T 89 PRESENTATION BY TITLE

OCEAN BOTTOM SEISMOMETER DATA RELATING TO CRUSTAL GENESIS AT A FAST SPREADING RISE CREST

J. A. Orcutt (Institute of Geophysics and Planetary Physics, Scripps Inst. of Oceanography, P. O. Box 1529, La Jolla, California 92037)
B. Kennett (Institute of Geophysics and Planetary Physics, Scripps Inst. of Oceanography, La Jolla, California 92037)
L. M. Dorman (Geological Research Division, Scripps Inst. of Oceanography, La Jolla, California 92037)
W. A. Prothero (Institute of Geophysics and Planetary Physics, Scripps Inst. of Oceanography, La Jolla, California 92037)

A seismic refraction survey of the East Pacific Rise at the Siqueiros Fracture Zone using digital ocean bottom seismometers was carried out in July 1974 in cooperation with the Hawaii Institute of Geophysics. Travel time data were inverted using both extremal inversion and Backus-Gilbert linearized inversion techniques. The results of the two techniques were consistent. A range of models determined from the travel time data were tested using a Fuchs-Muller reflectivity algorithm to generate synthetic seismograms. The results of the rise crest profile indicate a crustal low velocity channel underlying a thin, high velocity (greater than 6 km/sec) lid. The channel is underlain by a gradient increasing in velocity to a discontinuity marking the beginning of a low-velocity (approx. 7.7 km/sec) mantle. The low velocity channel is characterized by a sharp decrease in compressional velocity and a decrease in Q. On the flanks of the rise crest the crust evolves toward a "standard" layer 1, 2, 3, and 3a structure at an age of 5 x 10^6 yr.

T 90

GEOPHYSICAL STUDY OF THE OROZCO FRACTURE ZONE

Walter S. Lynn
Richard J. Blakely (both at: School of Oceanography, Oregon State University, Corvallis, Oregon 97331)

A geophysical survey of the Orozco fracture zone (OFZ) was conducted by Oregon State University during April, 1974. Magnetic data shows the axis of the East Pacific Rise (EPR) to be offset left-laterally 95 km. North of the OFZ the ridge crest trends due north as expected by Pacific-Cocos motion. South, to at least 11°N, the ridge axis is oriented N11°W. This trend appears to bend even more westward near the intersection with the fracture zone. The OFZ is characterized by a double trough which can be traced east from the ridge axis for over 200 km. This contrasts with the western extension of the fracture zone where the trough system dies out within 60 km of the ridge axis. Published bathymetric charts show the OFZ to have an anomalous trend from that expected from Pacific-Cocos motion. The bathymetric and gravity data verify this trend, which is approximately N55°E. This trend is essentially identical with Cocos-North American motion and should pose certain constraints on the Cocos plate segment north of the OFZ. Gravity models constructed across the OFZ required a shallow low density root (3.00 g/cc) in the upper mantle of approximately 1 to 2 km. A deep trough of over 4200 m with a relief of over 1000 m is found where the fracture zone intersects the northern segment of the EPR. Associated with this feature is an abnormally high magnetic anomaly of 1300 gammas. A comparison of this feature with a similar situation at the junction of the Juan de Fuca Ridge and the Blanco fracture zone suggests that the EPR is "leaking" in this area.

T 91 PRESENTATION BY TITLE

MAGNETIC ANOMALY FANNING ON THE NORTHERN COCOS PLATE

B.T.R. Lewis (Dept. of Oceanography and Geophysics Program, U. of Washington, Seattle, Washington 98195)
W. Lynn (School of Oceanography, Oregon State University, Corvallis, Oregon 97331)
W. Snydsman (Geophysics Program, U. of Washington, Seattle, Washington 98195)

Extensive magnetic data over the northern Cocos plate between 11°N and 17°N has been analysed. The high quality of the data and the track line density gives extremely good correlations between anomalies from 0 to 6 m.y. Reliable correlations can be continued out to 12 m.y. The isochrons show convincingly a fanning of the anomalies. The fanning begins at the central anomaly which trends N 10°W and can be observed beyond anomaly 5 where the trend is N 40°W. The pattern could be explained by a ridge reorientation; however, other magnetic evidence indicates the ridge was trending about N-S 10 m.y. ago. Alternatively, the fanning could be explained by spreading close to a pole of rotation. To produce the observed fanning we would require a Pacific Cocos pole at about 22°N and 108°W. A pole position of 41.3°N and 108.1°W determined by Minster et al. (1974) is too far away to produce this effect.

