02-24-2005/12:49:15 FILENAME: F:\FISSIO~1\U32A\04_04.FTA
04_04 U32A-05
Number of grains = 15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------

Grain no.	RhoS (cm^-2)	(Ns)	RhoI (cm^-2)	(Ni)	Grain age (Ma) Age	--95% CI--		P(X2) (%)	Sum age (Ma) Age	--95% CI--	
10	2.29E+05	6	3.33E+06	87	13.8	4.8	30.6	100.0	13.8	4.8	30.6
12	2.18E+05	7	3.15E+06	101	13.9	5.3	29.0	99.3	13.7	7.1	23.7
14	3.82E+05	10	4.59E+06	120	16.5	7.6	31.0	91.2	14.7	9.1	22.3
4	3.28E+05	6	3.55E+06	65	18.5	6.4	41.4	94.6	15.3	10.0	22.2
7	2.97E+05	7	3.19E+06	75	18.6	7.1	39.5	97.0	15.8	10.9	22.1
8	2.97E+05	7	3.14E+06	74	18.9	7.2	40.0	98.5	16.2	11.5	22.0
6	3.19E+05	10	3.31E+06	104	19.1	8.8	36.0	99.1	16.7	12.6	22.2
2	3.31E+05	13	3.41E+06	134	19.2	9.8	33.6	99.5	17.1	13.2	22.1
11	2.55E+05	8	2.52E+06	79	20.2	8.3	40.9	99.7	17.4	13.6	22.2
5	3.06E+05	12	2.85E+06	112	21.2	10.5	38.1	99.7	17.8	14.2	22.3
13	5.52E+05	13	5.10E+06	120	21.4	11.0	37.6	99.8	18.2	14.7	22.5
3	4.78E+05	15	3.85E+06	121	24.5	13.2	41.6	99.4	18.8	15.4	22.9
15	2.75E+05	9	2.08E+06	68	26.3	11.4	52.0	99.1	19.2	15.8	23.3
1	6.37E+05	15	4.59E+06	108	27.4	14.7	46.8	97.8	19.8	16.5	23.8
9	3.67E+05	12	2.51E+06	82	28.9	14.2	52.7	96.4	20.3	17.0	24.2
POOL	3.45E+05	150	3.33E+06	1450				96.4	20.3	17.0	24.2

MEAN URANIUM CONCENTRATION +/-2SE (ppm): 34.4, 2.1

POOLED AGE WITH 68% CONF. INTERVAL(Ma): 20.3, 18.5 -- 22.2 (-1.8 +1.9)
95% CONF. INTERVAL(Ma): 17.0 -- 24.2 (-3.3 +3.9)
REDUCED CHI^2, DEGREES OF FREEDOM: 0.4364, 14
CHI^2 PROBABILITY: 96.4%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma): 20.2, 18.5 -- 22.2 (-1.8 +1.9)
95% CONF. INTERVAL(Ma): 16.9 -- 24.2 (-3.3 +3.9)

```
                  AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   20.3,  18.5 --  22.2 (  -1.8   +1.9)
               95% CONF. INTERVAL (Ma):         17.0 --  24.2 (  -3.3   +3.9)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:15 FILENAME: F:\FISSIO~1\U32A\04_04.FTA
04_04  U32A-05
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    14.46 to    29.61 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       21.14            2.054                 17.44

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       20.65            2.047                 17.38

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:15 FILENAME: F:\FISSIO~1\U32A\04_04.FTA
04_04  U32A-05
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   9.2 -   0 :o
  10.2 -   0 : o
  11.3 -   0 :   o
  12.4 -   0 :      o
  13.7 -   0 :         o
  15.2 -  13 :***************o**************
  16.8 -   7 :***************      o
  18.5 -  13 :****************************o**
  20.5 -  27 :****************************o****************************
  22.6 -  13 :****************************o
  25.0 -   7 :***************          o
  27.6 -  13 :*******************o**********
  30.5 -   7 :*************o*
  33.7 -   0 :       o
  37.3 -   0 :   o
  41.2 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:23 FILENAME: F:\FISSIO~1\U32A\04_05.FTA
04_05  U32A-06

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.836E+06
                                    RELATIVE ERROR (%):      1.40
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   7.65E+05 (  12)  6.56E+06 ( 103)   24     68  14   22.9   11.3   41.3
   2   9.56E+04 (   2)  1.05E+06 (  22)   32     11   5   18.9    2.0   71.7
   3   1.53E+05 (   4)  1.41E+06 (  37)   40     15   5   21.8    5.4   58.4
   4   2.73E+05 (  10)  3.63E+06 ( 133)   56     38   7   14.8    6.9   27.7
   5   2.62E+05 (  12)  3.63E+06 ( 166)   70     38   6   14.2    7.1   25.2
   6   3.82E+05 (   9)  4.33E+06 ( 102)   36     45   9   17.4    7.6   33.9
   7   1.83E+05 (   6)  2.45E+06 (  80)   50     25   6   15.0    5.2   33.1
   8   2.94E+05 (   5)  4.35E+06 (  74)   26     45  11   13.5    4.1   32.1
   9   2.04E+05 (   4)  2.91E+06 (  57)   30     30   8   14.2    3.6   36.9
  10   2.04E+05 (   8)  3.06E+06 ( 120)   60     32   6   13.2    5.5   26.4
  11   2.55E+05 (  10)  3.19E+06 ( 125)   60     33   6   15.8    7.3   29.6
  12   2.55E+05 (  10)  3.77E+06 ( 148)   60     39   7   13.3    6.2   24.9
  13   1.89E+05 (  11)  2.25E+06 ( 131)   89     23   4   16.6    8.0   30.2
  14   7.22E+05 (  17)  7.39E+06 ( 174)   36     77  12   19.2   10.8   31.3
  15   5.95E+05 (  14)  4.59E+06 ( 108)   36     48   9   25.5   13.3   44.1

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:23 FILENAME: F:\FISSIO~1\U32A\04_05.FTA
04_05  U32A-06
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 10  2.04E+05 (   8) 3.06E+06 ( 120)  13.2   5.5  26.4 100.0   13.2   5.5  26.4
 12  2.55E+05 (  10) 3.77E+06 ( 148)  13.3   6.2  24.9  97.8   13.2   7.6  21.1
  8  2.94E+05 (   5) 4.35E+06 (  74)  13.5   4.1  32.1 100.0   13.2   8.2  20.0
  9  2.04E+05 (   4) 2.91E+06 (  57)  14.2   3.6  36.9 100.0   13.2   8.6  19.5
  5  2.62E+05 (  12) 3.63E+06 ( 166)  14.2   7.1  25.2 100.0   13.5   9.4  18.6
  4  2.73E+05 (  10) 3.63E+06 ( 133)  14.8   6.9  27.7 100.0   13.7  10.0  18.3
  7  1.83E+05 (   6) 2.45E+06 (  80)  15.0   5.2  33.1 100.0   13.9  10.5  18.3
 11  2.55E+05 (  10) 3.19E+06 ( 125)  15.8   7.3  29.6 100.0   14.1  10.9  18.2
 13  1.89E+05 (  11) 2.25E+06 ( 131)  16.6   8.0  30.2 100.0   14.4  11.3  18.3
  6  3.82E+05 (   9) 4.33E+06 ( 102)  17.4   7.6  33.9 100.0   14.6  11.7  18.4
  2  9.56E+04 (   2) 1.05E+06 (  22)  18.9   2.0  71.7 100.0   14.7  11.7  18.4
 14  7.22E+05 (  17) 7.39E+06 ( 174)  19.2  10.8  31.3  99.9   15.3  12.4  18.8
  3  1.53E+05 (   4) 1.41E+06 (  37)  21.8   5.4  58.4  99.9   15.4  12.6  18.9
  1  7.65E+05 (  12) 6.56E+06 ( 103)  22.9  11.3  41.3  99.6   15.9  13.1  19.3
 15  5.95E+05 (  14) 4.59E+06 ( 108)  25.5  13.3  44.1  97.3   16.5  13.7  19.9
POOL 2.91E+05(  134) 3.43E+06( 1580)                      97.3   16.5  13.7  19.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   35.6,   2.0

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   16.5,  15.1 --  18.2 (  -1.5   +1.6)
                 95% CONF. INTERVAL(Ma):          13.7 --  19.9 (  -2.8   +3.4)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.4101,   14
                      CHI^2 PROBABILITY:   97.3%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   16.5,  15.0 --  18.1 (  -1.5   +1.6)
```

```
                95% CONF. INTERVAL(Ma):          13.7 --  19.9 (  -2.8   +3.4)
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   16.5,  15.1 --  18.2 (  -1.5   +1.6)
               95% CONF. INTERVAL (Ma):          13.7 --  19.9 (  -2.8   +3.4)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:23 FILENAME: F:\FISSIO~1\U32A\04_05.FTA
04_05  U32A-06
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    13.72 to    25.97 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       16.24            1.983                 19.27

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       15.31            1.940                 18.86
       26.38            0.775                  7.53

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:23 FILENAME: F:\FISSIO~1\U32A\04_05.FTA
04_05  U32A-06
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   8.3 -   0 :o
   9.2 -   0 :  o
  10.2 -   0 :     o
  11.3 -   0 :          o
  12.4 -   0 :                o
  13.7 -  20 :************************o*******************
  15.2 -  27 :****************************o*******************************
  16.8 -  13 :*****************************o
  18.5 -   7 :***************           o
  20.5 -   7 :***************       o
  22.6 -  20 :*****************o**************************
  25.0 -   7 :*************o*
  27.6 -   0 :         o
  30.5 -   0 :     o
  33.7 -   0 :  o
  37.3 -   0 : o
  41.2 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:32 FILENAME: F:\FISSIO~1\U32A\04_06.FTA
04_06  U32A-07

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.814E+06
                                    RELATIVE ERROR (%):      1.37
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.78E+05 (   7)  1.86E+06 (  73)   60     19   5   18.9    7.2   40.1
   2   2.29E+05 (   9)  2.93E+06 ( 115)   60     31   6   15.4    6.8   29.7
   3   1.53E+05 (   6)  2.24E+06 (  88)   60     23   5   13.5    4.7   29.9
   4   1.91E+05 (   6)  2.77E+06 (  87)   48     29   6   13.7    4.8   30.2
   5   2.55E+05 (   6)  2.29E+06 (  54)   36     24   7   22.0    7.6   49.8
   6   3.19E+05 (  10)  2.55E+06 (  80)   48     27   6   24.5   11.2   46.7
   7   3.06E+05 (   8)  2.75E+06 (  72)   40     29   7   21.9    8.9   44.6
   8   1.78E+05 (   7)  2.22E+06 (  87)   60     23   5   15.9    6.1   33.4
   9   1.75E+05 (   4)  2.27E+06 (  52)   35     24   7   15.4    3.9   40.4
  10   2.14E+05 (   7)  2.60E+06 (  85)   50     27   6   16.3    6.2   34.2
  11   3.25E+05 (  17)  2.87E+06 ( 150)   80     30   5   22.1   12.4   36.3
  12   2.10E+05 (  11)  2.85E+06 ( 149)   80     30   5   14.5    7.0   26.3
  13   2.80E+05 (  11)  2.91E+06 ( 114)   60     30   6   18.9    9.1   34.6
  14   2.29E+05 (   9)  2.19E+06 (  86)   60     23   5   20.6    9.0   40.2
  15   1.36E+05 (   8)  2.26E+06 ( 133)   90     24   4   11.9    4.9   23.6

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:32 FILENAME: F:\FISSIO~1\U32A\04_06.FTA
04_06  U32A-07
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 15  1.36E+05 (   8) 2.26E+06 ( 133)  11.9   4.9  23.6 100.0   11.9   4.9  23.6
  3  1.53E+05 (   6) 2.24E+06 (  88)  13.5   4.7  29.9  82.2   12.4   6.6  21.0
  4  1.91E+05 (   6) 2.77E+06 (  87)  13.7   4.8  30.2  96.2   12.7   7.6  19.8
 12  2.10E+05 (  11) 2.85E+06 ( 149)  14.5   7.0  26.3  98.0   13.2   8.8  18.9
  2  2.29E+05 (   9) 2.93E+06 ( 115)  15.4   6.8  29.7  98.9   13.6   9.6  18.7
  9  1.75E+05 (   4) 2.27E+06 (  52)  15.4   3.9  40.4  99.7   13.7   9.8  18.5
  8  1.78E+05 (   7) 2.22E+06 (  87)  15.9   6.1  33.4  99.9   14.0  10.5  18.7
 10  2.14E+05 (   7) 2.60E+06 (  85)  16.3   6.2  34.2  99.9   14.2  10.8  18.6
 13  2.80E+05 (  11) 2.91E+06 ( 114)  18.9   9.1  34.6  99.7   14.8  11.5  19.0
  1  1.78E+05 (   7) 1.86E+06 (  73)  18.9   7.2  40.1  99.7   15.0  11.8  19.1
 14  2.29E+05 (   9) 2.19E+06 (  86)  20.6   9.0  40.2  99.5   15.5  12.3  19.4
  7  3.06E+05 (   8) 2.75E+06 (  72)  21.9   8.9  44.6  99.3   15.8  12.7  19.7
  5  2.55E+05 (   6) 2.29E+06 (  54)  22.0   7.6  49.8  99.3   16.1  13.0  19.9
 11  3.25E+05 (  17) 2.87E+06 ( 150)  22.1  12.4  36.3  98.5   16.7  13.7  20.4
  6  3.19E+05 (  10) 2.55E+06 (  80)  24.5  11.2  46.7  97.7   17.2  14.2  20.8
POOL 2.22E+05(  126) 2.51E+06( 1425)                      97.7   17.2  14.2  20.8

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   26.2,   1.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   17.2,  15.6 --  18.9 (  -1.6   +1.8)
                95% CONF. INTERVAL(Ma):          14.2 --  20.8 (  -3.0   +3.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.3941,   14
                     CHI^2 PROBABILITY:   97.7%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   17.1,  15.5 --  18.8 (  -1.6   +1.8)
```

```
                95% CONF. INTERVAL(Ma):          14.1 --  20.7 (  -3.0   +3.6)
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   17.2,  15.6 --  18.9 (  -1.6   +1.8)
               95% CONF. INTERVAL (Ma):          14.2 --  20.8 (  -3.0   +3.6)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:32 FILENAME: F:\FISSIO~1\U32A\04_06.FTA
04_06  U32A-07
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    12.31 to    25.20 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       18.99            1.850                 17.06

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       15.30            1.624                 14.97
       21.82            1.703                 15.70

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:32 FILENAME: F:\FISSIO~1\U32A\04_06.FTA
04_06  U32A-07
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   7.5 -   0 :o
   8.3 -   0 : o
   9.2 -   0 :   o
  10.2 -   0 :      o
  11.3 -   0 :            o
  12.4 -   7 :******************o
  13.7 -  13 :*************************o*************
  15.2 -  13 :*******************************o********
  16.8 -  20 :************************************o************************
  18.5 -   7 :********************                 o
  20.5 -  13 :***********************************o****
  22.6 -  20 :*******************************o****************************
  25.0 -   7 :********************   o
  27.6 -   0 :               o
  30.5 -   0 :       o
  33.7 -   0 :   o
  37.3 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-28-2005/14:44:57 FILENAME: F:\FISSIO~1\U32A\04_07.FTA
04_07  U32A-08

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.791E+06
                                    RELATIVE ERROR (%):      1.34
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.91E+05 (   3)  2.61E+06 (  41)   24     27   9   14.8    2.8   44.0
   2   3.67E+05 (   6)  5.44E+06 (  89)   25     57  12   13.3    4.6   29.3
   3   2.55E+05 (   2)  7.52E+06 (  59)   12     79  21    7.0    0.8   24.6
   4   2.55E+05 (   2)  4.20E+06 (  33)   12     44  15   12.5    1.4   45.5
   5   3.06E+05 (   3)  5.40E+06 (  53)   15     57  16   11.4    2.2   33.5
   6   1.91E+05 (   1)  4.40E+06 (  23)    8     46  19    9.5    0.2   51.3

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-28-2005/14:44:57 FILENAME: F:\FISSIO~1\U32A\04_07.FTA
04_07  U32A-08
Number of grains =  6
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  3  2.55E+05 (   2) 7.52E+06 (  59)   7.0   0.8  24.6 100.0    7.0   0.8  24.6
  6  1.91E+05 (   1) 4.40E+06 (  23)   9.5   0.2  51.3  84.2    7.4   1.4  21.3
  5  3.06E+05 (   3) 5.40E+06 (  53)  11.4   2.2  33.5  85.6    8.8   3.1  19.1
  4  2.55E+05 (   2) 4.20E+06 (  33)  12.5   1.4  45.5  93.4    9.3   3.9  18.5
  2  3.67E+05 (   6) 5.44E+06 (  89)  13.3   4.6  29.3  94.2   10.6   5.6  17.9
  1  1.91E+05 (   3) 2.61E+06 (  41)  14.8   2.8  44.0  96.7   11.1   6.3  17.9
POOL 2.71E+05(   17) 4.75E+06(  298)                     96.7   11.1   6.3  17.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   49.8,   5.9

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   11.1,   8.3 --  14.4 (  -2.8   +3.4)
                95% CONF. INTERVAL(Ma):          6.3 --  17.9 (  -4.8   +6.8)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.1891,    5
                    CHI^2 PROBABILITY:   96.7%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   11.0,   8.5 --  14.1 (  -2.4   +3.1)
                95% CONF. INTERVAL(Ma):          6.7 --  17.9 (  -4.3   +7.0)
                    AGE DISPERSION (%):    0.0

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   11.1,   8.3 --  14.4 (  -2.8   +3.4)
               95% CONF. INTERVAL (Ma):          6.3 --  17.9 (  -4.8   +6.8)
       NUMBER AND PERCENTAGE OF GRAINS:    6,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-28-2005/14:44:57 FILENAME: F:\FISSIO~1\U32A\04_07.FTA
04_07  U32A-08
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  6
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
```

