plications. High spreading rates result in large mid-ocean ridge volumes giving rise to high sea levels, lowered erosion and terrigenous sedimentation rates, extensive shelf carbonate (C_{ox}) deposition, and concomitant mass transfer of calcium from evaporites to carbonates and of sulfur from evaporites to sedimentary sulfides. The observed evidence of elevated global temperatures during such times may result from higher atmospheric CO_2 levels due to an increased rate of production of CO_2 from the decarbonation of limestones and the formation of calc-silicates at subduction zones.

During global low sea levels, higher erosion and terrigenous sedimentation rates restrict carbonates leading to the mass transfer of calcium from carbonates and of sulfur from sulfides to extensive evaporites. Total organic carbon (C_{red}) storage in sediments is greater (although preservation and concentration of organic carbon may also be high during anoxic high CO_2, high sea level times). Lower atmospheric CO_2 levels during these episodes may have been conducive to the observed evidence of epochs of glaciations and lowered world temperatures.

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Sedimentology of Tight Gas Sandstones: Well Log and Core Evaluation

A cooperative study with the Delta Drilling Company (Tyler, Texas) provided a unique correlation of experimental tools (induced gamma-ray spectroscopy, digital sonic) and commercial tools (natural gamma-ray spectroscopy, high-resolution dipmeter) with petrophysical/geologic measurements on a whole rock core from the tight gas sandstones of the Upper Jurassic Cotton Valley Group in east Texas.

For example, a SARABAND suite of logs and dipmeter analyses processed according to the major genetic units of sedimentation (barrier bar, tidal delta) demonstrates the dynamic conditions of fluvial and shallow-marine (tidal) systems. Induced and natural gamma-ray spectroscopy with a SARABAND presentation yields a stratigraphic analysis of the clay/non-clay fractions and the lithology. Of growing economic importance, fracture containment boundaries to hydraulic fracturing can be predicted from a mechanical properties log—a combination of SARABAND and digital sonic.

The tight gas sandstones are characteristically well-laminated and bedded lithic sandstones with low porosities ($<$ 10%) and low permeabilities ($<$ 0.1 md). The intergranular pores are lined with diagenetic minerals—quartz overgrowths and calcite, and are filled, lined, and/or bridged with non-expandable illite, chlorite, and illite/chlorite mixed-layer clay minerals.

The depositional paleoenvironment of the lower section of the Cotton Valley Group is interpreted as a sequence of shallow-marine, organically burrowed, layered, foreshore-shoreface deposits comprising the above-mentioned major genetic sedimentation units, the barrier bar and the tidal delta.

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Diagenetic Trends in Siliceous Facies of Monterey Formation, California

Much of the unique character of the siliceous facies of the Miocene Monterey Formation stems from diagenesis. At localities in California, soft, porous diatomites and diatomaceous mudrocks give way vertically and laterally to hard, dense, and brittle cherts, porcelanites, and siliceous mudrocks. Vertical lithologic transformations typically occur through several tens of meters of section; lateral changes may span several kilometers or more. A well-documented mineralogic progression from highly disordered amorphous silica (opal-A) to microcrystalline quartz through an intermediate cristobalitic stage (opal-CT) commonly accompanies these changes.

X-ray diffraction analyses of surface and subsurface samples define present boundaries of silica zones. Within the cristobalitic silica zone the d-(101) spacing of opal-CT may vary between 4.12 A and 4.04 A. In the Taft and Chico Martinez areas of the Temblor Range, boundaries between silica zones and stratigraphic horizons are generally parallel. In the Santa Maria region and in the Santa Ynez Mountains, silica zones cut obliquely across stratigraphic horizons. Off central Baja California, the opal-A to opal-CT transition in Monterey-equivalent rocks corresponds to a prominent bottom-parallel seismic reflector.

Time, temperature, and sediment composition affect rates of silica transformations. Oxygen isotopes of opal-CT and quartz provide estimates of the temperatures at which these transformations occurred. In nature the thermal history of any sediment is largely a function of the thermal gradient and sedimentation rate. In the Santa Maria region, most silica conversions probably occurred during the last 3 to 4 m.y. in response to accelerated rates of sedimentation and, therefore, to burial heating during the Pliocene. In contrast, rates of silica transormations in the Monterey Shale in the Cholame area probably varied with proximity to hydrothermally altered intrusive serpentine.

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Authigenic Dolomite in Monterey Formation, California, and Related Rocks from Offshore California and Baja California

Authigenic carbonate rocks occur as thin layers and concretionary zones in the Monterey Formation in California and in equivalent strata off southern California and Baja California. Calcium-rich dolomite (49 to 56 mol % $CaCO_3$) is the dominant carbonate although authigenic calcite also occurs. Sedimentary structures, including laminations and burrows, are common in these carbonate rocks and commonly continue across concretion and layer boundaries. Microtextures run the spectrum from sparsely distributed dolomite crystals in dolomitic mudrocks to dolomites composed completely of interlocking 5 to 10 μm crystals. Dolomite cements and impregnates the host lithology. Dolomitization of existing biogenic carbonate also occurs.

Isotopic and chemical data suggest that these dolomites formed in shallow subsurface zones of high alkalinity spawned by abundant carbon dioxide and methane production during progressive microbial decay of organic matter. Oxygen isotopes range from 23 to 34 ppt SMOW (Monterey dolomites) and from 27 to 35 ppt SMOW (offshore dolomites). Approximate ranges in formation temperatures computed from these values are 17 to 72°C and 10 to 50°C, respectively. Highly variable carbon isotopes, -25 to $+21$ ppt PDB (Monterey dolomites) and -30 to $+16$ ppt PDB (offshore dolomites), reflect the isotopic reservoirs in which the carbonates formed. Oxidation of organic matter through microbial reduction of sulfate at shallow burial depths favors light-carbon dolomites; heavy-carbon dolomites probably formed below this zone