T 92

RESULTS OF A DETAILED MARINE GEOPHYSICAL SURVEY ON THE FIJI PLATEAU

A. J. Halunen and G. H. Sutton (Hawaii Institute of Geophysics, University of Hawaii, Honolulu, Hawaii 96822)

This paper reports the results of a detailed marine geophysical survey on the Fiji plateau near 17°30'S, 171°30'E. A group of seamounts in the survey area, which are oriented northeast-southwest, may correspond to the Nova rise of Luyendyk, et al., 1974. Three heat flow measurements taken in a small pocket of sediments among these seamounts vary from <1.0 to >30 microcal/cm^2 sec). A series of 15 heat-flow measurements in a 10 by 20 nautical mile area about 30 miles west of these seamounts has a mean of 3.65 microcal/cm^2 sec (standard deviation = 0.84). Our seismic reflection data show only a single pocket of sediment in the area of the seamounts and about 0.20 sec of sediment west of the seamounts. A single seismic refraction measurement using the ASPER technique shows about 500 meters of consolidated sediment and a basal crustal layer of 7.5 km/sec 8.5 km deep.

Luyendyk, B. P., W. B. Bryan, and P. A. Jezek, Shallow Structure of the New Hebrides Island Arc, Geol. Soc. Am. Bull., v. 85, p. 1287-1300, 1974.

T 93

NEOTECTONICS OF EASTERN TAIWAN

James E. York (Dept. of Geological Sciences, Kimball Hall, Cornell University, Ithaca, New York 14850)

The Longitudinal Valley of eastern Taiwan marks the suture of a late Cenozoic collision between an island arc and the Asian continent. At present the Longitudinal Valley represents the main active tectonic feature of the boundary between the China and Philippine plates in the Taiwan region. Previously published instantaneous poles of rotation indicate that this boundary in the Taiwan region is predominantly convergent with a component of left-lateral strike-slip motion, although historic surface faulting and fault plane solutions suggest that the boundary is a transform fault. New geologic field work provides evidence of both convergence and strike-slip motion during the Quaternary. Some convergence is apparently also occurring west of the Longitudinal Valley, causing uplift of the Central Range and intermediate depth earthquakes beneath this range.

T 94

WIDESPREAD LATE NEOGENE AND QUATERNARY CALC-ALKALINE VULCANISM ON THE TIBETAN PLATEAU

W.S.F. Kidd (Dept. Geological Sci., State Univ. of New York at Albany, Albany, New York 12222)

Observations and specimens collected by explorers on traverses during 1890-1906, and ERTS images reveal abundant evidence of young vulcanism over most of the Tibetan Plateau between longitudes 80E to 93E. In the south volcanics cover more than 60% of an area 1000 km E-W by 400 km N-S adjoining (north of) the Indus Suture. In the north, sporadic volcanic areas occur in the west, but a huge area 86-93E, 34-37N has abundant volcanic cover. The area between these two major bands has few volcanic accumulations. Some of the volcanics in the south may be as old as late Cretaceous, representing an Andean arc on the northern side of the ocean that subsequently closed about 35 my ago with the collision of India and Asia. Other volcanics, particularly in the northern part of the southern band, show very young geomorphic features, and the presence of magma under most of the southern area is demonstrated by the reports of abundant boiling springs in many places. All the volcanics in the rest of the Tibetan Plateau show very young geomorphic features (well-preserved flow fronts, lava and ignimbrite plateaux, cones, domes, and calderas) and are very unlikely to be older than late Neogene (~10 my). One ERTS image taken on July 16, 1973, shows a small eruption cloud coming from the ring fracture of a caldera. Specimens collected by Sven Hedin show that basalts are uncommon; most of the volcanics are andesites, dacites and rhyolites, and a large proportion are welded tuffs. The few available analyses show that the rocks are calc-alkaline, have high K/Na ratios and high total alkalis. Their composition and extent are attributed to widespread partial melting of the lower part of the overthickened (~70 km) crust of Tibet produced by continued plate convergence after the Indian continental collision. Himalayan granites 9-12 my old are part of the same magmatism.