At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages = 8.08 to 16.21 Ma

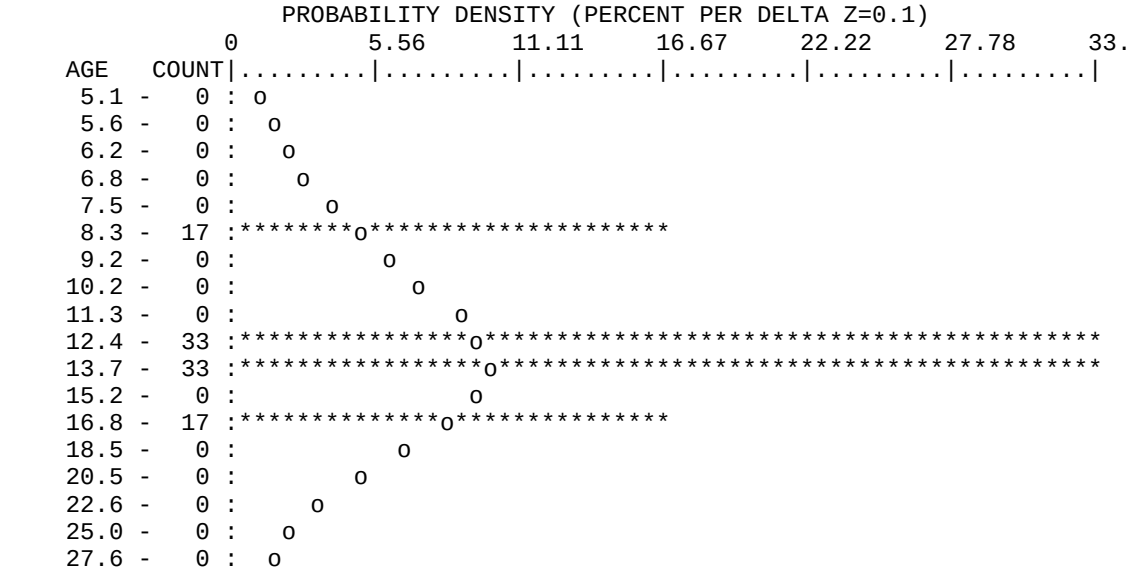
First Search: peaks with zero first derivatives.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
13.65	0.603	9.44

Second search: find minima in the second derivative of the Gaussian probability density function.

AGE (Ma)	PROBABILTY DENSITY AT PEAK (grains/DZ=0.1)	EST. N (grains)
13.91	0.602	9.42

==========ZetaAge Program v. 4.8 (Brandon 8/13/02)==========
DATE/TIME: 02-28-2005/14:44:57 FILENAME: F:\FISSIO~1\U32A\04_07.FTA
04_07 U32A-08
Kernel factor = .6 (Ratio of kernel window size to standard error)
Number of grains = 6 Barwidth (Z units) = .1
Histogram shown by asterisks and probability distribution by circles.



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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:41 FILENAME: F:\FISSIO~1\U32A\04_08.FTA
04_08  U32A-09

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.768E+06
                                    RELATIVE ERROR (%):      1.32
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   3.57E+05 (   7)  4.54E+06 (  89)   30     48  10   15.3    5.9   32.2
   2   4.78E+05 (  15)  5.57E+06 ( 175)   48     59   9   16.5    9.0   27.8
   3   2.12E+05 (   5)  3.78E+06 (  89)   36     40   9   11.1    3.4   26.0
   4   3.19E+05 (   5)  3.50E+06 (  55)   24     37  10   17.9    5.4   43.0
   5   6.12E+05 (  12)  6.88E+06 ( 135)   30     73  13   17.2    8.6   30.6
   6   5.10E+05 (   7)  6.12E+06 (  84)   21     65  14   16.3    6.2   34.2
   7   3.06E+05 (   6)  4.13E+06 (  81)   30     44  10   14.5    5.0   32.1
   8   1.82E+05 (   5)  2.84E+06 (  78)   42     30   7   12.6    3.9   29.8
   9   4.97E+05 (  13)  6.31E+06 ( 165)   40     67  11   15.2    7.8   26.5
  10   1.53E+05 (   4)  1.80E+06 (  47)   40     19   6   16.9    4.3   44.4
  11   2.55E+05 (  10)  3.41E+06 ( 134)   60     36   6   14.5    6.7   27.0
  12   2.55E+05 (   3)  2.55E+06 (  30)   18     27  10   20.0    3.7   61.2
  13   2.55E+05 (   7)  3.35E+06 (  92)   42     35   7   14.9    5.7   31.2
  14   3.44E+05 (   9)  4.82E+06 ( 126)   40     51   9   13.9    6.1   26.7
  15   3.57E+05 (   7)  5.50E+06 ( 108)   30     58  11   12.7    4.9   26.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:41 FILENAME: F:\FISSIO~1\U32A\04_08.FTA
04_08  U32A-09
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  3  2.12E+05 (   5) 3.78E+06 (  89)  11.1   3.4  26.0 100.0   11.1   3.4  26.0
  8  1.82E+05 (   5) 2.84E+06 (  78)  12.6   3.9  29.8  83.9   11.6   5.4  21.6
 15  3.57E+05 (   7) 5.50E+06 ( 108)  12.7   4.9  26.4  96.8   11.9   6.8  19.3
 14  3.44E+05 (   9) 4.82E+06 ( 126)  13.9   6.1  26.7  98.1   12.5   8.0  18.4
 11  2.55E+05 (  10) 3.41E+06 ( 134)  14.5   6.7  27.0  99.0   12.9   8.9  18.0
  7  3.06E+05 (   6) 4.13E+06 (  81)  14.5   5.0  32.1  99.7   13.1   9.3  17.8
 13  2.55E+05 (   7) 3.35E+06 (  92)  14.9   5.7  31.2  99.9   13.3  10.0  17.9
  9  4.97E+05 (  13) 6.31E+06 ( 165)  15.2   7.8  26.5  99.9   13.7  10.5  17.8
  1  3.57E+05 (   7) 4.54E+06 (  89)  15.3   5.9  32.2 100.0   13.8  10.7  17.7
  6  5.10E+05 (   7) 6.12E+06 (  84)  16.3   6.2  34.2 100.0   14.0  11.0  17.7
  2  4.78E+05 (  15) 5.57E+06 ( 175)  16.5   9.0  27.8 100.0   14.3  11.5  17.8
 10  1.53E+05 (   4) 1.80E+06 (  47)  16.9   4.3  44.4 100.0   14.4  11.6  17.8
  5  6.12E+05 (  12) 6.88E+06 ( 135)  17.2   8.6  30.6 100.0   14.6  11.9  18.0
  4  3.19E+05 (   5) 3.50E+06 (  55)  17.9   5.4  43.0 100.0   14.7  12.1  18.0
 12  2.55E+05 (   3) 2.55E+06 (  30)  20.0   3.7  61.2 100.0   14.8  12.2  18.1
POOL 3.31E+05(  115) 4.28E+06( 1488)                  100.0   14.8  12.2  18.1

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   45.3,   2.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   14.8,  13.4 --  16.4 (  -1.4   +1.6)
                95% CONF. INTERVAL(Ma):         12.2 --  18.1 (  -2.7   +3.2)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.1196,   14
                     CHI^2 PROBABILITY:  100.0%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   14.8,  13.3 --  16.3 (  -1.4   +1.6)
```

```
                95% CONF. INTERVAL(Ma):          12.1 --  18.0 (  -2.7   +3.2)
                    AGE DISPERSION (%):    0.0

