Oaks + others, 1985

Earthquakes preceding the Sep. 10, 1984 dome-building eruption are used to illustrate this technique. More than thirty events occurring during a ten-hour period prior to the beginning of extrusion are located in a volume, approximately 50 m in diameter, beneath the dome. The earthquakes following the extrusion do not occur in multiplets and appear to be distributed over a much larger volume.

10:15

MICROSEISMICITY OF THE IDAHO/WYOMING SEGMENT OF THE OVERTHRUST BELT

WOOD, C.K., U.S. Bureau of Reclamation, P.O. Box 25007, MC D-1632, Denver Federal Center, Denver, CO 80225

The region between Jackson, Wyoming and Soda Springs, Idaho is characterized by pervasive low level earthquake activity superposed on a zone of extensive Laramide deformation of the upper crust. Abundant evidence for late Quaternary normal faulting is also present in the area. The relationship of seismicity to local structure and regional tectonics was examined with data obtained from a 4-month microearthquake survey in 1982, and from a 2-week aftershock survey in 1983. A network of 7 analog and 6 digital stations was operated in various configurations over a 10,000 km^2 area to obtain a homogeneous short term sample of seismicity over the entire region while maintaining a capability for moderately accurate hypocentral location. Over 500 events were located, which allowed for the inversion of a layered velocity model. Swarm activity was widespread and showed no apparent correlation to surface structure. Activity was well correlated in time (but some hundred km distant) with the occurrence of a magnitude 4.7 event in Soda Springs. Fault plane solutions indicated east-west extension on planes with orientation similar to the structural grain of the region. Recently published geologic cross sections interpreted from seismic reflection profiles and drill hole data (Dixon, 1982) provided a unique opportunity to correlate microseismicity with subsurface structure. Microseismicity did not correlate with thrust structures in the upper 7 km of the crust, but did show correlation with inferred basement cutting faults having no surface expression. Seismicity was well distributed over a depth range of 2 - 16 km, with no events located deeper than 18 km.

10:30

NOVEMBER 7, 1882, COLORADO EARTHQUAKE REINTERPRETED IN LIGHT OF THE OCTOBER 18, 1984, WYOMING EARTHQUAKE

OAKS, S. D., HOPPER, M. G., BARNHARD, L. M., and ALGERMISSEN, S. T., U.S. Geological Survey, Box 25046, Denver Federal Center, M.S. 966, Denver, CO 80225

A large but poorly documented earthquake (M_L =6.5, $m_b(L_g)$=6.2) on November 7, 1882, was felt as far west as Salt Lake City, Utah, and as far east as Salina, Kansas, and was apparently centered somewhere in northern Colorado. Uncertainties about the nature and location of this event may be partly resolved through comparisons with the similar but somewhat smaller earthquake of October 18, 1984 (M_L =5.5, m_b=5.1), centered about 50 km southwest of Douglas, Wyoming.

The epicenter of the 1882 shock was previously estimated to be near Denver. However, evidence of relatively high intensities in northern Utah and southwestern Wyoming led to later speculations that the epicenter was somewhere in northwestern Colorado or that there were two simultaneous earthquakes. The 1984 event, like that of 1882, was felt as far west as Salt Lake City and hundreds of kilometers eastward on the Great Plains. Our study compared intensity reports for the two events in north-central Colorado: we revisited sites that had provided reliable intensity reports for the 1882 quake. The 1882 earthquake caused damage in Denver, Boulder, Louisville, and LaPorte and near Loveland, but the 1984 event produced damage in Golden. Environmental differences such as vibration and [illegible] and the design and age of buildings were taken into consideration in the site-by-site investigation. While the effects of the 1984 event were not as pronounced as those of 1882, our study showed that the site-intensity distributions of the two earthquakes were similar, especially in the Front Range urban area of Colorado.

Although the occurrence of two simultaneous earthquakes in 1882 cannot be precluded, the well-documented 1984 intensity distribution demonstrates that a single, moderate-size earthquake in the central Rocky Mountains can produce shaking similar to that of 1882 at widely separated points on both sides of the Continental Divide.

10:45

PRELIMINARY RESULTS OF THE AFTERSHOCK INVESTIGATION OF THE OCTOBER 18, 1984, LARAMIE MOUNTAINS, WYOMING, EARTHQUAKE

LANGER, C. J., U.S. Geological Survey, Box 25046, MS 966, Denver Federal Center, Denver, CO 80225; MARTIN, R. A., JR., and WOOD, C. K., U.S. Bureau of Reclamation, Box 25007, MC D-1632, Denver Federal Center, Denver, CO 80225

The magnitude-5.5 (M_L) Laramie Mountains, Wyo., earthquake of October 18, 1984, was the largest earthquake documented in southeastern Wyoming during historical time. Although the shock was felt over an area of 287,000 km^2, effects of the ground shaking caused only minor damage to structures near the epicenter. A temporary network of 23 stations (16 analog and 7 digital systems) was installed around the epicentral locale to record aftershocks for a period of 10 days (October 19-29). Early results show a northwest-southeast elongate aftershock zone that is approximately 5 km long by 3.5 km wide. Depths of the aftershock hypocenters range from about 20.0 to 25.5 km. Several single-event focal mechanism solutions indicate both right-lateral strike slip and normal modes of faulting with near horizontal "T" axes trending from N. 10° E. to N. 60° E.