T 95

RECENT TURKEY PLATE MOVEMENTS: A FINITE ELEMENT MODEL

Barbara R. Williams (Dept. of Geology and Mineralogy, Univ. of Michigan, Ann Arbor, Michigan 48104)

The westward movement of the Turkey and Aegean microplates is derived from a thin shell finite element model of the Eastern Mediterranean. The elements which comprise the microplates are not loaded, but move entirely in response to the African and Arabian plates which interact with Europe, as suggested by Mckenzie(1970). The northern boundary along the Anatolian fault system and the eastern Arabian subduction zone boundary must be allowed to slip in order to attain the west displacements. A clamped boundary would produce eastward movement of Turkey. The forces applied to Africa and Arabia represent a distributed load with directions defined by the pole of rotation with respect to a fixed Europe. The displacement vector directions in the model best fit the observations of plate motions from seismic source mechanism solutions when the distributed load is scaled with radial distance from the pole of rotation.

PLATE TECTONICS: ITS RIGOROUS GEOLOGIC BASIS I

(Cosponsored by O, S)
Sheraton South Room
Thursday 0830h

W. JASON MORGAN (Dept. Geology, Princeton Univ., Princeton, N.J. 08540)
ANTHONY F. GANGI (Dept. Geosciences, Texas A & M Univ., College Station, Texas 77843), Cochairmen

T 96 PRESENTATION BY TITLE

KINETICS OF THE OLIVINE→SPINEL TRANSITION IN DOWNGOING LITHOSPHERE: IMPLICATIONS TO DEEP EARTHQUAKE GENESIS

R.G. Burns
C-M. Sung (both at: Dept. of Earth and Planetary Sciences, M.I.T., Cambridge, Massachusetts 02139)

The transitions: olivine (α-phase) → spinel (γ-phase), olivine+spinel → modified spinel (β-phase), and olivine → β-phase contribute to the 20° discontinuity at 400 km depth. The kinetics of the transitions increase exponentially with rising temperature and overpressure, and are also greatly promoted by diminishing grain size, applying shear stress and introducing water or other catalysts in laboratory experiments. As a result, rates of olivine→"spinel" transitions measured in the laboratory are orders of magnitude higher than those encountered in the mantle.

The stability field of the β-phase is wedged out at low temperatures, so that within the cold interior of a downgoing plate olivine transforms directly to spinel (γ-phase). Since syntheses of Mg-rich spinels below 700°C have been unsuccessful, it is likely that the olivine→spinel transition can be depressed below this temperature in the mantle. The temperature at the cold interior of a fast plunging plate will then be low enough to depress the olivine→spinel transition even down to the lower transition zone. As soon as the temperature rises sufficiently to initiate the transformation, the reaction will be implosive because of its exothermic nature. Such an implosion will

T 75

CRUSTAL STRUCTURE EAST AND WEST OF THE MAGNETIC ROUGH-QUIET BOUNDARY IN THE WESTERN NORTH ATLANTIC

Bhoopal Naini and John Ewing (Lamont-Doherty Geological Observatory of Columbia University, Palisades, New York 10964)

Detailed wide-angle seismic reflection and refraction surveys were made with expendable radio sonobuoys in two regions approximately 1/2 square degree located on either side of the magnetic rough-quiet boundary in the western North Atlantic between 30° and 33° N. The first group of sonobuoys was recorded over the Keathly sequence and the second group in the magnetic quiet zone west of it with approximate crustal ages of 145 and 160 m.y. respectively. Distribution of the compressional wave velocities on either side of the magnetic rough-quiet boundary correspond to those of the oceanic crust. Velocities of layer 2 recorded east and west of the boundary were 5.18 ± 0.3 km/sec and 5.22 ± 0.19 km/sec with thickness of 1.56 ± 0.21 km and 1.57 ± 0.31 km respectively. Layer 3 velocities recorded were 6.91 ± 0.13 km/sec and 6.91±.11 km/sec east and west of the boundary respectively. The quiet zone has an average 2.22 km thick layered sedimentary sequence, but the region east of it has only 0.82 km thick sediment. Depth to basement computed from both reflected and refracted arrivals is the same in almost all the cases in the quiet zone. However, in the Keathly sequence in about 50% of the cases basement depth computed from refracted arrivals is greater. This may have some implication on the nature of the observed magnetic anomaly characteristic for this region.