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   14.8,  13.4 --  16.4 (  -1.4   +1.6)
               95% CONF. INTERVAL (Ma):          12.2 --  18.1 (  -2.7   +3.2)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:41 FILENAME: F:\FISSIO~1\U32A\04_08.FTA
04_08  U32A-09
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    11.74 to    21.91 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       15.86            2.349                 23.28

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       16.00            2.346                 23.26

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:41 FILENAME: F:\FISSIO~1\U32A\04_08.FTA
04_08  U32A-09
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   6.8 -   0 :o
   7.5 -   0 :o
   8.3 -   0 : o
   9.2 -   0 :   o
  10.2 -   0 :       o
  11.3 -   7 :************o*
  12.4 -   0 :                     o
  13.7 -  20 :***************************o***************
  15.2 -  27 :*********************************o************************
  16.8 -  27 :*********************************o************************
  18.5 -  13 :***************************o**
  20.5 -   0 :                   o
  22.6 -   7 :***********o***
  25.0 -   0 :      o
  27.6 -   0 :   o
  30.5 -   0 : o
  33.7 -   0 :o
```

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==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:50 FILENAME: F:\FISSIO~1\U32A\04_10.FTA
04_10  U32A-11

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.723E+06
                                    RELATIVE ERROR (%):      1.27
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.19E+06 (   7)  5.27E+06 (  31)    9     56  20   43.3   15.8   98.1
   2   2.55E+05 (   3)  2.04E+06 (  24)   18     22   9   24.7    4.6   77.4
   3   3.06E+05 (   3)  3.87E+06 (  38)   15     41  13   15.6    2.9   46.9
   4   8.15E+05 (   8)  3.98E+06 (  39)   15     43  14   39.3   15.6   83.7
   5   1.91E+05 (   2)  3.54E+06 (  37)   16     38  12   11.0    1.2   39.5
   6   1.70E+05 (   1)  1.70E+06 (  10)    9     18  11   21.3    0.4  131.5
   7   2.87E+05 (   3)  4.20E+06 (  44)   16     45  14   13.5    2.6   40.1
   8   3.82E+05 (   4)  5.73E+06 (  60)   16     61  16   13.1    3.3   33.9
   9   3.82E+05 (   3)  1.91E+06 (  15)   12     20  10   39.3    7.0  132.3
  10   6.12E+05 (   4)  3.82E+06 (  25)   10     41  16   31.2    7.6   87.0
  11   3.67E+05 (   6)  2.57E+06 (  42)   25     27   8   27.6    9.4   63.5
  12   1.91E+05 (   2)  2.77E+06 (  29)   16     30  11   14.0    1.5   51.3
  13   4.59E+05 (   9)  3.26E+06 (  64)   30     35   9   26.9   11.6   53.5
  14   4.08E+05 (   4)  3.36E+06 (  33)   15     36  12   23.7    5.9   64.1
  15   1.02E+05 (   1)  3.36E+06 (  33)   15     36  12    6.5    0.1   34.1

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:50 FILENAME: F:\FISSIO~1\U32A\04_10.FTA
04_10  U32A-11
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 15  1.02E+05 (   1) 3.36E+06 (  33)   6.5   0.1  34.1 100.0    6.5   0.1  34.1
  5  1.91E+05 (   2) 3.54E+06 (  37)  11.0   1.2  39.5  63.9    8.5   1.6  24.6
  8  3.82E+05 (   4) 5.73E+06 (  60)  13.1   3.3  33.9  77.8   10.4   4.0  21.5
  7  2.87E+05 (   3) 4.20E+06 (  44)  13.5   2.6  40.1  90.0   11.0   5.1  20.4
 12  1.91E+05 (   2) 2.77E+06 (  29)  14.0   1.5  51.3  96.1   11.3   5.7  19.9
  3  3.06E+05 (   3) 3.87E+06 (  38)  15.6   2.9  46.9  97.8   11.9   6.5  19.8
  6  1.70E+05 (   1) 1.70E+06 (  10)  21.3   0.4 131.5  98.7   12.2   6.8  19.9
 14  4.08E+05 (   4) 3.36E+06 (  33)  23.7   5.9  64.1  95.4   13.4   8.0  20.9
  2  2.55E+05 (   3) 2.04E+06 (  24)  24.7   4.6  77.4  94.7   14.2   8.8  21.6
 13  4.59E+05 (   9) 3.26E+06 (  64)  26.9  11.6  53.5  84.7   16.3  10.9  23.3
 11  3.67E+05 (   6) 2.57E+06 (  42)  27.6   9.4  63.5  83.5   17.4  12.1  24.2
 10  6.12E+05 (   4) 3.82E+06 (  25)  31.2   7.6  87.0  83.4   18.1  12.8  24.8
  9  3.82E+05 (   3) 1.91E+06 (  15)  39.3   7.0 132.3  80.8   18.8  13.4  25.5
  4  8.15E+05 (   8) 3.98E+06 (  39)  39.3  15.6  83.7  66.5   20.5  15.3  27.3
  1  1.19E+06 (   7) 5.27E+06 (  31)  43.3  15.8  98.1  54.5   21.8  16.6  28.6
POOL 3.87E+05(   60) 3.38E+06(  524)                      54.5   21.8  16.6  28.6

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   36.1,   3.3

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   21.8,  18.9 --  25.0 (  -2.8   +3.2)
                 95% CONF. INTERVAL(Ma):         16.6 --  28.6 (  -5.2   +6.8)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.9118,   14
                     CHI^2 PROBABILITY:   54.5%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   21.6,  18.8 --  24.8 (  -2.8   +3.2)
```

```
                95% CONF. INTERVAL(Ma):          16.4 --  28.4 (  -5.2   +6.8)
                    AGE DISPERSION (%):    1.8

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   21.8,  18.9 --  25.0 (  -2.8   +3.2)
               95% CONF. INTERVAL (Ma):          16.6 --  28.6 (  -5.2   +6.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:49:50 FILENAME: F:\FISSIO~1\U32A\04_10.FTA
04_10  U32A-11
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     8.46 to    44.84 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       29.09            1.029                 14.86

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       13.74            0.663                  9.57
       28.38            1.028                 14.84
       41.06            0.793                 11.45
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:49:50 FILENAME: F:\FISSIO~1\U32A\04_10.FTA
04_10  U32A-11
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   5.1 -   0 :o
   5.6 -   0 :o
   6.2 -   0 :o
   6.8 -   0 : o
   7.5 -   0 :  o
   8.3 -   7 :***o**********
   9.2 -   0 :    o
  10.2 -   0 :     o
  11.3 -   0 :       o
  12.4 -   7 :********o******
  13.7 -   7 :*********o*****
  15.2 -   7 :**********o****
  16.8 -  13 :**********o******************
  18.5 -   0 :           o
  20.5 -   0 :           o
  22.6 -   0 :            o
  25.0 -   7 :**************o
  27.6 -  27 :**************o*******************************************
  30.5 -   0 :              o
  33.7 -   7 :**************o
  37.3 -   0 :             o
  41.2 -  13 :***********o******************
  45.5 -   7 :*********o*****
  50.3 -   0 :       o
  55.5 -   0 :    o
  61.3 -   0 :  o
  67.8 -   0 : o
  74.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:00 FILENAME: F:\FISSIO~1\U32A\04_12.FTA
04_12  U32A-13

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.678E+06
                                      RELATIVE ERROR (%):      1.23
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                               SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   4.78E+05 (   5)  1.91E+06 (  20)   16     21   9   47.6   13.7  127.0
   2   1.53E+06 (  15)  4.99E+06 (  49)   15     54  15   57.3   29.7  102.9
   3   1.73E+06 (  17)  5.61E+06 (  55)   15     61  16   57.8   31.3  100.2
   4   1.15E+06 (  15)  4.43E+06 (  58)   20     48  13   48.5   25.4   85.8
   5   5.73E+05 (   6)  1.82E+06 (  19)   16     20   9   59.8   19.2  151.8
   6   7.01E+05 (  11)  2.87E+06 (  45)   24     31   9   46.0   21.2   89.1
   7   1.36E+06 (  16)  4.67E+06 (  55)   18     51  14   54.5   29.0   95.5
   8   2.17E+06 (  17)  5.61E+06 (  44)   12     61  18   72.2   38.5  127.6
   9   8.01E+05 (  11)  3.35E+06 (  46)   21     36  11   45.0   20.8   87.0
  10   2.08E+06 (  19)  5.35E+06 (  49)   14     58  17   72.4   40.1  124.1
  11   1.40E+06 (  11)  5.86E+06 (  46)   12     63  19   45.0   20.8   87.0
  12   1.15E+06 (  12)  4.11E+06 (  43)   16     44  14   52.4   25.0   99.9
  13   7.65E+05 (   9)  3.82E+06 (  45)   18     41  12   37.8   16.0   76.9
  14   1.53E+06 (  10)  6.12E+06 (  40)   10     66  21   47.1   20.8   94.3
  15   1.10E+06 (  13)  4.25E+06 (  50)   18     46  13   48.8   24.1   90.1

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:00 FILENAME: F:\FISSIO~1\U32A\04_12.FTA
04_12  U32A-13
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 13  7.65E+05 (   9) 3.82E+06 (  45)  37.8  16.0  76.9 100.0   37.8  16.0  76.9
 11  1.40E+06 (  11) 5.86E+06 (  46)  45.0  20.8  87.0  71.8   41.2  23.9  66.8
  9  8.01E+05 (  11) 3.35E+06 (  46)  45.0  20.8  87.0  91.9   42.3  27.6  62.5
  6  7.01E+05 (  11) 2.87E+06 (  45)  46.0  21.2  89.1  97.7   43.1  29.9  60.3
 14  1.53E+06 (  10) 6.12E+06 (  40)  47.1  20.8  94.3  99.3   43.7  31.6  59.2
  1  4.78E+05 (   5) 1.91E+06 (  20)  47.6  13.7 127.0  99.8   44.1  32.9  59.1
  4  1.15E+06 (  15) 4.43E+06 (  58)  48.5  25.4  85.8  99.9   44.9  34.5  58.3
 15  1.10E+06 (  13) 4.25E+06 (  50)  48.8  24.1  90.1 100.0   45.4  35.6  57.8
 12  1.15E+06 (  12) 4.11E+06 (  43)  52.4  25.0  99.9 100.0   46.1  36.7  57.9
  7  1.36E+06 (  16) 4.67E+06 (  55)  54.5  29.0  95.5 100.0   47.1  38.0  58.2
  2  1.53E+06 (  15) 4.99E+06 (  49)  57.3  29.7 102.9 100.0   48.0  39.3  58.8
  3  1.73E+06 (  17) 5.61E+06 (  55)  57.8  31.3 100.2 100.0   49.0  40.5  59.3
  5  5.73E+05 (   6) 1.82E+06 (  19)  59.8  19.2 151.8 100.0   49.3  40.9  59.5
  8  2.17E+06 (  17) 5.61E+06 (  44)  72.2  38.5 127.6  99.7   50.9  42.6  60.9
 10  2.08E+06 (  19) 5.35E+06 (  49)  72.4  40.1 124.1  98.9   52.5  44.2  62.3
POOL 1.17E+06(  187) 4.14E+06(  664)                     98.9   52.5  44.2  62.3

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   44.9,   3.7

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   52.5,  48.1 --  57.3 (  -4.4   +4.8)
                95% CONF. INTERVAL(Ma):         44.2 --  62.3 (  -8.3   +9.8)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.3413,   14
                     CHI^2 PROBABILITY:   98.9%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   52.4,  48.0 --  57.2 (  -4.4   +4.8)
                95% CONF. INTERVAL(Ma):         44.1 --  62.2 (  -8.3   +9.8)
```

```
                  AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   52.5,  48.1 --  57.3 (  -4.4   +4.8)
               95% CONF. INTERVAL (Ma):         44.2 --  62.3 (  -8.3   +9.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:00 FILENAME: F:\FISSIO~1\U32A\04_12.FTA
04_12  U32A-13
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    38.86 to    73.13 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       52.14            2.306                 19.32

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       51.29            2.301                 19.28

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:00 FILENAME: F:\FISSIO~1\U32A\04_12.FTA
04_12  U32A-13
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  22.6 -   0 :o
  25.0 -   0 :o
  27.6 -   0 :o
  30.5 -   0 :  o
  33.7 -   0 :      o
  37.3 -   7 :***********o**
  41.2 -   0 :                     o
  45.5 -  20 :****************************o***************
  50.3 -  27 :********************************o************************
