T 16

PROPAGATING RIFT EXPLANATION FOR THE TECTONIC EVOLUTION OF THE JUAN DE FUCA REGION

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We have reinterpreted the magnetic anomalies in the Juan de Fuca region originally discovered during the Pioneer survey and identified by Fred Vine. Our anomaly identifications are mostly identical to his except that where he interpreted doubled anomalies on profiles to result from faulting, we interpret them to result from ridge jumps and to mark fossil spreading centers. In addition we have used an updated version of the reversal time scale, and for these two reasons our new isochron map differs slightly from Vine's. A simple propagating rift model can produce this isochron pattern with its distinctive V pattern of magnetic anomaly offsets, and we hope to have a movie showing the detailed plate tectonic evolution of this area completed by the time of the meeting.

T 17

SUBMARINE LANDSLIDING AT THE EASTERN END OF THE TAMAYO TRANSFORM FAULT, GULF OF CALIFORNIA

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The eastern end of the Tamayo Transform fault is defined on conventional bathymetry by an up to 600 m high, south-facing slope, inclined overall at 30° down into the intersection depression with the East Pacific Rise spreading ridge axis, here defined by a rift valley. A program of submersible dives using DSRV ALVIN investigated this slope in the course of a study of the transform-spreading axis intersection zone. Extensive evidence of active downslope mass-wasting was encountered during three dives located up to 7 km from the ridge axis-transform intersection. Scalloped heads to rotational failure surfaces are prominent features, nucleated on steep faults of the principal transform displacement zone. Most of these faults have vertical offsets of 5 m or less, almost exclusively with downthrow toward the south. Poorly to moderately consolidated sediments dipping downslope are exposed by these faults. Mass-wasting from the fault scarps has produced deposits containing blocks of consolidated sediment and some basalt in a fine sediment matrix. Downslope creep of unconsolidated sediment, often from burrow sources, produces a prominent streaking on steep slopes. The presently unfaulted upper portions of the slope 5-8 km west of the ridge axis expose numerous scattered loose blocks (typically 10-50 cm), most consisting of consolidated sediments, but a minority of basalt. These blocks may have been produced in mass wasting events near the ridge intersection and been carried laterally along the transform away from their source. If true, this requires the PTDZ to migrate parallel with and toward the spreading ridge axis. Alternatively, fault scarp sources for the blocks above their present position have recently been tectonically and erosionally degraded so they are not now exposed.

T 18

SEISMICITY AND TECTONICS NEAR THE UNSTABLE COCOS, NORTH AMERICAN, CARIBBEAN TRIPLE JUNCTION

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Geological observations and recent seismicity suggest that crustal movements in South West Mexico are consistent with a slow clockwise rotation of a small triangular fragment of the North American plate at its South West corner. The boundaries of this triangular region are given by a proposed left lateral strike slip fault paralleling the strike of the Tehuantepec Ridge, a zone of compressional tectonics east of Tuxtla Guttierez, and the extension of the Polochic-Motagua fault zones. It is suggested that deformations in this region are a result of the interaction between the Cocos and North American plates along the portion of the North American Cocos boundary created by the migration of the North American, Cocos, Caribbean triple junction. Anomalously high seismicity occurs at the intersection of the Middle American trench and the extension of the Motagua fault. Bursts of seismicity which are precursory to major earthquakes occur in this region.

T 19

TECTONIC AND VOLCANIC ELEMENTS AT EASTERN GALAPAGOS RIFT - 85°20'W TRANSFORM

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The eastern end of the Galapagos Rift and its termination with the 85°20'W transform fault was investigated in January 1980 by ALVIN and remote camera tows. The dominant structural and volcanic features recognized by submersible and remote photographic and visual observations include: (1) eruptive fissures (2) recent extensional fissures (3) ponded lava fields (4) small volcanic cones and (5) normal faults. The recently active fissures are concentrated in the central rift in the study area between 86°W and the rift's termination with the transform at 85°20' W. On the western end of the study area, along a volcanic high in the middle of the active spreading center a single extension fissure was traced for 2 km which varied in width from 2 meters to several cm. In some cases, individual pillows were split in half. Near the eastern end of the transect, the rift bisected a 20 meter high volcanic cone. Between this area and the eastern termination of the rift a variety of extensional fabrics were mapped, including en echelon eruptive fissures and anastomatosing fissures. Several localized areas of collasped ponded lavas were observed. In the western area these lava fields are young, with pervasive glassy surfaces. In the eastern area they are covered with thin sediment through which the collaspe cracks penetrate. The transition between the E-W spreading and the N-S transform faulting occurs over less than 0.5 km. The transform is marked by a series of dip-slip normal faults through massive extrusive basaltic terrain. These faults are downthrown to the west and have 60-90° faces. The talus at the base of these faults is often separated from the wall by a deep cleft, indicating contemporary motion. We intend to document these observations with still photos, slides, and video.