T 76

A COMPARISON OF MULTICHANNEL VELOCITY DATA WITH EARLIER REFRACTION VELOCITIES ON ATLANTIC MARGIN BETWEEN CAPE HATTERAS AND GEORGES BANK

J.A. Grow, R.E. Sheridan, J.C. Behrendt } U. S. Geological Survey, Woods Hole, Mass. 02543
R.F. Mattick (U.S.G.S., Reston, Va. 22092)

The interval velocities derived from three U.S. Geological Survey multichannel seismic reflection profiles (12-fold) across the continental margin off Maryland, New Jersey, and Georges Bank have been compared with earlier seismic refraction data. On all three lines over the shelf, both techniques identify a thin (0.5 - 1.5 km) upper sequence having velocities between 1.6 - 2.0 km/sec which is probably Eocene to recent in age. Earlier shelf refraction lines show an intermediate layer which have velocities between 2.9 - 3.6 km/sec and is 1 - 4 km thick over a high velocity (5 km/sec) "basement." The new data show that velocity gradations within the "consolidated sediment" layer range from 2.0 - 5.0 km/sec; their thickness ranges from 1 - 5 km and these overlie sedimentary rocks having velocities between 5 - 6 km/sec. Off Maryland, the strata thicken from 4 km near the coast to 12 km near the shelf edge with no evidence of a basement ridge. On the New Jersey line, the strata thicken from 2 km near the coast to 10 - 12 km in mid shelf. On this line a dome exists in the middle shelf which has an erosional unconformity at a depth of about 2-1/2 km. Near the shelf edge on the New Jersey line, a 30 km wide flat platform at a depth of 6 km forms a high-impedence terminal reflector which appears to be a carbonate horizon (reef?) that continues out under the upper slope; this layer appears to be the "basement" ridge observed in earlier refraction studies. On Georges Bank, the sedimentary strata thicken from 2 to 8 km and are interrupted by an irregular, weakly defined ridge which rises to less than 3 km below sea level. This ridge also correlates with a high velocity refractor near the shelf edge in earlier studies. Our data are inconclusive as to whether this ridge is either volcanic or sedimentary.

T 77

MINOR FAULT MOTIONS IN RELATION TO MESOZOIC TECTONICS OF SOUTHERN NEW ENGLAND

D.U. Wise, M.J. Hozik, A.G. Goldstein, R.G. Piepul (Department of Geology, University of Massachusetts, Amherst, Massachusetts 01002

Movement patterns have been analyzed for 1500 minor faults in several areas of the Connecticut Valley and Rhode Island coast to study Mesozoic stresses associated with an opening Atlantic. Strike-slip motions on minor faults are surprisingly common. The approximate percentages of minor strike-slip faults are: Greenfield area, Mass. (N. Conn. Valley), 50%; Meriden area, Conn., 90%; Gaillard Graben (S. Conn. Valley), 5%; Narragansett, R.I., 20%. In the Narragansett area at least four sets of faults, involving 2/3 of the fault data, trend E-W to N55W and have significant left-lateral components of motion, suggesting a transform fault-related origin of the southern New England continental margin. The Conn. Valley has a pervasive N30E grain of joints, veins, dikes, and faults. A model is proposed of Mesozoic N60W crustal extension operating on the pre-existing N-S trending structural grain of the Conn. Valley-Gaspe Synclinorium. This N-S zone localized the average trend of the Mesozoic graben along it, incorporating early N30E extension fractures and fault blocks into it. Where the border fault trends N30E (New Haven area) the minor faults are dominantly normal, indicating simple NW extension. In other areas where the older structural zone strikes N-S oblique to the direction of regional extension, right-lateral motions were produced across the zone. In these areas minor N30E fractures combine both right and left-lateral components with the normal motions. The same areas have NW trending right-lateral and E-W trending thrust faults as minor elements of the system. The regional stresses apparently were reoriented within parts of the graben and within individual blocks to produce additional fault motions related to N-S relative compression.