  55.5 -  20 :********************************o************
  61.3 -  13 :**************************o**
  67.8 -   0 :                    o
  74.8 -  13 :**************o***************
  82.7 -   0 :        o
  91.3 -   0 :   o
 100.8 -   0 : o
 111.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:08 FILENAME: F:\FISSIO~1\U32A\04_13.FTA
04_13  U32A-14

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.655E+06
                                      RELATIVE ERROR (%):      1.21
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                               SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   9.17E+05 (   6)  3.52E+06 (  23)   10     38  16   49.2   16.1  121.2
   2   1.33E+06 (  13)  3.98E+06 (  39)   15     43  14   62.1   30.2  117.3
   3   8.41E+05 (  11)  2.75E+06 (  36)   20     30  10   57.0   26.0  112.9
   4   7.01E+05 (  11)  3.19E+06 (  50)   24     35  10   41.2   19.1   79.0
   5   7.14E+05 (  14)  1.89E+06 (  37)   30     21   7   70.3   34.9  131.7
   6   5.46E+05 (  15)  2.15E+06 (  59)   42     23   6   47.4   24.8   83.7
   7   8.49E+05 (  10)  2.55E+06 (  30)   18     28  10   62.2   26.9  128.8
   8   7.14E+05 (  14)  2.50E+06 (  49)   30     27   8   53.2   27.0   96.9
   9   1.02E+06 (   8)  4.33E+06 (  34)   12     47  16   44.2   17.4   95.4
  10   7.14E+05 (   7)  3.06E+06 (  30)   15     33  12   43.9   16.0   99.9
  11   9.34E+05 (  11)  3.40E+06 (  40)   18     37  12   51.4   23.6  100.6
  12   8.60E+05 (   9)  3.06E+06 (  32)   16     33  12   52.6   21.9  111.0
  13   8.41E+05 (  11)  3.36E+06 (  44)   20     37  11   46.7   21.6   90.7
  14   6.69E+05 (   7)  3.15E+06 (  33)   16     34  12   40.0   14.7   89.9
  15   4.59E+05 (   6)  2.68E+06 (  35)   20     29  10   32.4   10.9   76.0

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:08 FILENAME: F:\FISSIO~1\U32A\04_13.FTA
04_13  U32A-14
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 15  4.59E+05 (   6) 2.68E+06 (  35)  32.4  10.9  76.0 100.0   32.4  10.9  76.0
 14  6.69E+05 (   7) 3.15E+06 (  33)  40.0  14.7  89.9  72.5   35.7  17.9  64.5
  4  7.01E+05 (  11) 3.19E+06 (  50)  41.2  19.1  79.0  89.8   37.8  23.2  58.7
 10  7.14E+05 (   7) 3.06E+06 (  30)  43.9  16.0  99.9  96.1   38.9  25.4  57.3
  9  1.02E+06 (   8) 4.33E+06 (  34)  44.2  17.4  95.4  98.6   39.8  27.3  56.2
 13  8.41E+05 (  11) 3.36E+06 (  44)  46.7  21.6  90.7  99.1   41.0  29.5  55.8
  6  5.46E+05 (  15) 2.15E+06 (  59)  47.4  24.8  83.7  99.5   42.4  32.3  55.8
  1  9.17E+05 (   6) 3.52E+06 (  23)  49.2  16.1 121.2  99.8   42.9  33.0  55.7
 11  9.34E+05 (  11) 3.40E+06 (  40)  51.4  23.6 100.6  99.8   43.8  34.2  56.0
 12  8.60E+05 (   9) 3.06E+06 (  32)  52.6  21.9 111.0  99.9   44.5  35.2  56.2
  8  7.14E+05 (  14) 2.50E+06 (  49)  53.2  27.0  96.9  99.9   45.4  36.4  56.6
  3  8.41E+05 (  11) 2.75E+06 (  36)  57.0  26.0 112.9  99.9   46.3  37.5  57.1
  2  1.33E+06 (  13) 3.98E+06 (  39)  62.1  30.2 117.3  99.8   47.4  38.8  58.0
  7  8.49E+05 (  10) 2.55E+06 (  30)  62.2  26.9 128.8  99.8   48.2  39.7  58.6
  5  7.14E+05 (  14) 1.89E+06 (  37)  70.3  34.9 131.7  99.4   49.6  41.2  59.8
POOL 7.65E+05(  153) 2.85E+06(  571)                     99.4   49.6  41.2  59.8

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   31.1,   2.7

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   49.6,  45.1 --  54.6 (  -4.5   +5.0)
                95% CONF. INTERVAL(Ma):         41.2 --  59.8 (  -8.4  +10.2)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.3046,   14
                     CHI^2 PROBABILITY:   99.4%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   49.5,  45.0 --  54.5 (  -4.5   +4.9)
                95% CONF. INTERVAL(Ma):         41.1 --  59.7 (  -8.4  +10.2)
```

```
                  AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   49.6,  45.1 --  54.6 (  -4.5   +5.0)
               95% CONF. INTERVAL (Ma):         41.2 --  59.8 (  -8.4  +10.2)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:08 FILENAME: F:\FISSIO~1\U32A\04_13.FTA
04_13  U32A-14
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    33.88 to    71.34 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       51.34            2.146                 19.28

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       50.76            2.144                 19.26

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:08 FILENAME: F:\FISSIO~1\U32A\04_13.FTA
04_13  U32A-14
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  20.5 -   0 :o
  22.6 -   0 :o
  25.0 -   0 : o
  27.6 -   0 :    o
  30.5 -   0 :       o
  33.7 -   7 :************o******
  37.3 -   0 :                     o
  41.2 -  13 :*****************************o*********
  45.5 -  20 :*************************************o********************
  50.3 -  20 :*******************************************o****************
  55.5 -  20 :*******************************************o******************
  61.3 -  13 :**********************************o*****
  67.8 -   0 :                           o
  74.8 -   7 :***************o***
  82.7 -   0 :        o
  91.3 -   0 :   o
 100.8 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:32 FILENAME: F:\FISSIO~1\U32A\04_14.FTA
04_14  U32A-24

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.428E+06
                                    RELATIVE ERROR (%):      1.20
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   4.97E+05 (  13)  3.36E+06 (  88)   40     39   8   25.9   13.1   46.1
   2   3.82E+05 (  12)  2.20E+06 (  69)   48     26   6   30.5   14.9   56.1
   3   5.35E+05 (   7)  4.13E+06 (  54)   20     48  13   23.0    8.7   49.6
   4   4.46E+05 (  14)  2.87E+06 (  90)   48     33   7   27.3   14.2   47.7
   5   2.55E+05 (   5)  2.60E+06 (  51)   30     30   8   17.5    5.3   42.4
   6   3.82E+05 (  20)  2.85E+06 ( 149)   80     33   5   23.5   13.8   37.3
   7   3.28E+05 (  15)  2.38E+06 ( 109)   70     28   5   24.1   12.9   41.2
   8   4.46E+05 (  14)  3.50E+06 ( 110)   48     41   8   22.3   11.7   38.7
   9   2.29E+05 (   6)  2.10E+06 (  55)   40     24   7   19.4    6.7   43.9
  10   3.82E+05 (  10)  3.59E+06 (  94)   40     42   9   18.8    8.6   35.5
  11   7.65E+05 (  20)  5.39E+06 ( 141)   40     63  11   24.8   14.6   39.5
  12   7.65E+05 (  24)  3.41E+06 ( 107)   48     40   8   39.1   23.9   61.0
  13   5.73E+05 (   9)  3.44E+06 (  54)   24     40  11   29.4   12.6   59.0
  14   3.44E+05 (  18)  2.69E+06 ( 141)   80     31   5   22.4   12.8   36.3
  15   5.10E+05 (  12)  3.44E+06 (  81)   36     40   9   26.0   12.8   47.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:32 FILENAME: F:\FISSIO~1\U32A\04_14.FTA
04_14  U32A-24
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  5  2.55E+05 (   5) 2.60E+06 (  51)  17.5   5.3  42.4 100.0   17.5   5.3  42.4
 10  3.82E+05 (  10) 3.59E+06 (  94)  18.8   8.6  35.5  88.7   18.2   9.8  30.6
  9  2.29E+05 (   6) 2.10E+06 (  55)  19.4   6.7  43.9  98.5   18.4  11.0  28.7
  8  4.46E+05 (  14) 3.50E+06 ( 110)  22.3  11.7  38.7  95.9   19.7  13.4  27.9
 14  3.44E+05 (  18) 2.69E+06 ( 141)  22.4  12.8  36.3  97.7   20.6  15.4  27.5
  3  5.35E+05 (   7) 4.13E+06 (  54)  23.0   8.7  49.6  99.2   20.8  15.8  27.3
  6  3.82E+05 (  20) 2.85E+06 ( 149)  23.5  13.8  37.3  99.5   21.4  16.8  27.1
  7  3.28E+05 (  15) 2.38E+06 ( 109)  24.1  12.9  41.2  99.7   21.7  17.4  27.1
 11  7.65E+05 (  20) 5.39E+06 ( 141)  24.8  14.6  39.5  99.8   22.2  18.1  27.1
  1  4.97E+05 (  13) 3.36E+06 (  88)  25.9  13.1  46.1  99.8   22.5  18.6  27.3
 15  5.10E+05 (  12) 3.44E+06 (  81)  26.0  12.8  47.4  99.9   22.7  18.9  27.3
  4  4.46E+05 (  14) 2.87E+06 (  90)  27.3  14.2  47.7  99.9   23.1  19.3  27.5
 13  5.73E+05 (   9) 3.44E+06 (  54)  29.4  12.6  59.0  99.9   23.3  19.6  27.7
  2  3.82E+05 (  12) 2.20E+06 (  69)  30.5  14.9  56.1  99.9   23.7  20.0  28.0
 12  7.65E+05 (  24) 3.41E+06 ( 107)  39.1  23.9  61.0  93.0   24.9  21.2  29.1
POOL 4.40E+05(  199) 3.08E+06( 1393)                     93.0   24.9  21.2  29.1

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   35.7,   2.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   24.9,  22.9 --  27.0 (  -1.9   +2.1)
                95% CONF. INTERVAL(Ma):         21.2 --  29.1 (  -3.6   +4.3)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.5077,   14
                     CHI^2 PROBABILITY:   93.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   24.8,  22.9 --  26.9 (  -1.9   +2.1)
                95% CONF. INTERVAL(Ma):         21.2 --  29.1 (  -3.6   +4.3)
```

```
                    AGE DISPERSION (%):    0.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   24.9,  22.9 --  27.0 (  -1.9   +2.1)
               95% CONF. INTERVAL (Ma):         21.2 --  29.1 (  -3.6   +4.3)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:32 FILENAME: F:\FISSIO~1\U32A\04_14.FTA
04_14  U32A-24
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    18.56 to    39.54 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.60            2.512                 19.78

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.45            2.511                 19.77
       40.32            0.525                  4.14

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:32 FILENAME: F:\FISSIO~1\U32A\04_14.FTA
04_14  U32A-24
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  11.3 -   0 :o
  12.4 -   0 :o
  13.7 -   0 :  o
  15.2 -   0 :    o
  16.8 -   0 :        o
  18.5 -  13 :***************o**************
  20.5 -   7 :***************         o
  22.6 -  13 :******************************    o
  25.0 -  27 :************************************o**********************
  27.6 -  20 :******************************o*************
  30.5 -  13 :**********************o*******
  33.7 -   0 :              o
  37.3 -   0 :          o
  41.2 -   7 :******o********
  45.5 -   0 :   o
  50.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:39 FILENAME: F:\FISSIO~1\U32A\04_15.FTA
04_15  U32A-25

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.405E+06
                                    RELATIVE ERROR (%):      1.22
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   2.39E+04 (   1)  6.21E+05 (  26)   64      7   3    7.6    0.2   40.4
   2   0.00E+00 (   0)  6.45E+05 (  27)   64      8   3    4.5    0.2   25.3
   3   2.73E+04 (   1)  6.55E+05 (  24)   56      8   3    8.2    0.2   44.0
   4   6.37E+04 (   2)  2.07E+06 (  65)   48     24   6    5.7    0.6   20.0
   5   0.00E+00 (   0)  6.88E+05 (  18)   40      8   4    6.8    0.2   39.2
   6   2.73E+04 (   1)  4.91E+05 (  18)   56      6   3   10.9    0.2   60.6
   7   2.39E+04 (   1)  4.78E+05 (  20)   64      6   2    9.8    0.2   53.8
   8   0.00E+00 (   0)  4.01E+05 (  21)   80      5   2    5.8    0.2   33.1
   9   1.91E+04 (   1)  6.88E+05 (  36)   80      8   3    5.5    0.1   28.5
  10   0.00E+00 (   0)  4.78E+05 (  20)   64      6   2    6.1    0.2   34.9
