S3-1-A-12

A LARGE APERTURE SEISMIC EXPERIMENT

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Large aperture (>10 km) seismic reflection data are required to probe the lower part of the crust on continental margins, deep ocean basins and the ocean-continent boundary. The wide angle reflections and refractions observed during a large aperture experiment will allow detailed determination of the crustal velocity structure and imaging of deep crustal reflection horizons. During a feasability study across the continental margin of the U.S. East Coast off New Jersey in June, 1981, Lamont-Doherty Geological Observatory, Woods Hole Oceanographic Institution, the Marine Science Institute of the University of Texas, and the Bedford Institute of Oceanography collected ~1300 km of 144-channel, Common Midpoint (CMP) seismic reflection/refraction data with source-receiver separations from 0.3 to 13.5 km every 150 m along the track. Over most of the track the data quality is good to excellent. In this experiment the CSS DAWSON fired air guns alternately with the FRED B. MOORE, which also recorded all shots with its 3.3 km array. R/V OCEANUS steamed behind the MOORE array and recorded all shots with its 2.4 km array. The individual ships navigated with identical Loran-C units and this data, along with shot and recording times, were logged on all ships with DAWSON also recording ranges to MOORE and OCEANUS. This information will allow us to sort all the seismic data into CMP gathers.

S3-1-A-13

IMPLICATIONS OF MODELING FOR CRUSTAL REFLECTION INTERPRETATION

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Modeling by means of 2-D synthetic seismograms is the major control on crustal-reflection interpretations and is also a key aid for planning data acquisition. Synthetic seismograms have been calculated for a floored, sheet-like granite batholith, a granite diapir, a greenstone belt, a mylonite zone, an island arc and the central Alps. The synthetic seismograms are characterized by numerous arcuate and dipping events so that we conclude that the reflection wave field from typical crustal structures is extremely complex. All of the models are typified by events arriving from great lateral offsets. This problem would be accentuated even more if the third dimension were considered. Such events may cause an intrusion to appear "floored" where no floor was included in the model and may cover up "transparent zones" associated with homogeneous rock bodies. In the Alpine seismogram, structure of the Helvetic nappes can be determined and the root zone appears as a broad band of dipping reflections. For the island arc, the synthetic seismogram shows a complex pattern of short reflection segments, a layered mafic intrusion can be recognized, and most interestingly, the Moho appears as an irregular, discontinuous reflection. Modeling illustrates the validity and dangers of crustal reflection interpretations.

California Seismicity

(JT) Japanese Pavilion Wed PM
J.P. Eaton (USGS), *Mary Ann Spieth* (Geophysical Systems Corp.), Presiding

S3-2-A-1

PRELIMINARY STUDY OF THE WESTMORELAND, CALIFORNIA EARTHQUAKE SWARM

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In late April and early May, 1981, the northern Imperial Valley, California, was struck by an earthquake swarm containing in excess of 2000 locatable events. The largest shock, M_L 5.7 on April 26, was felt throughout southern California and caused damage in and around the town of Westmoreland. In this preliminary study, we present master event relocations and focal mechanisms for a selection of the best recorded swarm members. The epicenters outline at least two structures transverse to the Brawley seismic zone, which are consistent with the left-lateral plane in the predominantly strike-slip mechanism. Activity on both these two transverse structures initiated with a very tight cluster, followed by a "sizable" shock (M_L 4.1 in one case, 5.7 in the other) after which the respective transverse trend is apparent in the seismicity. We suggest that the "swarm" consisted of left-lateral strike-slip activity on faults transverse to the trend of the Brawley seismic zone, each displaying a cluster of foreshocks, a main shock with bilateral rupture, and aftershocks. Following this activity, epicenters migrated both along the transverse trend as far as the Superstition Hills and Algodones fault, and northward along the Brawley seismic zone.

S3-2-A-2

IMPERIAL VALLEY SEISMICITY AND THE SAN ANDREAS FAULT

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The tectonics of the Gulf of California is dominated by a series of northwest-trending, right-stepping, right-lateral faults capable of causing potentially damaging earthquakes with recurrence intervals averaging several decades. Seismicity in the regions of local crustal spreading associated with fault offsets occurs as earthquake swarms and appears to be governed by the occurrence of earthquakes on the major strike-slip faults. The most northerly of these offset regions is the Imperial Valley in which seismicity is primarily confined to a narrow (< 10 km) pod-shapped linear zone (the Brawley seismic zone) joining the northern section of the Imperial fault and the south terminus of the San Andreas fault near Bombay Beach, on the east shore of the Salton Sea. Major events on the Imperial fault in 1940 and 1979 significantly affected Imperial Valley seismicity; the epicenters of these events are closely associated ith the south tip of the Brawley sei.mic zone (1940) and the north tip of a similar seismic zone linking the northern Cerro Prieto fault with the southern section of the Imperial fault (1979). Therefore, we suggest that careful monitoring of seismic activity in the Imperial Valley, as well as increased instrumentation near Bombay Beach, may be an important factor in predicting a major earthquake on the southern section of the San Andreas fault.