T 78 PRESENTATION BY TITLE

GEOLOGIC HISTORY OF BASEMENT FAULT MOTIONS IN THE BALTIMORE CANYON TROUGH CORRELATED WITH NORTH ATLANTIC SEA FLOOR SPREADING

R.E. Sheridan (U.S. Geological Survey, Woods Hole, Massachusetts, 02543
P.M. Brown (U.S. Geological Survey, Raleigh, North Carolina, 27611)

Analyses of drilling data on the Atlantic Coastal Plain from North Carolina to Long Island indicate that the basement is broken by faults into distinguishable blocks whose directions of tilt were controlled by the motions on the faults. Two hinge zones are found, one N-S and the other N25°E, as are two complementary shear zones, one NW-SE and the other N-S. These trends are also interpreted to exist as fundamental basement faults bounding the isolated marginal basins of the Atlantic continental margin, including the Baltimore Canyon Trough. The N-S hinge zones define the E-W tensional axis called the Atlantic stress system, and the NE-SW hinge zones define the NW-SE tensional axis of the White Mountain system. Facies variations indicate that NW-SE tension existed from Neocomian to early Albian, then E-W tension prevailed from middle Albian to early Eocene, the NW-SE tension sporadically recurring in the Eocene, Miocene and post-Miocene. These stress orientations can be correlated with the orientation of spreading in the North Atlantic as determined by finite-difference poles of rotation. The drift path of Africa away from North America was southeastward from 180 to at least 110 MY, then as the Labrador Sea opened, Africa and Europe both moved eastward from North America from at least 81 to 53 MY, and finally Africa and Europe again moved southeastward from 53 MY to the present. The stress systems deduced for the Baltimore Canyon are compatible with the stresses from such spreading of the Atlantic and the rotation of North America; the times of reorientation in stress are very similar. This suggests that the Atlantic margin was not absolutely rigid during spreading.

T 79

ELECTRICAL CONDUCTIVITY STRUCTURE IN THE NORTHWEST ATLANTIC

K.A. Poehls (Dept. Geol. and Geophys., Woods Hole Oceanog. Inst., Woods Hole, Massachusetts 02543)
R.P. Von Herzen (Dept. Geol. and Geophys. Woods Hole Oceanog. Inst., Woods Hole, Massachusetts 02543)

Geomagnetic time variations have been recorded at four seafloor sites during two field experiments south of Bermuda. A 1973 March-June experiment occupied sites in the Hatteras Abyssal Plain (27°51'N, 70°40'W; 27°09'N, 69°32'W) while an August-November program in 1974 worked south and east of Bermuda (28°01'N, 63°00'W; 30°00'N, 56°30'W). The four magnetometer sites sample crustal ages of 80-150 m.y. Electrical conductivity structures are calculated for each site using the method of the vertical gradient of horizontal field variations. Sea surface geomagnetic variations are estimated from simultaneous recordings on Bermuda and Fredericksburg, Virginia. Latitude corrections have been made where necessary.

The large conductivity contrast between ocean and continent found by magnetotelluric studies off California does not appear to exist in the western Atlantic. Resistivities are more compatible with those found in continental regions. Diurnal harmonics and long period storm results indicate apparent resistivities of 20-50 ohm-m at all sites. Apparent resistivities for the period range 30 minutes to 2 hours at 1974 stations (younger ages) are found to be about 40-60 ohm-m while those at the older 1973 stations average about 90-120 ohm-m.