  11   5.46E+04 (   2)  1.31E+06 (  48)   56     15   4    7.7    0.8   27.4
  12   0.00E+00 (   0)  4.78E+05 (  10)   32      6   3   12.4    0.4   76.7
  13   3.82E+04 (   1)  1.34E+06 (  35)   40     16   5    5.6    0.1   29.3
  14   0.00E+00 (   0)  4.78E+05 (  25)   80      6   2    4.9    0.2   27.4
  15   0.00E+00 (   0)  5.10E+05 (  16)   48      6   3    7.6    0.3   44.7

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:39 FILENAME: F:\FISSIO~1\U32A\04_15.FTA
04_15  U32A-25
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  2  0.00E+00 (   0) 6.45E+05 (  27)   4.5   0.2  25.3 100.0    4.5   0.2  25.3
 14  0.00E+00 (   0) 4.78E+05 (  25)   4.9   0.2  27.4 100.0    2.3   0.1  12.7
  9  1.91E+04 (   1) 6.88E+05 (  36)   5.5   0.1  28.5  49.1    2.2   0.0  11.2
 13  3.82E+04 (   1) 1.34E+06 (  35)   5.6   0.1  29.3  69.4    3.0   0.3  10.4
  4  6.37E+04 (   2) 2.07E+06 (  65)   5.7   0.6  20.0  82.2    3.8   1.0   9.6
  8  0.00E+00 (   0) 4.01E+05 (  21)   5.8   0.2  33.1  83.0    3.4   0.9   8.6
 10  0.00E+00 (   0) 4.78E+05 (  20)   6.1   0.2  34.9  84.3    3.1   0.8   7.8
  5  0.00E+00 (   0) 6.88E+05 (  18)   6.8   0.2  39.2  86.2    2.9   0.8   7.3
  1  2.39E+04 (   1) 6.21E+05 (  26)   7.6   0.2  40.4  90.0    3.3   1.0   7.5
 15  0.00E+00 (   0) 5.10E+05 (  16)   7.6   0.3  44.7  91.3    3.1   1.0   7.1
 11  5.46E+04 (   2) 1.31E+06 (  48)   7.7   0.8  27.4  92.4    3.7   1.4   7.5
  3  2.73E+04 (   1) 6.55E+05 (  24)   8.2   0.2  44.0  94.8    3.9   1.6   7.6
  7  2.39E+04 (   1) 4.78E+05 (  20)   9.8   0.2  53.8  96.0    4.2   1.9   7.8
  6  2.73E+04 (   1) 4.91E+05 (  18)  10.9   0.2  60.6  96.7    4.4   2.1   8.1
 12  0.00E+00 (   0) 4.78E+05 (  10)  12.4   0.4  76.7  97.3    4.3   2.0   7.9
POOL 1.75E+04(   10) 7.17E+05(  409)                     97.3    4.3   2.0   7.9

MEAN URANIUM CONCENTRATION +/-2SE (ppm):    8.4,   0.9

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):    4.3,   2.9 --   6.1 (  -1.4   +1.8)
                95% CONF. INTERVAL(Ma):           2.0 --   7.9 (  -2.3   +3.6)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.4082,   14
                     CHI^2 PROBABILITY:   97.3%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):    4.2,   3.1 --   5.8 (  -1.2   +1.6)
```

```
                95% CONF. INTERVAL(Ma):          2.3 --   7.9 (  -2.0   +3.7)
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    4.3,   2.9 --   6.1 (  -1.4   +1.8)
               95% CONF. INTERVAL (Ma):          2.0 --   7.9 (  -2.3   +3.6)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/12:50:39 FILENAME: F:\FISSIO~1\U32A\04_15.FTA
04_15  U32A-25
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     3.14 to    14.00 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        8.10           0.830                 23.69

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        1.65           0.172                  4.91
        8.23           0.830                 23.68
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:39 FILENAME: F:\FISSIO~1\U32A\04_15.FTA
04_15  U32A-25
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         2.22      4.44      6.67      8.89      11.11     13.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   1.9 -   0 :     o
   2.1 -   0 :      o
   2.3 -   0 :       o
   2.5 -   0 :       o
   2.8 -   0 :        o
   3.1 -   7 :**********o******************
   3.4 -   7 :**********o******************
   3.7 -   0 :            o
   4.1 -  13 :**************o*****************************************
   4.6 -   7 :****************o*************
   5.1 -   7 :******************o***********
   5.6 -   0 :                    o
   6.2 -   0 :                      o
   6.8 -  13 :**********************o************************************
   7.5 -   7 :************************o*****
   8.3 -   7 :************************o*****
   9.2 -   7 :************************o******
  10.2 -  13 :**********************o************************************
  11.3 -   0 :                     o
  12.4 -   7 :******************o***********
  13.7 -   7 :****************o*************
  15.2 -   0 :              o
  16.8 -   0 :            o
  18.5 -   0 :          o
  20.5 -   0 :        o
  22.6 -   0 :      o
  25.0 -   0 :    o
  27.6 -   0 :   o
  30.5 -   0 :  o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:50 FILENAME: F:\FISSIO~1\U32A\04_16.FTA
04_16  U32A-26

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.382E+06
                                    RELATIVE ERROR (%):      1.24
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                              SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   2.39E+04 (   1)  5.02E+05 (  21)   64      6   3    9.3    0.2   50.7
   2   0.00E+00 (   0)  5.42E+05 (  17)   48      6   3    7.1    0.3   41.5
   3   2.55E+04 (   1)  6.12E+05 (  24)   60      7   3    8.1    0.2   43.7
   4   1.91E+04 (   1)  6.12E+05 (  32)   80      7   3    6.1    0.1   32.1
   5   0.00E+00 (   0)  4.20E+05 (  11)   40      5   3   11.2    0.4   68.1
   6   0.00E+00 (   0)  3.34E+05 (  14)   64      4   2    8.7    0.3   51.6
   7   0.00E+00 (   0)  6.69E+05 (  35)   80      8   3    3.4    0.1   19.1
   8   2.39E+04 (   1)  5.26E+05 (  22)   64      6   3    8.9    0.2   48.1
   9   0.00E+00 (   0)  8.66E+05 (  17)   30     10   5    7.1    0.3   41.5
  10   2.39E+04 (   1)  5.02E+05 (  21)   64      6   3    9.3    0.2   50.7
  11   0.00E+00 (   0)  4.30E+05 (  18)   64      5   2    6.7    0.2   38.9
  12   0.00E+00 (   0)  4.78E+05 (  20)   64      6   2    6.1    0.2   34.7
  13   0.00E+00 (   0)  4.59E+05 (   9)   30      5   4   13.7    0.5   86.4
  14   2.39E+04 (   1)  6.21E+05 (  26)   64      7   3    7.5    0.2   40.1
  15   3.19E+04 (   1)  3.50E+05 (  11)   48      4   2   17.6    0.4  106.5

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:50 FILENAME: F:\FISSIO~1\U32A\04_16.FTA
04_16  U32A-26
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  7  0.00E+00 (   0) 6.69E+05 (  35)   3.4   0.1  19.1 100.0    3.4   0.1  19.1
 12  0.00E+00 (   0) 4.78E+05 (  20)   6.1   0.2  34.7 100.0    2.2   0.1  11.9
  4  1.91E+04 (   1) 6.12E+05 (  32)   6.1   0.1  32.1  43.0    2.3   0.0  11.3
 11  0.00E+00 (   0) 4.30E+05 (  18)   6.7   0.2  38.9  52.5    1.9   0.0   9.3
  2  0.00E+00 (   0) 5.42E+05 (  17)   7.1   0.3  41.5  60.1    1.6   0.0   8.0
  9  0.00E+00 (   0) 8.66E+05 (  17)   7.1   0.3  41.5  65.9    1.4   0.0   7.0
 14  2.39E+04 (   1) 6.21E+05 (  26)   7.5   0.2  40.1  72.2    2.2   0.2   7.6
  3  2.55E+04 (   1) 6.12E+05 (  24)   8.1   0.2  43.7  78.8    2.9   0.6   8.1
  6  0.00E+00 (   0) 3.34E+05 (  14)   8.7   0.3  51.6  81.6    2.7   0.5   7.5
  8  2.39E+04 (   1) 5.26E+05 (  22)   8.9   0.2  48.1  85.8    3.2   0.8   7.9
  1  2.39E+04 (   1) 5.02E+05 (  21)   9.3   0.2  50.7  89.4    3.6   1.1   8.3
 10  2.39E+04 (   1) 5.02E+05 (  21)   9.3   0.2  50.7  92.6    4.0   1.4   8.5
  5  0.00E+00 (   0) 4.20E+05 (  11)  11.2   0.4  68.1  93.7    3.8   1.3   8.2
 13  0.00E+00 (   0) 4.59E+05 (   9)  13.7   0.5  86.4  94.9    3.7   1.3   7.9
 15  3.19E+04 (   1) 3.50E+05 (  11)  17.6   0.4 106.5  92.1    4.1   1.6   8.4
POOL 1.24E+04(    7) 5.27E+05(  298)                     92.1    4.1   1.6   8.4

MEAN URANIUM CONCENTRATION +/-2SE (ppm):    6.2,   0.7

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):    4.1,   2.5 --   6.2 (  -1.6   +2.1)
                95% CONF. INTERVAL(Ma):           1.6 --   8.4 (  -2.5   +4.3)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.5237,   14
                     CHI^2 PROBABILITY:   92.1%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):    4.0,   2.7 --   5.9 (  -1.3   +1.9)
```

```
                95% CONF. INTERVAL(Ma):          1.9 --   8.5 (  -2.1   +4.5)
                    AGE DISPERSION (%):    0.2

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):    4.1,   2.5 --   6.2 (  -1.6   +2.1)
               95% CONF. INTERVAL (Ma):          1.6 --   8.4 (  -2.5   +4.3)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:50 FILENAME: F:\FISSIO~1\U32A\04_16.FTA
04_16  U32A-26
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     2.42 to    22.35 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        9.71            0.741                 22.24

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        2.01            0.211                  6.32
       10.33            0.738                 22.14
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/12:50:50 FILENAME: F:\FISSIO~1\U32A\04_16.FTA
04_16  U32A-26
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         2.22      4.44      6.67      8.89      11.11     13.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   1.5 -   0 :   o
   1.7 -   0 :    o
   1.9 -   0 :     o
   2.1 -   0 :     o
   2.3 -   0 :      o
   2.5 -   7 :*******o**********************
   2.8 -   0 :        o
   3.1 -   0 :         o
   3.4 -   0 :          o
   3.7 -   0 :           o
   4.1 -   7 :************o****************
   4.6 -   7 :************o****************
   5.1 -  13 :**************o*********************************************
   5.6 -   0 :                o
   6.2 -   7 :*****************o************
   6.8 -   0 :                  o
   7.5 -  13 :*******************o*************************************
   8.3 -   0 :                    o
   9.2 -   7 :*********************o********
  10.2 -  13 :*********************o*************************************
  11.3 -   7 :*********************o********
  12.4 -  13 :*********************o*************************************
  13.7 -   0 :                   o
  15.2 -   0 :                  o
  16.8 -   0 :               o
  18.5 -   0 :             o
  20.5 -   0 :            o
  22.6 -   7 :*********o*******************
  25.0 -   0 :       o
  27.6 -   0 :      o
  30.5 -   0 :    o
  33.7 -   0 :   o
  37.3 -   0 :  o
  41.2 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-21-2004/14:47:20 FILENAME: E:\FISSIO~1\MONTARIO\03_101.FTA
03_101  U31A-12

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.682E+06
                                      RELATIVE ERROR (%):      1.46
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    103.13     3.39
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.91E+05 (   5)  4.97E+05 (  13)   40      5   3   74.0   20.3  214.8
   2   1.06E+05 (   5)  2.76E+05 (  13)   72      3   2   74.0   20.3  214.8
   3   1.25E+05 (   5)  4.26E+05 (  17)   61      5   2   56.9   16.1  155.9
   4   1.91E+05 (   2)  7.65E+05 (   8)   16      8   6   50.0    4.9  233.7
   5   8.49E+04 (   2)  3.40E+05 (   8)   36      4   3   50.0    4.9  233.7
   6   9.56E+04 (   2)  4.30E+05 (   9)   32      5   3   44.5    4.4  200.8
   7   3.40E+05 (   4)  1.27E+06 (  15)   18     14   7   51.9   12.2  157.1