T 20

TECTONICS OF THE GUATEMALA BASIN

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Detailed geophysical surveys were carried out in the eastern Guatemala Basin aboard R/V Endeavor in February 1980 and aboard R/V Robert D. Conrad in April 1979. These surveys have been combined with existing data and used as a guide in interpreting the tectonics of the Guatemala Basin. The tectonic fabric of the basin is more complicated than had been previously believed. Basement ridges and scarps trending WNW-ESE form a significant part of the morphology. Previously only ENE-WSW trending scarps and ridges along fracture zones had been identified. Several "fracture zone" scarps identified from tracks of opportunity are in fact associated with ridges trending perpendicular to the fracture zones. The fracture zone scarps can usually be identified by magnetic anomalies of several hundred gammas which are due to edge effects of adjacent crustal blocks of differing polarity. The WNW ridges have only samll magnetic anomalies associated with them. The WNW ridges are associated with gently sloping fault block covered by thick sediments (400m). The morphology of the blocks and scarps are similar to that seen elsewhere on the East-Pacific Rise-Galapagos Spreading Center system but the size of the scarps is somewhat larger here. Seismic profiler and 3.5 kHz echosounder records provide clear evidence for local decreases in sedimentation rate along the base of the fracture zone scarps. Evidence for erosion and for mass motion of sediments was also occasionally observed.

T 21

PLATE TECTONICS IN THE PAN-AFRICAN: THE DAMARA MOBILE BELT, NAMIBIA.

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(Sponsor: I.H. Campbell)

Pan-African mobile belts have been until recently considered as ensalic. The 600 km long NE trending Damara Mobile Belt stretches across central Namibia. Three features of this belt are incompatible with an ensalic model:
a) An asymmetric deformation pattern, outlined by 5 linear structural zones characterized by; extensive thrusting; an intense shallowly dipping schistosity; vertical schistosity; diapir structures and granitic intrusions; waning deformation; from north to south respectively.
b) The metamorphic pattern is also asymmetric. In the 2 southern zones the geothermal gradient is 20 C°/km, while in the diapir and vertical schistosity zones gradients of 45 C°/km are inferred.
c) Evolution of Damara igneous rocks: The earliest (900 my) igneous rocks are alkali; the mid-Damara amphibolites resemble ocean floor basalt. During early deformation (700 my) alpine ultramafics were emplaced into the low grade metamorphic zone while in the high grade belt a calc-alkali suite was emplaced.

A model compatible with the above is; initial rifting and alkali volcanism; development of ocean crust forming ocean floor basalt; initiation of subduction; ocean closure and continental collision resulting in the asymmetric structural and metamorphic zones and emplacement of alpine ultramafics; partial melting of the lower continental crust and the subduction zone forming a calc-alkali suite.

T 22

TECTONIC INTERPRETATION OF FISSION TRACK AGES FROM THE LESSER HIMALAYAS, NORTHERN PAKISTAN

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Fission track ages of sphene, zircon, and apatite from rocks collected along the Swat Valley date the recent uplift history of this region. A major E-W fault (MMT or Patan Fault) crosses the Swat Valley and separates regions of markedly differing uplift history. Ages ranging from 50 to 55 m.y. for sphene, 35 to 55 m.y. for zircon, and 14 m.y. for apatite were obtained from the region north of this fault. To the south the ages are about 22 m.y. for sphene, 21 m.y. for zircon, and 17 m.y. for apatite. This distribution of ages indicates that differential uplift occurred across the MMT prior to 15 m.y. The region north of the MMT experienced an average uplift rate of 11 cm/1000 years from 55 to 15 m.y. The region lying south of the fault was uplifted at an average rate of 75 cm/1000 years from about 21 to 17 m.y. During the past 15 m.y. both sides of the MMT have been uplifted together at an average rate of 18 cm/1000 years, indicating that the MMT has been locked during this interval. The above uplift rates have been calculated using estimated annealing temperatures for the minerals dated and an estimated geothermal gradient of 25°C/km. The choice of these parameters, however, is not crucial in defining relative uplift rates (from sample-to-sample).

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Cover. A topographic map of Venus. The Pioneer Venus radar altimeter has obtained data for more than 80% of the Venusian surface, and these data have been used to generate maps from which the geomorphology and geologic history of the planet can be inferred. The map shown was generated from data taken at l/2-km intervals.

Three highland areas are recognizable from the topographic data collected to date. The northern region, Ishtar Terra, is the size of Australia. Its western part consists of an extensive high plateau, Lakshmi Planum, which is higher than the Tibetan plateau on earth. Like Tibet, it is rimmed by high mountains, Akna and Freyja Montes to the west and north and Maxwell Montes to the east. The highest point in Maxwell Montes is as high as Everest; it may be a large volcano with a caldera 100 km in diameter offset from the summit. The asymmetric location of the caldera suggests that the northern and eastern parts of the feature have been partially disrupted by faulting.

Aphrodite Terra, an equatorial highland area half the size of Africa, appears to be less topographically distinct than Ishtar. Its degraded appearance may indicate it is older. Three rift valleys with flanking ridges lie south and east of Aphrodite Terra, and mark a tectonically disturbed region. A similarly disrupted zone lies east of Ishtar Terra.

The third highland region, named Beta Regio, contains two great volcanic shields that are thought to be basaltic in composition. This volcanic zone is longer than the Hawaii-Midway region. From ground-based observations, a high region may occur in the area where Pioneer Venus has not yet obtained altimetry data; this gap will be filled in during the spring of 1980.

The most extensive terrain unit on Venus is a rolling upland plains unit that is prominently displayed in the central part of the map. This geological unit includes about 70% of the mapped surface. It contains many near-circular features that probably are impact craters; however, volcanic centers may also occur in this region.

Lowland areas comprise about 20% of the surface; they are located in the northeastern part of the map and form a large x-shaped area centered at 30°N, 30°E. The lowlands are not cratered and may be covered by relatively young basalt flows like the lowlands of the earth, moon, and Mars. (Photo courtesy of H. Masursky and E. Eliason, U.S. Geological Survey, and G. Pettengill and P. Ford, M.I.T. An expanded article will appear in an upcoming issue of *EOS*.)