11:00

RECENT FOCAL MECHANISMS FOR THE INTERMOUNTAIN U.S. AND THEIR TECTONIC IMPLICATIONS

WONG, I.G. and HUMPHREY, J.R., Woodward-Clyde Consultants, 1390 Market Street, San Francisco, CA 94102

Focal mechanisms have been determined for several recent earthquakes in the Intermountain U.S. These include events near: (1) Crownpoint, NM in 1976 (M_L 4.5) and 1977 (M_L 4.2); (2) Parks, AZ in 1980 (M_L 3.6); (3) Glen Canyon, UT in 1983 (M_L 3.3 and 3.2); (4) Hanksville, UT in 1983 (M_L 3.5); (5) Capitol Reef, UT in 1979 (M_L 3.2) and 1982 (M_L 3.5); (6) Carbondale, CO in 1984 (M_L 3.1 and 3.2); and (7) Cimarron, CO in 1983 (M_L 3.4). Several composite mechanisms have also been determined from microearthquake studies conducted in the Paradox Basin and the eastern Wasatch Plateau, Utah. These mechanisms, in addition to several mechanisms recently determined from other studies, suggest that the Zoback and Zoback (1980) tectonic stress boundaries for the central and southern Intermountain U.S. need to be redefined. The recommended changes are: (1) the boundary between the Basin and Range and the Colorado Plateau provinces in Utah and Arizona should be relocated 50 to 100 km toward the plateau interior, indicating greater encroachment by Basin and Range tectonic stresses than previously thought; (2) similarly, the boundary between the Colorado Plateau and the Rio Grande rift stress provinces should be relocated at least 50 km toward the plateau; and (3) the observed tectonic extension in western Colorado suggests that the eastern boundary of the Colorado Plateau stress province should be relocated approximately 100 km westward. The latter also requires redefinition of the Rio Grande rift - Southern Great Plains province boundary in south-central Colorado. These suggested new boundaries will require continued refinement as additional data become available.

11:15

COLLABORATIVE STUDY OF COAL-MINING-INDUCED AND TECTONIC SEISMICITY, EASTERN WASATCH PLATEAU, CENTRAL UTAH—A PRELIMINARY REPORT

ARABASZ, W.J., PECHMANN, J.C., WILLIAMS, D., Dept. of Geol. & Geophys., Univ. of Utah, Salt Lake City, UT 84112; MARTIN, R.A., JR., and WOOD, C.K., U.S. Bureau of Reclamation, Denver Federal Center, Denver, CO 80225; WONG, I.G., HUMPHREY, J.R., and ADAMS, J.A., Woodward-Clyde Consultants, 1390 Market Street, San Francisco, CA 94102.

During June to August, 1984, a joint field experiment was carried out in the East Mt.-Gentry Mt.-Joes Valley area of the Wasatch Plateau by the University of Utah, the U.S. Bureau of Reclamation, and Woodward-Clyde Consultants. Up to 40 analog and digital seismographs were operated simultaneously within a 40x25 km area located in the eastern part of the Basin & Range (BR)-Colorado Plateau (CP) transition. Multiple objectives included: (1) precise resolution of intense mining-induced seismicity—both at and below levels of active underground coal mining in two target areas; (2) source characterization of mining-induced and tectonic earthquakes (neighboring both vertically and laterally), especially in relationship to an inferred subjacent detachment and Holocene faulting in the Joes Valley area; (3) digital recording of steeply incident waves, both at underground mine level and at surface, to investigate path/site effects on high-frequency spectral content; (4) investigation of near-field ground motion at mine level (by WCC); and (5) spatial mapping of stress orientation within the BR-CP transition. Thousands of seismic events (M≤2), predominantly mining-related, were recorded—including abundant mine-level events with ubiquitous dilatational first motions. Shear events reflecting tectonic stress release occur below mine level down to about 5 km, and also beneath the adjacent Joes Valley area at similar depth. Simultaneous subsurface-surface digital recordings were achieved in two separate target areas. The primary purpose of this presentation is to communicate experiment design, accomplishments, and preliminary results.

11:30

LOCAL MAGNITUDE OBSERVATIONS IN THE GREAT BASIN

CHAVEZ, D.E., and PRIESTLEY, K.F., Seismological Laboratory, Mackay School of Mines, University of Nevada, Reno, NV 89557

We have converted digital seismograms of 85 Mammoth Lakes, California earthquakes into equivalent Wood-Anderson seismograms and computed local magnitude ML following the original definition by Richter. We have found that for small events (ML less than 5.5) at distances less than about 10 km Richter's attenuation curve causes ML to be systematically overestimated by as much as one magnitude unit relative to ML determined at Berkeley and Pasadena. On the other hand, magnitudes of events larger than 5.5 are systematically underestimated at distances less than 20 km. Similar variations in near source local magnitude determinations have been found by others using data from southern California and northern Baja California. We have determined corrections to Richter's curve which remove the near source distance dependence for the smaller events. Jennings and Kanamori's correction curve (BSSA, 1983) is appropriate for the larger events. We have also determined ML using broad-band seismograms from stations distributed throughout the Great Basin, as well as Wood-Anderson recordings at Dugway, Utah, and have found no evidence to suggest that the Great Basin attenuation curve differs from Richter's southern California curve at distances greater than about 100 km.