S3-2-A-3

THE FEBRUARY 1981 EARTHQUAKE SWARM NEAR ANZA, CALIFORNIA

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An earthquake swarm consisting of more than 400 events with magnitudes (M_L) as great as 3.7 and as small as .2 were recorded by the SCARLET array during fall and winter (1980-81) near Anza, California. At the peak of this swarm, a seismology class from UCSB deployed 3 portable smoked paper recorders in the swarm region for 24 hrs. The combined UCSB-SCARLET data allow for increased epicenter location accuracy and better constrained fault plane solutions for these events. Locations from the combined array generally agree with SCARLET locations to better than 1.5 km in hypocentral coordinates. Depths are shallow (between 2 and 6 km). Fault plane solutions of the swarm events recorded by the combined array are quite consistent and show strike-slip motion with the compression axis approximately 40° East of North. Activity in the area began early in 1980 centered at 33°30.07'N, 116°47.05' W. As time progressed, new activity centered 1.5 km to the northeast began, apparently forming two clusters of earthquakes, with activity in both clusters peaking February 1 and 2 of 1981. The b-value computed for 30 event groups is fairly constant at .5 early in the swarm, fluctuates between .5 and .94 during the peak of activity, and then decays toward the .5 level. The region of this swarm is approximately 20 km southwest of the San Jacinto fault and not associated with a mapped fault in the area.

S3-2-A-4

THE STATE OF STRESS NEAR THE ANZA SEISMIC GAP, SAN JACINTO FAULT ZONE, SOUTHERN CALIFORNIA

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The fault geometries, types of faults, amounts and ages of fault displacement, topographic features, seismicity, and earthquake source mechanisms in the area of the San Jacinto fault zone near Anza, California, suggest that considerable fault-normal compression as well as fault-parallel right-slip characterize the stress regime locally.

The San Jacinto fault zone narrows from 11 km wide across the Buck Ridge, San Jacinto, and Coyote Creek faults to 1.5 km wide near Anza. All of these faults show many kilometers of total offset and also geomorphic evidence of recent activity. The uplifted Coyote Ridge block and several shallow thrust faults oriented parallel to segments of the right-slip fault zone are evidence of the compressive forces in the area of this fault zone constriction. Seismicity maps show a 22 km long quiet section of the fault zone, the Anza seismic gap. Data from seismological studies by Arabasz et al. (1970) and Kanamori (1980, unpub. data) on nearby moderate earthquakes indicate that this seismic gap is probably a locked segment of the San Jacinto fault. This locked segment or asperity may be partially due to excess fault-normal compression caused by local distortions of the stress field.

Earthquake source mechanisms for small earthquakes in the Anza area indicate that the axes of maximum compression in the block SW of the San Jacinto fault and NW of the termination of the Coyote Creek fault are rotated up to 40° clockwise with respect to the regional compression axis as determined by strain calculations (Savage et al. 1981). The composite source mechanisms for several earthquakes in the crustal block very near the locked segment indicate maximum compression directed normal to the San Jacinto fault.

S3-2-A-5

SEISMIC CLUSTER IN SANTA BARBARA CHANNEL, CALIFORNIA, 22 FEB 81

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A cluster of more than 95 identifiable earthquakes was centered beneath the Montalvo Trend in the eastern part of the Santa Barbara Channel near 34°16'N 119°39'W at a depth of 11 km. The earthquakes commenced at about 1900 PST, 21 Feb 81, and continued for about eight hours, interrupted by three seismically quiet periods of about 1/2 hour duration. A few small events occurred in the following days. The largest nine events ($1.9 \le M_L \le 2.8$) were well recorded by local permanent land and ocean bottom stations. Very consistent arrival times and first motions may be interpreted as the product of a single repeating source involved in four episodes of steep N dipping reverse faulting. A crustal model, based on explosion seismology and featuring three parallel E-W crustal velocity profiles, was used to determine the hypocenter. Near surface seismic reflection profiles in this part of the channel show E-W striking, steeply dipping faults associated with >2 km vertical offset of Pliocene beds. Although continuity of such features to the 11 km hypocentral depth cannot be demonstrated, of these nearby faults the Pitas Point shows uplift of the north side hanging wall consistent with the earthquake motion.

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