T 80

PRESENT-DAY MOTIONS OF THE CARIBBEAN PLATE

T.H. Jordan (Dept. Geological and Geophysical Sciences, Princeton University, Princeton, N.J. 08540)

Data pertaining to the instantaneous relative motions of the Caribbean plate with respect to the North American and Cocos plates have been inverted using the iterative fitting algorithm formulated by Minster, Jordan, Molnar and Haines (1974). The best-fitting CARB-NOAM pole is located at 50°N ± 18°, 116°E ± 9°, and the computed angular rate is 0.20 ± .07 °/My, which corresponds to a spreading rate of 2.1 cm/yr across the Mid-Cayman Rise. The model predicts that the present-day motion of South America with respect to the Caribbean is northwestward and suggests that since the late Tertiary this motion has be accomodated along an en echelon series of NW-trending strike-slip faults and NE-trending thrust faults that occupy a broad zone of deformation extending from the Curacao Ridge and its westward extension into the South Caribbean Basin to the frontal thrusts bounding the Venezuelan Coast Ranges. The model predicts that the CARB-NAZC relative motion is parallel to the continental margin south of the Gulf of Panama. The rate of motion of the Caribbean plate with respect to the mesosphere, deduced from the fixed hotspot hypothesis, is very small, and this plate may in fact be stationary over the mantle.

PLATE TECTONICS: ITS RIGOROUS GEOLOGIC BASIS IV

(Cosponsored by O, S)
Sheraton South Room
Wednesday 1330h

E. MARK PARMETIER (Dept. Geological Sciences, Cornell Univ., Ithaca, N.Y. 14853)
TANYA ATWATER (Dept. Earth and Planetary Sciences, MIT, Cambridge, Mass. 02139), Cochairmen

T 81

GEOLOGY AND TECTONICS OF MONA PASSAGE

J.D. Weaver (Dept. Geology, Univ. Puerto Rico, Mayaguez, Puerto Rico 00708)
A.L. Smith, (Dept. Geology, Univ. Puerto Rico, Mayaguez, Puerto Rico 00708)
G.A. Seiglie, (Dept. Geology, Univ. Puerto Rico, Mayaguez, Puerto Rico 00708)

Seismic reflection studies from Mona Passage, which separates Puerto Rico from Hispaniola, have indicated the presence of two systems of faults. A NW-SE system (parallel to the older structural trend of Hispaniola and Puerto Rico), which includes the seaward extension of the Great Southern Puerto Rico fault zone, is seen to affect rocks of at least Miocene age. This system appears to be truncated by a N-S series of right lateral faults.

TRANSACTIONS
AMERICAN GEOPHYSICAL UNION
VOL. 56, NO. 6, JUNE 1975

Published monthly by the American Geophysical Union from 1909 K Street, N.W., Washington, D.C. 20006. Editorial and Advertising Offices: 1909 K Street, N.W., Washington, D.C. 20006. Subscription rate: $15.00 for calendar year 1975; this issue $5.00. Second class postage paid at Washington, D.C. and at additional mailing offices.

Claims for missing numbers, sent to AGU, will be honored only if received within 60 days after normal delivery date. No claims will be allowed because of failure to supply AGU with a change of address or because copy is 'missing from files.'

1974 AGU Publications Report 306

The President's Page
Report of the Treasurer 307

Article
The Gravity and Shape of the Moon
William M. Kaula 309

Supporting Members 316

New Publications 317

AGU
Eighth GEOP Research Conference Report 318

Classified 326

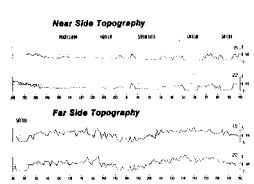
Geophysical Year 327

Geophysical Abstracts in Press 329

Spring Annual Meeting 342

Session Summary 344

Abstract Author Index 475



Cover Topographic elevations on the Moon measured by the Apollo 15 laser altimeter. See William M. Kaula's article (from which this figure was taken) on the gravity and shape of the moon, and the Eighth GEOP Research Conference report, 'Lunar dynamics and Selenodesy.'

E⊕S is devoted to the publication of contributions dealing with the interface of all aspects of geophysics with society, and of semitechnical reviews of currently exciting areas of geophysics. Through E⊕S earth scientists should enjoy keeping abreast of new activity and be better prepared to face their own work with a broad perspective. This journal is an effective way to address or redress those who are involved in the study of the earth and its environment in space.