   8   2.68E+05 (   7)  8.41E+05 (  22)   40      9   4   61.1   21.8  144.9
   9   1.67E+05 (   7)  8.36E+05 (  35)   64      9   3   38.6   14.2   86.2
  10   2.55E+05 (   5)  1.07E+06 (  21)   30     12   5   46.1   13.3  122.1
  11   6.12E+04 (   1)  4.28E+05 (   7)   25      5   3   30.3    0.6  207.8
  12   1.15E+05 (   3)  9.94E+05 (  26)   40     11   4   22.9    4.2   71.1
  13   8.74E+04 (   4)  3.71E+05 (  17)   70      4   2   45.9   10.9  135.6
  14   1.53E+05 (   4)  8.41E+05 (  22)   40      9   4   35.6    8.6  100.9
  15   3.06E+05 (   4)  1.61E+06 (  21)   20     17   8   37.2    9.0  106.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-21-2004/14:47:20 FILENAME: E:\FISSIO~1\MONTARIO\03_101.FTA
03_101  U31A-12
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 12  1.15E+05 (   3) 9.94E+05 (  26)  22.9   4.2  71.1 100.0   22.9   4.2  71.1
 11  6.12E+04 (   1) 4.28E+05 (   7)  30.3   0.6 207.8  86.2   23.8   5.9  64.4
 14  1.53E+05 (   4) 8.41E+05 (  22)  35.6   8.6 100.9  85.5   28.0  11.3  58.1
 15  3.06E+05 (   4) 1.61E+06 (  21)  37.2   9.0 106.4  92.7   30.3  14.8  55.3
  9  1.67E+05 (   7) 8.36E+05 (  35)  38.6  14.2  86.2  95.8   32.7  18.8  53.0
  6  9.56E+04 (   2) 4.30E+05 (   9)  44.5   4.4 200.8  98.1   33.4  19.8  53.0
 13  8.74E+04 (   4) 3.71E+05 (  17)  45.9  10.9 135.6  98.7   34.7  21.6  53.2
 10  2.55E+05 (   5) 1.07E+06 (  21)  46.1  13.3 122.1  99.2   36.1  23.5  53.4
  5  8.49E+04 (   2) 3.40E+05 (   8)  50.0   4.9 233.7  99.6   36.7  24.2  53.5
  4  1.91E+05 (   2) 7.65E+05 (   8)  50.0   4.9 233.7  99.8   37.1  24.8  53.7
  7  3.40E+05 (   4) 1.27E+06 (  15)  51.9  12.2 157.1  99.9   38.2  26.1  54.2
  3  1.25E+05 (   5) 4.26E+05 (  17)  56.9  16.1 155.9  99.8   39.6  27.7  55.1
  8  2.68E+05 (   7) 8.41E+05 (  22)  61.1  21.8 144.9  99.7   41.6  29.9  56.6
  2  1.06E+05 (   5) 2.76E+05 (  13)  74.0  20.3 214.8  99.3   43.3  31.6  58.1
  1  1.91E+05 (   5) 4.97E+05 (  13)  74.0  20.3 214.8  99.0   45.0  33.7  60.0
POOL 1.52E+05(   60) 6.43E+05(  254)                     99.0   45.0  33.7  60.0

MEAN URANIUM CONCENTRATION +/-2SE (ppm):    7.0,   0.9

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   45.0,  38.8 --  52.1 (  -6.1   +7.1)
                 95% CONF. INTERVAL(Ma):         33.7 --  60.0 ( -11.3  +15.0)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.3352,   14
                      CHI^2 PROBABILITY:   99.0%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   44.7,  38.6 --  51.8 (  -6.1   +7.1)
                 95% CONF. INTERVAL(Ma):         33.5 --  59.7 ( -11.2  +15.0)
```

```
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   45.0,  38.8 --  52.1 (  -6.1   +7.1)
                95% CONF. INTERVAL (Ma):         33.7 --  60.0 ( -11.3  +15.0)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-21-2004/14:47:20 FILENAME: E:\FISSIO~1\MONTARIO\03_101.FTA
03_101  U31A-12
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    25.03 to    76.89 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       51.03            1.339                 19.55

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       48.53            1.332                 19.44
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-21-2004/14:47:20 FILENAME: E:\FISSIO~1\MONTARIO\03_101.FTA
03_101  U31A-12
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  15.2 -   0 :o
  16.8 -   0 : o
  18.5 -   0 :  o
  20.5 -   0 :   o
  22.6 -   0 :    o
  25.0 -   7 :*******o***********
  27.6 -   0 :         o
  30.5 -   0 :             o
  33.7 -   0 :                o
  37.3 -  13 :*******************o*******************
  41.2 -  13 :***********************o***************
  45.5 -   0 :                          o
  50.3 -  20 :*************************o*********************************
  55.5 -  20 :*************************o*********************************
  61.3 -  13 :************************o**************
  67.8 -   0 :                       o
  74.8 -  13 :******************o*********************
  82.7 -   0 :              o
  91.3 -   0 :          o
 100.8 -   0 :      o
 111.3 -   0 :    o
 122.9 -   0 :  o
 135.7 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:14 FILENAME: E:\FISSIO~1\MONTARIO\03_102.FTA
03_102  U31A-11

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.700E+06
                                      RELATIVE ERROR (%):      1.48
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    103.13     3.39
                               SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   0.00E+00 (   0)  7.65E+05 (   8)   16      8   6   17.2    0.6  110.9
   2   1.27E+05 (   1)  1.15E+06 (   9)   12     12   8   23.8    0.5  151.3
   3   2.97E+05 (   7)  3.02E+06 (  71)   36     32   8   19.2    7.3   40.7
   4   1.53E+05 (   2)  1.45E+06 (  19)   20     16   7   21.4    2.3   82.8
   5   0.00E+00 (   0)  1.83E+06 (  43)   36     20   6    3.1    0.1   17.1
   6   6.80E+05 (   4)  8.15E+06 (  48)    9     88  25   16.5    4.2   43.3
   7   2.55E+05 (   3)  2.04E+06 (  24)   18     22   9   24.9    4.6   78.1
   8   1.43E+05 (   3)  1.48E+06 (  31)   32     16   6   19.3    3.6   59.0
   9   2.04E+05 (   2)  2.34E+06 (  23)   15     25  10   17.7    1.9   66.8
  10   1.70E+05 (   2)  1.53E+06 (  18)   18     16   8   22.6    2.4   88.0
  11   4.78E+04 (   1)  1.29E+06 (  27)   32     14   5    8.0    0.2   42.8
  12   1.27E+05 (   2)  3.70E+06 (  58)   24     40  10    7.1    0.8   24.8
  13   6.37E+04 (   1)  1.15E+06 (  18)   24     12   6   12.0    0.3   66.8
  14   5.10E+04 (   1)  9.17E+05 (  18)   30     10   5   12.0    0.3   66.8
  15   0.00E+00 (   0)  1.38E+06 (  19)   21     15   7    7.1    0.3   40.8

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:14 FILENAME: E:\FISSIO~1\MONTARIO\03_102.FTA
03_102  U31A-11
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
  5  0.00E+00 (   0) 1.83E+06 (  43)   3.1   0.1  17.1 100.0    3.1   0.1  17.1
 12  1.27E+05 (   2) 3.70E+06 (  58)   7.1   0.8  24.8  22.7    4.1   0.5  14.0
 15  0.00E+00 (   0) 1.38E+06 (  19)   7.1   0.3  40.8  35.0    3.4   0.4  11.7
 11  4.78E+04 (   1) 1.29E+06 (  27)   8.0   0.2  42.8  53.9    4.1   0.8  11.6
 13  6.37E+04 (   1) 1.15E+06 (  18)  12.0   0.3  66.8  62.5    4.8   1.2  12.1
 14  5.10E+04 (   1) 9.17E+05 (  18)  12.0   0.3  66.8  71.8    5.4   1.7  12.4
  6  6.80E+05 (   4) 8.15E+06 (  48)  16.5   4.2  43.3  55.3    7.6   3.4  14.4
  1  0.00E+00 (   0) 7.65E+05 (   8)  17.2   0.6 110.9  61.2    7.3   3.2  13.9
  9  2.04E+05 (   2) 2.34E+06 (  23)  17.7   1.9  66.8  64.7    8.1   3.9  14.6
  3  2.97E+05 (   7) 3.02E+06 (  71)  19.2   7.3  40.7  55.2   10.4   6.0  16.6
  8  1.43E+05 (   3) 1.48E+06 (  31)  19.3   3.6  59.0  60.9   11.1   6.7  17.1
  4  1.53E+05 (   2) 1.45E+06 (  19)  21.4   2.3  82.8  66.5   11.5   7.2  17.4
 10  1.70E+05 (   2) 1.53E+06 (  18)  22.6   2.4  88.0  71.2   12.0   7.6  17.8
  2  1.27E+05 (   1) 1.15E+06 (   9)  23.8   0.5 151.3  76.8   12.2   7.8  18.0
  7  2.55E+05 (   3) 2.04E+06 (  24)  24.9   4.6  78.1  77.6   12.8   8.4  18.6
POOL 1.29E+05(   29) 1.93E+06(  434)                     77.6   12.8   8.4  18.6

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   20.8,   2.1

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   12.8,  10.3 --  15.7 (  -2.5   +2.9)
                95% CONF. INTERVAL(Ma):           8.4 --  18.6 (  -4.4   +5.8)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.7003,   14
                     CHI^2 PROBABILITY:   77.6%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   12.7,  10.5 --  15.5 (  -2.3   +2.7)
```

```
                95% CONF. INTERVAL(Ma):          8.7 --  18.7 (  -4.0   +5.9)
                    AGE DISPERSION (%):    0.8

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   12.8,  10.3 --  15.7 (  -2.5   +2.9)
               95% CONF. INTERVAL (Ma):          8.4 --  18.6 (  -4.4   +5.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:14 FILENAME: E:\FISSIO~1\MONTARIO\03_102.FTA
03_102  U31A-11
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     2.19 to    30.05 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       20.26            1.045                 23.34

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        1.80            0.075                  1.66
        7.22            0.319                  7.13
       20.22            1.045                 23.34
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-10-2004/16:48:14 FILENAME: E:\FISSIO~1\MONTARIO\03_102.FTA
03_102  U31A-11
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   1.4 -   0 :o
   1.5 -   0 :o
   1.7 -   0 :o
   1.9 -   0 : o
   2.1 -   0 : o
   2.3 -   7 :*o******************
   2.5 -   0 : o
   2.8 -   0 : o
   3.1 -   0 : o
   3.4 -   0 : o
   3.7 -   0 :  o
   4.1 -   0 :  o
   4.6 -   0 :  o
   5.1 -   7 :***o****************
   5.6 -   0 :    o
   6.2 -   0 :    o
   6.8 -   0 :     o
   7.5 -   0 :      o
   8.3 -   7 :******o*************
   9.2 -   0 :       o
  10.2 -   7 :********o***********
  11.3 -   7 :*********o**********
  12.4 -   0 :           o
  13.7 -   0 :             o
  15.2 -  13 :***************o************************
  16.8 -   0 :                   o
  18.5 -   7 :******************o
  20.5 -  20 :********************o****************************************
  22.6 -   0 :                    o
  25.0 -  13 :*****************o**********************
  27.6 -   7 :***************o****
  30.5 -   7 :************o*******
  33.7 -   0 :         o
  37.3 -   0 :       o
  41.2 -   0 :     o
  45.5 -   0 :   o
  50.3 -   0 :  o
  55.5 -   0 : o
  61.3 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:36 FILENAME: E:\FISSIO~1\MONTARIO\03_103.FTA
03_103  U31A-10

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.718E+06
                                    RELATIVE ERROR (%):      1.50
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    103.13     3.39
                           SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   0.00E+00 (   0)  1.22E+06 (   8)   10     13   9   17.3    0.6  111.4
   2   9.56E+04 (   1)  9.56E+05 (  10)   16     10   6   21.6    0.4  133.4
   3   2.55E+05 (   1)  1.78E+06 (   7)    6     19  14   30.6    0.6  209.8
   4   0.00E+00 (   0)  7.65E+05 (   6)   12      8   6   23.4    0.8  160.9
   5   1.02E+05 (   1)  8.15E+05 (   8)   15      9   6   26.9    0.5  176.4
   6   2.55E+05 (   2)  4.08E+06 (  32)   12     44  15   12.8    1.4   46.8
   7   2.04E+05 (   2)  1.94E+06 (  19)   15     21   9   21.5    2.3   83.2
   8   0.00E+00 (   0)  7.65E+05 (  10)   20      8   5   13.7    0.5   85.0
   9   1.46E+05 (   2)  1.31E+06 (  18)   21     14   7   22.7    2.4   88.4
  10   1.22E+05 (   2)  9.17E+05 (  15)   25     10   5   27.2    2.8  109.1
  11   0.00E+00 (   0)  1.10E+06 (  26)   36     12   5    5.2    0.2   29.2
  12   3.82E+05 (   4)  1.91E+06 (  20)   16     20   9   39.4    9.5  113.5
