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# Origin and Diagenesis of Clay Minerals in the Monterey Formation, Santa Maria Basin Area, California

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**Abstract:** The clay mineralogy of the Miocene Monterey Formation was determined for onshore and offshore sequences in the Santa Maria basin area, California. The <0.1- $\mu\text{m}$  fraction of clayey, opal-CT porcelanites, siliceous mudstones, and dolostones from the Pt. Pedernales area consists of mixed-layered illite/smectite (I/S) that contains <10% illite layers. The underlying Tranquillon Volcanics and Obispo Tuff, the presence of bentonite beds, zeolite minerals, and unaltered volcanic ash beds in the Monterey Formation, and the highly smectitic composition of the I/S suggest that a significant amount of the I/S formed from the alteration of vitreous volcanic ash. The alteration of volcanic glass to smectite coincides with the transformation of biogenic opal-A (mostly diatoms) to opal-CT. Alteration of volcanic glass to smectite may inhibit the opal-A to opal-CT transformation by removing pore-water Mg, promote dolomite precipitation by raising the pH, alter the Sr isotopic composition of the pore waters, and provide an additional source of silica to these predominantly biogenic siliceous rocks. The 0.1- to 2- $\mu\text{m}$  fraction contains mica minerals (discrete illite, biotite, and muscovite) as well as I/S. Clayey, opal-A diatomites from the overlying Sisquoc Formation contain detrital kaolinite and random ( $R = 0$ ) I/S, but the percent illite layers in the I/S is uncertain.

The <0.1- $\mu\text{m}$  fraction of quartz rocks from the Lions Head area and the offshore B-2 well is far more variable, and contains random or ordered ( $R = 1$ ) I/S, kaolinite, and chlorite. Corrensite was observed at the base of the Lions Head area. The percent illite layers in the I/S increases from 10% to 80% over a stratigraphic depth of 0.8 km that corresponds to a present-day temperature range of 80 to 115° C. Initial illitization of smectite coincides with the opal-CT to quartz transformation. Ordered ( $R = 1$ ) I/S is associated with abundant diagenetic kaolinite and dolomite in several metabentonite beds. The dominance of sodic plagioclase over K-feldspar, and the absence of kaolinite and chlorite in rocks of equivalent age that have not undergone illitization suggest that limited availability of K results in the alteration of smectite to kaolinite, chlorite, and possibly late dolomite. Minor amounts of clinoptilolite were found in opal-A and opal-CT rocks. Minor to trace amounts of analcime and mordenite were tentatively identified, primarily in quartz rocks.

**Key Words:** Bentonite • Diagenesis • Illite/Smectite • Illitization • Kaolinite • Zeolite

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