SEISMOLOGY OF THE WESTERN BASIN AND RANGE PROVINCE

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This paper summarizes results of recent seismological research by the University of Nevada. Analysis of the distribution of small earthquakes for 1970-1973 indicates relatively high seismic potential for a number of areas, including the northern Owens Valley, Fishlake Valley, the Mina area, and a zone in the Reno-Tahoe-Carson City area. The "seismic cycle" in this region appears to be at least several centuries long, and aftershock activity continues for about a century following a large earthquake. Focal mechanisms from the northern Owens Valley to the Oregon border are consistent with regional extension in the WNW-ESE direction, and larger events generally involve right-lateral oblique slip on north-trending, east-dipping faults. Refraction profiles indicate sharp discontinuities in crustal structure west of Reno and north-west of Lovelock. Teleseismic P-residuals suggest the presence of a high-velocity lithospheric plate striking northeast and dipping south-east under northern Nevada. Strain recordings at Mina and Round Mountain strain rates of 1-2 x 10^6 per year, in general agreement with estimated spreading rates and geodetic measurements in the province.

PALEOCENE GEOGRAPHY OF SOUTHERN CALIFORNIA

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Paleocene strata of southern California reveal stratigraphic sequences, conglomerate clast and sandstone types, sedimentary structures, and paleocurrent patterns, that allow reconstruction of Paleocene geography. These data indicate for Paleocene time (1) a contiguous series of braided and meandering rivers flowing southwest into a northwest-southeast trending lagoonal-shallow marine environment; (2) offshore sub-marine fans and channels, sloping southwesterly into a northwest-southeast trending basin; (3) pelagic sedimentation in deeper portions of the basin; (4) marine transgression and basin deepening through time, and (5) a nearby source area of moderate relief to the northeast and east; composed of acidic to intermediate plutonic, gneissic, and acidic to intermediate porphyritic volcanic rocks.

A distinctive lower Paleocene facies, trending northwest-south-east, has been displaced about 40 kilometers by right-slip on the Whittier-Elsinore fault system and at least 60 kilometers by left-slip on the Malibu Coast fault system. Palinspastic reconstructions by others indicate that probable Paleocene source rocks once existed within the Santa Ana Mountains--Perris Block basement complex. Paleocene geography indicates this source complex extended northwestward into the Coast Ranges. Later faulting along the San Gabriel-San Andreas fault system has moved source rocks and Paleocene strata to the southeast, northwest, and west.

Pre-Cretaceous rocks of similar composition to Paleocene conglomerate clasts, and to inferred Santa Ana Mountains-Perris Block source complex, are found in Sonora, Mexico. These relations suggest approximately 310 kilometers of post-Paleocene right-slip on the San Andreas fault system.

PRELIMINARY REPORT ON THE MAFIC-ULTRAMAFIC BELT OF THE SOUTHWESTERN SIERRA NEVADA FOOTHILLS, CALIFORNIA

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Mafic and ultramafic igneous and metaigneous rocks with associated metasedimentary rocks are exposed between the Tule and Kings rivers as northwest trending septa within the Sierra Nevada batholith. Much of this belt is apparently composed of a partly metamorphosed ophiolite. It includes serpentinized tectonitic dunite and harzburgite with metabasite dikes, overlain by cumulus pyroxenite, troctolite, anorthosite and gabbro, a metadiabase dike complex, albitite, hornblende tonalite, metabasalt (commonly pillowed), metakeratophyre, metachert, and marble. Small-scale isoclinal folds within the ophiolite have moderate to steeply plunging axes and generally northwest striking axial surfaces. Stratigraphically the top is to the east. The ophiolite is in tectonic contact with highly deformed metasedimentary rocks (pelitic, calc-silicate, psammitic and volcaniclastic) along its eastern margin. Hornblende gabbro and diorite were intruded across this contact prior to emplacement of quartz diorite of the Sierra Nevada batholith. Similar mafic intrusive rocks cut the ophiolite and metasediments in several localities along the belt. U/Pb age determinations on zircons from a hornblende tonalite that lies between gabbro and basalt zones of the ophiolite are concordant at 170±1 m.y. Whether the tonalite is part of the ophiolite or belongs to the later intrusions remains to be resolved. The ophiolite is evidently a fragment of tectonically emplaced mid-Jurassic (?) oceanic crust. Mafic intrusions that crosscut the ophiolite and the juxtaposed metasedimentary complex may represent an early stage of arc plutonism that preceded large scale emplacement of quartz diorite plutons.

REGIONAL HEAT FLOW AS AN INDICATOR OF GEOTHERMAL RESOURCES * 143

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A geothermal resource exists where a local concentration of the earth's thermal energy can be exploited economically. The quantitative definition of a "resource" is, of course, subject to the evolving state of the energy market and of the technology of geothermal energy extraction. Basically, what is needed is hot rock (at least 200-300°C) in an appropriate hydrologic setting accessible to a drill. Detailed resource investigations are justified not only in areas of late Quaternary felsic igneous activity, but also in older rocks with sufficiently high observed heat flow. The resource may consist of heat concentrated near the surface by deep large-scale ground-water circulation or by the shallow intrusion of magma. The Basin and Range province is characterized by relatively high heat flow (q) of $\sim$ 2 HFU (1 HFU = 10^{-6} cal cm^{-2} sec^{-1} = 41.8 mW m^{-2}). It also contains at least two sub-areas ($\sim$ 1000 km^2 or larger) within which heat flows are greater than 2.5, and a few isolated localities with heat flow exceeding 5 HFU. These localities are attractive exploration targets, even though many individual heat-flow measurements may reflect local vertical water movement with only a small amount of stored and extractable energy. The larger areas with $q > 2.5$ HFU should be explored on a scale which will allow detection of more intense thermal anomalies ($q \gtrsim 5$) covering areas of 100 km^2 or less.