  13   2.51E+04 (   1)  6.27E+05 (  25)   61      7   3    8.7    0.2   46.7
  14   1.02E+05 (   2)  2.85E+06 (  56)   30     31   8    7.4    0.8   25.9
  15   1.53E+05 (   4)  1.91E+06 (  50)   40     20   6   15.9    4.0   41.7

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:36 FILENAME: E:\FISSIO~1\MONTARIO\03_103.FTA
03_103  U31A-10
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 11  0.00E+00 (   0) 1.10E+06 (  26)   5.2   0.2  29.2 100.0    5.2   0.2  29.2
 14  1.02E+05 (   2) 2.85E+06 (  56)   7.4   0.8  25.9  33.8    5.0   0.6  17.4
 13  2.51E+04 (   1) 6.27E+05 (  25)   8.7   0.2  46.7  61.7    5.7   1.1  16.1
  6  2.55E+05 (   2) 4.08E+06 (  32)  12.8   1.4  46.8  67.4    7.1   2.2  16.5
  8  0.00E+00 (   0) 7.65E+05 (  10)  13.7   0.5  85.0  73.6    6.6   2.1  15.3
 15  1.53E+05 (   4) 1.91E+06 (  50)  15.9   4.0  41.7  67.1    8.8   3.9  16.8
  1  0.00E+00 (   0) 1.22E+06 (   8)  17.3   0.6 111.4  72.2    8.5   3.8  16.1
  7  2.04E+05 (   2) 1.94E+06 (  19)  21.5   2.3  83.2  71.5    9.5   4.6  17.0
  2  9.56E+04 (   1) 9.56E+05 (  10)  21.6   0.4 133.4  77.6    9.9   5.0  17.3
  9  1.46E+05 (   2) 1.31E+06 (  18)  22.7   2.4  88.4  79.0   10.7   5.7  18.1
  4  0.00E+00 (   0) 7.65E+05 (   6)  23.4   0.8 160.9  82.1   10.4   5.6  17.6
  5  1.02E+05 (   1) 8.15E+05 (   8)  26.9   0.5 176.4  84.9   10.8   5.9  18.0
 10  1.22E+05 (   2) 9.17E+05 (  15)  27.2   2.8 109.1  84.3   11.6   6.6  18.8
  3  2.55E+05 (   1) 1.78E+06 (   7)  30.6   0.6 209.8  86.4   12.0   6.9  19.1
 12  3.82E+05 (   4) 1.91E+06 (  20)  39.4   9.5 113.5  68.3   13.7   8.4  21.0
POOL 1.00E+05(   22) 1.41E+06(  310)                     68.3   13.7   8.4  21.0

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   15.2,   1.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   13.7,  10.6 --  17.3 (  -3.1   +3.6)
                95% CONF. INTERVAL(Ma):           8.4 --  21.0 (  -5.3   +7.3)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.7885,   14
                     CHI^2 PROBABILITY:   68.3%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   13.6,  10.9 --  17.0 (  -2.7   +3.4)
```

```
                95% CONF. INTERVAL(Ma):           8.8 --  21.1 (  -4.8   +7.5)
                    AGE DISPERSION (%):    0.6

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   13.7,  10.6 --  17.3 (  -3.1   +3.6)
                95% CONF. INTERVAL (Ma):           8.4 --  21.0 (  -5.3   +7.3)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:36 FILENAME: E:\FISSIO~1\MONTARIO\03_103.FTA
03_103  U31A-10
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     3.62 to    41.95 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       21.42            0.737                 17.97

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        7.49            0.340                  8.30
       17.90            0.717                 17.48
       37.65            0.608                 14.83
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-10-2004/16:48:36 FILENAME: E:\FISSIO~1\MONTARIO\03_103.FTA
03_103  U31A-10
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         2.22      4.44      6.67      8.89      11.11     13.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   2.3 -   0 : o
   2.5 -   0 : o
   2.8 -   0 :  o
   3.1 -   0 :  o
   3.4 -   0 :  o
   3.7 -   7 :***o*************************
   4.1 -   0 :   o
   4.6 -   0 :    o
   5.1 -   0 :     o
   5.6 -   0 :      o
   6.2 -   0 :       o
   6.8 -   0 :        o
   7.5 -   0 :         o
   8.3 -   7 :**********o******************
   9.2 -   7 :************o****************
  10.2 -   0 :              o
  11.3 -  13 :**************o*********************************************
  12.4 -   0 :                 o
  13.7 -   0 :                  o
  15.2 -  13 :******************o*****************************************
  16.8 -   7 :********************o*********
  18.5 -   0 :                      o
  20.5 -   0 :                      o
  22.6 -   0 :                      o
  25.0 -  13 :**********************o*****************************************
  27.6 -   7 :********************o*********
  30.5 -   7 :********************o*********
  33.7 -   7 :********************o**********
  37.3 -   7 :******************o************
  41.2 -   7 :****************o*************
  45.5 -   0 :             o
  50.3 -   0 :            o
  55.5 -   0 :        o
  61.3 -   0 :      o
  67.8 -   0 :    o
  74.8 -   0 :   o
  82.7 -   0 :  o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:48 FILENAME: E:\FISSIO~1\MONTARIO\03_104.FTA
03_104  U31A-9

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.736E+06
                                    RELATIVE ERROR (%):      1.53
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    103.13     3.39
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   1.91E+05 (   2)  1.62E+06 (  17)   16     17   8   24.2    2.5   94.8
   2   9.56E+04 (   1)  2.20E+06 (  23)   16     23  10    9.5    0.2   51.4
   3   6.12E+04 (   1)  7.95E+05 (  13)   25      8   5   16.8    0.3   98.0
   4   2.55E+05 (   2)  1.78E+06 (  14)   12     19  10   29.3    3.0  118.8
   5   1.91E+05 (   1)  9.56E+05 (   5)    8     10   9   42.7    0.8  335.6
   6   3.82E+05 (   2)  2.87E+06 (  15)    8     31  16   27.3    2.8  109.6
   7   3.40E+05 (   2)  2.55E+06 (  15)    9     27  14   27.3    2.8  109.6
   8   3.82E+06 (  10)  1.22E+07 (  32)    4    130  46   60.6   26.3  124.4
   9   3.06E+05 (   2)  2.29E+06 (  15)   10     24  12   27.3    2.8  109.6
  10   3.28E+05 (   6)  8.74E+05 (  16)   28      9   5   73.0   23.1  191.6
  11   0.00E+00 (   0)  1.78E+06 (   7)    6     19  14   20.0    0.7  132.4
  12   8.60E+05 (   9)  5.16E+06 (  54)   16     55  15   32.5   13.9   65.3
  13   3.64E+05 (  10)  1.97E+06 (  54)   42     21   6   36.1   16.2   70.4
  14   0.00E+00 (   0)  2.48E+06 (  39)   24     26   8    3.5    0.1   19.1
  15   1.70E+05 (   1)  1.70E+06 (  10)    9     18  11   21.7    0.4  134.1

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:48 FILENAME: E:\FISSIO~1\MONTARIO\03_104.FTA
03_104  U31A-9
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 14  0.00E+00 (   0) 2.48E+06 (  39)   3.5   0.1  19.1 100.0    3.5   0.1  19.1
  2  9.56E+04 (   1) 2.20E+06 (  23)   9.5   0.2  51.4  19.9    3.6   0.1  18.0
  3  6.12E+04 (   1) 7.95E+05 (  13)  16.8   0.3  98.0  29.9    5.5   0.6  19.2
 11  0.00E+00 (   0) 1.78E+06 (   7)  20.0   0.7 132.4  42.1    5.1   0.6  17.5
 15  1.70E+05 (   1) 1.70E+06 (  10)  21.7   0.4 134.1  46.7    6.6   1.3  18.9
  1  1.91E+05 (   2) 1.62E+06 (  17)  24.2   2.5  94.8  45.9    9.1   2.8  21.2
  7  3.40E+05 (   2) 2.55E+06 (  15)  27.3   2.8 109.6  48.7   11.1   4.3  23.1
  6  3.82E+05 (   2) 2.87E+06 (  15)  27.3   2.8 109.6  55.0   12.7   5.6  24.4
  9  3.06E+05 (   2) 2.29E+06 (  15)  27.3   2.8 109.6  62.3   13.9   6.7  25.3
  4  2.55E+05 (   2) 1.78E+06 (  14)  29.3   3.0 118.8  68.4   15.1   7.8  26.2
 12  8.60E+05 (   9) 5.16E+06 (  54)  32.5  13.9  65.3  61.0   19.2  11.7  29.6
 13  3.64E+05 (  10) 1.97E+06 (  54)  36.1  16.2  70.4  56.7   22.4  14.9  32.2
  5  1.91E+05 (   1) 9.56E+05 (   5)  42.7   0.8 335.6  63.8   22.7  15.2  32.5
  8  3.82E+06 (  10) 1.22E+07 (  32)  60.6  26.3 124.4  32.0   26.5  18.7  36.4
 10  3.28E+05 (   6) 8.74E+05 (  16)  73.0  23.1 191.6  19.9   28.7  20.7  38.8
POOL 3.22E+05(   49) 2.16E+06(  329)                     19.9   28.7  20.7  38.8

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   23.0,   2.6

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   28.7,  24.3 --  33.7 (  -4.4   +5.0)
                95% CONF. INTERVAL(Ma):         20.7 --  38.8 (  -8.0  +10.1)
      REDUCED CHI^2, DEGREES OF FREEDOM:    1.2983,   14
                     CHI^2 PROBABILITY:   19.9%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   27.7,  22.8 --  33.7 (  -4.9   +6.0)
```

```
                95% CONF. INTERVAL(Ma):          18.8 --  40.7 (  -8.8  +13.0)
                    AGE DISPERSION (%):   39.5

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   28.7,  24.3 --  33.7 (  -4.4   +5.0)
               95% CONF. INTERVAL (Ma):          20.7 --  38.8 (  -8.0  +10.1)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:48:48 FILENAME: E:\FISSIO~1\MONTARIO\03_104.FTA
03_104  U31A-9
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =     2.44 to    75.45 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       33.90            1.053                 21.67

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
        1.96            0.050                  1.03
       34.50            1.051                 21.63
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-10-2004/16:48:48 FILENAME: E:\FISSIO~1\MONTARIO\03_104.FTA
03_104  U31A-9
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         3.33      6.67      10        13.33     16.67     20
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   1.5 -   0 :o
   1.7 -   0 :o
   1.9 -   0 :o
   2.1 -   0 :o
   2.3 -   0 :o
   2.5 -   7 :o******************
   2.8 -   0 :o
   3.1 -   0 :o
   3.4 -   0 :o
   3.7 -   0 :o
   4.1 -   0 :o
   4.6 -   0 :o
   5.1 -   0 : o
   5.6 -   0 : o
   6.2 -   0 : o
   6.8 -   0 : o
   7.5 -   0 : o
   8.3 -   0 :  o
   9.2 -   0 :  o
  10.2 -   0 :   o
  11.3 -   0 :   o
  12.4 -  13 :****o***********************************
  13.7 -   0 :     o
  15.2 -   0 :      o
  16.8 -   0 :       o
  18.5 -   0 :         o
  20.5 -   7 :**********o*********
  22.6 -   0 :            o
  25.0 -   0 :              o
  27.6 -  13 :*****************o**********************
  30.5 -  20 :*******************o****************************************
  33.7 -  13 :********************o******************
  37.3 -   7 :*******************o
  41.2 -   0 :                  o
  45.5 -   0 :               o
  50.3 -   7 :************o*******
  55.5 -   0 :           o
  61.3 -   7 :**********o*********
  67.8 -   0 :         o
  74.8 -   7 :*******o************
  82.7 -   0 :     o
  91.3 -   0 :   o
 100.8 -   0 :  o
 111.3 -   0 : o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/13:33:48 FILENAME: F:\FISSIO~1\U32A\03_105.FTA
03_105  U32A-35

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.133E+06
                                      RELATIVE ERROR (%):      1.57
                EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                  ZETA FACTOR AND STANDARD ERROR (yr cm^2):    101.52     2.70
                               SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                            Age     --95% CI--
   1   9.56E+05 (   5)  3.25E+06 (  17)    8     41  20    47.7   13.5  130.8
   2   1.02E+06 (   4)  7.14E+06 (  28)    6     91  34    23.5    5.8   64.7
   3   9.56E+05 (   5)  5.93E+06 (  31)    8     75  27    26.3    7.8   66.3
   4   7.65E+05 (   5)  7.19E+06 (  47)   10     91  27    17.4    5.2   42.3
