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Sandstone Intrusions, Sandstone Extrusions, and Cold Seeps from the California Coast Ranges: Increasing Reservoir Connectivity

by
Casey Moore, University of California at Santa Cruz

ABSTRACT

Two major shallow (~ 1 km or less) fluid migration systems occur in the Western San Joaquin Valley and Santa Cruz Mountains. Sandstone dikes and sills characterize both systems. Methane migrated during the sand intrusion in one system and oil migrated post-intrusion in the other. The orientations of the intrusions provide clues to tectonic stresses at the time of emplacement and are consistent with mechanics of intrusion at shallow depths. Similar clastic intrusions occur in the North Sea (and elsewhere) and increase reservoir connectivity and complexity.

In the Panoche Hills, Upper Cretaceous-Paleocene shales preserve a fluid migration system that developed along the western margin of the former Great Valley forearc basin. The system consists of a network of interconnected sandstone intrusions linked to overlying fossiliferous carbonates whose geochemistry, fauna, and petrology are characteristic of active methane seeps. The system is greater than 800 m thick and represents episodic migration and seafloor expulsion of fluids over at least 0.5 million years. This locality has the most extensive exposure yet discovered of a complete seep system, from underlying fluid pathways to seep deposits and associated biological communities.

The late Miocene sandstone intrusions of Northern Santa Cruz County, California, include the largest known subaerial exposures of clastic intrusions. Dikes are the frequent and thickest intrusion type and tend to striking NE and dip steeply. One giant intrusion is 150 m wide. The majority of the intrusions probably were injected shallowly as some extrude onto the seafloor. Intrusions are locally bituminous with oil migration occurring after emplacement of the sand. Primarily NE-striking, steeply dipping dikes and secondarily, shallowly dipping sills are most significant in terms of regional connectivity of the formation. The orientation of the dikes and sills indicates a regional stress field with a horizontal NE-SW maximum and NW-SE minimum compressive directions, consistent with concurrent right-lateral strike-slip faulting. Similar clastic intrusions occur in the Point Reyes area and are probably offset along the San Gregorio Fault.

BIOGRAPHY

Research Professor, Earth and Planetary Sciences, UC Santa Cruz, Santa Cruz, CA 95064

Education and Employment:
B.A. Geology, University of California, Santa Barbara, 1968.
Ph.D. Geology, Princeton University, 1971
1970-present, Faculty, Earth and Planetary Sciences, UC Santa Cruz

Research Interests:

Structural Geology and Geofluids: Mostly at Convergent Margins—Southern Alaska, Cascadia, California, S. Mexico, Mississippi Fan, Barbados, SW Japan