   5   4.59E+05 (   3)  4.59E+06 (  30)   10     58  21    16.6    3.1   51.0
   6   1.15E+06 (   9)  7.65E+06 (  60)   12     97  25    24.2   10.4   48.2
   7   5.46E+05 (   5)  6.12E+06 (  56)   14     78  21    14.6    4.4   35.1
   8   8.92E+05 (   7)  7.39E+06 (  58)   12     94  25    19.6    7.4   42.0
   9   3.82E+05 (   4)  2.87E+06 (  30)   16     36  13    21.9    5.4   59.9
  10   6.69E+05 (   7)  4.97E+06 (  52)   16     63  18    21.8    8.2   47.2
  11   3.82E+05 (   4)  2.20E+06 (  23)   16     28  12    28.5    6.9   80.5
  12   4.08E+05 (   4)  5.71E+06 (  56)   15     73  19    11.8    3.0   30.7
  13   6.12E+05 (   4)  3.21E+06 (  21)   10     41  18    31.2    7.6   89.2
  14   1.53E+06 (  12)  9.56E+06 (  75)   12    121  28    25.7   12.6   47.0
  15   3.82E+05 (   3)  2.68E+06 (  21)   12     34  15    23.7    4.3   75.7

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/13:33:48 FILENAME: F:\FISSIO~1\U32A\03_105.FTA
03_105  U32A-35
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 12  4.08E+05 (   4) 5.71E+06 (  56)  11.8   3.0  30.7 100.0   11.8   3.0  30.7
  7  5.46E+05 (   5) 6.12E+06 (  56)  14.6   4.4  35.1  74.8   13.0   5.7  25.1
  5  4.59E+05 (   3) 4.59E+06 (  30)  16.6   3.1  51.0  90.6   13.6   6.8  24.2
  4  7.65E+05 (   5) 7.19E+06 (  47)  17.4   5.2  42.3  94.9   14.4   8.1  23.5
  8  8.92E+05 (   7) 7.39E+06 (  58)  19.6   7.4  42.0  94.8   15.5   9.7  23.5
 10  6.69E+05 (   7) 4.97E+06 (  52)  21.8   8.2  47.2  94.5   16.5  11.0  23.9
  9  3.82E+05 (   4) 2.87E+06 (  30)  21.9   5.4  59.9  96.7   17.0  11.6  24.0
  2  1.02E+06 (   4) 7.14E+06 (  28)  23.5   5.8  64.7  97.8   17.4  12.1  24.2
 15  3.82E+05 (   3) 2.68E+06 (  21)  23.7   4.3  75.7  98.7   17.7  12.5  24.3
  6  1.15E+06 (   9) 7.65E+06 (  60)  24.2  10.4  48.2  98.6   18.5  13.5  24.8
 14  1.53E+06 (  12) 9.56E+06 (  75)  25.7  12.6  47.0  98.0   19.6  15.0  25.7
  3  9.56E+05 (   5) 5.93E+06 (  31)  26.3   7.8  66.3  98.6   20.0  15.4  25.9
 11  3.82E+05 (   4) 2.20E+06 (  23)  28.5   6.9  80.5  98.9   20.3  15.8  26.1
 13  6.12E+05 (   4) 3.21E+06 (  21)  31.2   7.6  89.2  99.0   20.6  16.1  26.4
  1  9.56E+05 (   5) 3.25E+06 (  17)  47.7  13.5 130.8  94.9   21.4  16.8  27.1
POOL 7.00E+05(   81) 5.23E+06(  605)                     94.9   21.4  16.8  27.1

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   66.4,   5.8

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   21.4,  18.9 --  24.1 (  -2.5   +2.8)
                95% CONF. INTERVAL(Ma):         16.8 --  27.1 (  -4.5   +5.8)
      REDUCED CHI^2, DEGREES OF FREEDOM:    0.4721,   14
                     CHI^2 PROBABILITY:   94.9%
 >>> Beware: possible upward bias in Chi^2 probability due to low counts <<<

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   21.3,  18.8 --  24.0 (  -2.4   +2.8)
```

```
                95% CONF. INTERVAL(Ma):          16.7 --  27.0 (  -4.5   +5.7)
                    AGE DISPERSION (%):    0.1

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   21.4,  18.9 --  24.1 (  -2.5   +2.8)
               95% CONF. INTERVAL (Ma):          16.8 --  27.1 (  -4.5   +5.8)
       NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-24-2005/13:33:48 FILENAME: F:\FISSIO~1\U32A\03_105.FTA
03_105  U32A-35
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    12.65 to    49.79 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.20            1.582                 18.62

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       24.94            1.573                 18.52
       61.65            0.140                  1.65
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-24-2005/13:33:48 FILENAME: F:\FISSIO~1\U32A\03_105.FTA
03_105  U32A-35
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         4.44      8.89      13.33     17.78     22.22     26.6
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
   7.5 -   0 :o
   8.3 -   0 :o
   9.2 -   0 : o
  10.2 -   0 :  o
  11.3 -   0 :   o
  12.4 -   7 :*****o*********
  13.7 -   0 :        o
  15.2 -   7 :**********o****
  16.8 -   0 :             o
  18.5 -  13 :*****************o************
  20.5 -   7 :***************     o
  22.6 -  13 :**********************o*******
  25.0 -  27 :**********************o************************************
  27.6 -   7 :***************      o
  30.5 -   7 :***************  o
  33.7 -   7 :************o**
  37.3 -   0 :         o
  41.2 -   0 :      o
  45.5 -   0 :    o
  50.3 -   7 :***o**********
  55.5 -   0 :  o
  61.3 -   0 : o
  67.8 -   0 :o
```

```
==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:49:01 FILENAME: E:\FISSIO~1\MONTARIO\03_106.FTA
03_106  U31A-7

>>NEW PARAMETERS--ZETA METHOD<<
EFFECTIVE TRACK DENSITY FOR FLUENCE MONITOR (tracks/cm^2):      3.772E+06
                                    RELATIVE ERROR (%):      1.58
               EFFECTIVE URANIUM CONTENT OF MONITOR (ppm):     39.81
                 ZETA FACTOR AND STANDARD ERROR (yr cm^2):    103.13     3.39
                            SIZE OF COUNTER SQUARE (cm^2):      6.540E-07
------ GRAIN AGES IN ORIGINAL ORDER ------
Grain    RhoS    (Ns)     RhoI    (Ni)  Squares  U+/-2s     Grain  Age (Ma)
 no.    (cm^-2)          (cm^-2)                           Age     --95% CI--
   1   7.95E+05 (  13)  3.55E+06 (  58)   25     37  10   43.9   21.9   80.1
   2   7.14E+05 (  14)  2.91E+06 (  57)   30     31   8   48.0   24.5   86.4
   3   1.30E+06 (  17)  5.66E+06 (  74)   20     60  14   44.9   24.7   76.1
   4   1.15E+06 (  15)  4.66E+06 (  61)   20     49  13   48.1   25.2   84.7
   5   1.04E+06 (  17)  4.28E+06 (  70)   25     45  11   47.4   26.0   80.7
   6   6.55E+05 (  12)  3.28E+06 (  60)   28     35   9   39.2   19.0   72.7
   7   6.12E+05 (   6)  2.75E+06 (  27)   15     29  11   44.0   14.6  106.1
   8   1.10E+06 (  13)  5.18E+06 (  61)   18     55  14   41.7   20.8   75.9
   9   6.37E+05 (   5)  3.31E+06 (  26)   12     35  14   38.3   11.2   98.3
  10   6.12E+05 (   6)  2.75E+06 (  27)   15     29  11   44.0   14.6  106.1
  11   7.14E+05 (   7)  3.57E+06 (  35)   15     38  13   39.5   14.6   88.4
  12   1.02E+06 (  10)  5.50E+06 (  54)   15     58  16   36.4   16.3   71.1
  13   1.08E+06 (  17)  5.16E+06 (  81)   24     54  12   41.0   22.6   69.2
  14   1.34E+06 (  14)  4.68E+06 (  49)   16     49  14   55.8   28.3  101.6
  15   1.66E+06 (  13)  5.99E+06 (  47)   12     63  18   54.1   26.6  100.4

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)===================
DATE/TIME: 02-10-2004/16:49:01 FILENAME: E:\FISSIO~1\MONTARIO\03_106.FTA
03_106  U31A-7
Number of grains =  15
------ GRAIN AGES ORDERED WITH INCREASING AGE ------
Grain  RhoS    (Ns)    RhoI    (Ni)    Grain age (Ma)  P(X2)     Sum age (Ma)
 no.  (cm^-2)         (cm^-2)         Age   --95% CI--  (%)    Age   --95% CI--
 12  1.02E+06 (  10) 5.50E+06 (  54)  36.4  16.3  71.1 100.0   36.4  16.3  71.1
  9  6.37E+05 (   5) 3.31E+06 (  26)  38.3  11.2  98.3  95.0   36.7  19.5  63.6
  6  6.55E+05 (  12) 3.28E+06 (  60)  39.2  19.0  72.7  98.7   37.6  23.8  56.8
 11  7.14E+05 (   7) 3.57E+06 (  35)  39.5  14.6  88.4  99.8   37.8  25.3  54.7
 13  1.08E+06 (  17) 5.16E+06 (  81)  41.0  22.6  69.2  99.9   38.7  28.0  52.4
  8  1.10E+06 (  13) 5.18E+06 (  61)  41.7  20.8  75.9 100.0   39.4  29.9  51.9
  1  7.95E+05 (  13) 3.55E+06 (  58)  43.9  21.9  80.1 100.0   40.0  31.0  51.6
  7  6.12E+05 (   6) 2.75E+06 (  27)  44.0  14.6 106.1 100.0   40.2  31.5  51.4
 10  6.12E+05 (   6) 2.75E+06 (  27)  44.0  14.6 106.1 100.0   40.4  31.8  51.3
  3  1.30E+06 (  17) 5.66E+06 (  74)  44.9  24.7  76.1 100.0   41.0  32.9  51.1
  5  1.04E+06 (  17) 4.28E+06 (  70)  47.4  26.0  80.7 100.0   41.7  34.0  51.3
  2  7.14E+05 (  14) 2.91E+06 (  57)  48.0  24.5  86.4 100.0   42.3  34.7  51.5
  4  1.15E+06 (  15) 4.66E+06 (  61)  48.1  25.2  84.7 100.0   42.8  35.4  51.6
 15  1.66E+06 (  13) 5.99E+06 (  47)  54.1  26.6 100.4 100.0   43.4  36.2  52.1
 14  1.34E+06 (  14) 4.68E+06 (  49)  55.8  28.3 101.6 100.0   44.2  37.0  52.7
POOL 9.44E+05(  179) 4.15E+06(  787)                   100.0   44.2  37.0  52.7

MEAN URANIUM CONCENTRATION +/-2SE (ppm):   43.8,   3.4

 POOLED AGE WITH 68% CONF. INTERVAL(Ma):   44.2,  40.4 --  48.3 (  -3.8   +4.2)
                95% CONF. INTERVAL(Ma):         37.0 --  52.7 (  -7.2   +8.5)
     REDUCED CHI^2, DEGREES OF FREEDOM:    0.1459,   14
                     CHI^2 PROBABILITY:  100.0%

CENTRAL AGE WITH 68% CONF. INTERVAL(Ma):   44.1,  40.3 --  48.2 (  -3.8   +4.2)
                95% CONF. INTERVAL(Ma):         36.9 --  52.6 (  -7.1   +8.5)
```

```
                    AGE DISPERSION (%):    0.0

 CHI^2 AGE WITH 68% CONF. INTERVAL (Ma):   44.2,  40.4 --  48.3 (  -3.8   +4.2)
               95% CONF. INTERVAL (Ma):         37.0 --  52.7 (  -7.2   +8.5)
        NUMBER AND PERCENTAGE OF GRAINS:   15,   100%

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-10-2004/16:49:01 FILENAME: E:\FISSIO~1\MONTARIO\03_106.FTA
03_106  U31A-7
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15
PEAKS IN PROBABILITY DISTRIBUTION
The modes in the distribution are found by inspecting the derivatives
of the probability density as a function of Z.
Probability distribution uses grain-only standard errors.
Total probability mass integrates to N (= number of grains).
Probability density is given as grains per delta Z=0.1.
At 50 Ma, delta Z=0.1 is equivalent to a time interval of 5 m.y.

Total range for grain ages =    37.36 to    56.73 Ma

First Search: peaks with zero first derivatives.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       45.54            2.654                 22.50

Second search: find minima in the second derivative of the Gaussian
probability density function.

       AGE     PROBABILTY DENSITY AT PEAK    EST. N
       (Ma)         (grains/DZ=0.1)         (grains)
       45.45            2.654                 22.50

==================ZetaAge Program v. 4.8 (Brandon 8/13/02)==================
DATE/TIME: 02-10-2004/16:49:01 FILENAME: E:\FISSIO~1\MONTARIO\03_106.FTA
03_106  U31A-7
Kernel factor =  .6  (Ratio of kernel window size to standard error)
Number of grains =  15    Barwidth (Z units) =  .1
Histogram shown by asterisks and probability distribution by circles.

               PROBABILITY DENSITY (PERCENT PER DELTA Z=0.1)
           0         5.56      11.11     16.67     22.22     27.78     33.3
  AGE   COUNT|.........|.........|.........|.........|.........|.........|
  22.6 -   0 :o
  25.0 -   0 :o
  27.6 -   0 :  o
  30.5 -   0 :      o
  33.7 -   0 :            o
  37.3 -   7 :************        o
  41.2 -  33 :***************************o*****************************
  45.5 -  27 :******************************o***************
  50.3 -  20 :***************************o*******
  55.5 -  13 :********************o***
  61.3 -   0 :            o
  67.8 -   0 :     o
  74.8 -   0 :  o
  82.7 -   0 :o
```