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Overpressuring, Diagenesis, and Fluid Flow at the Matagorda Island 519 Field, Offshore Texas, Gulf of Mexico

The relations between overpressuring, diagenesis, and fluid flow in sedimentary basins are complex and multifaceted. Matagorda Island 519 field (MI519), offshore Texas, provides an excellent area for investigating these relations. The top of overpressure at MI519 occurs at a depth of 3.5 to 3.8 km in a Lower Miocene deltaic sequence. Based on log-derived lithostratigraphy, geochemical, mineralogical, and cuttings information, the precipitation of diagenetic calcite and possibly quartz cement has been the major factor in seal development. Stratigraphic variation in mudstone chemistry indicates diagenesis has been an open-system process, with significant loss of Ca, Si, Mg, and Fe and gain of K in sediments below the pressure seal. Fluid pressures calculated from shale resistivities provide evidence for several vertically-stacked overpressured compartments. Lateral sealing within the overpressured section may be provided by faults. Likely causes of overpressuring at MI519 are clay mineral dewatering, petroleum generation, and a large column of natural gas.

Multiple stages of fluid flow and/or diagenetic development have occurred at MI519: 1) calcite cementation within preferred intervals from fluids that originated by dissolution of updip salt domes, 2) deep overpressure development and upward focused flow of underlying Mesozoic brines and the development of secondary porosity in reservoir beds by carbonate dissolution, 3) precipitation of a seal by mixing of deeply-sourced and updip-sourced fluids, 4) hydrocarbon generation and shallow overpressure development, with hydrocarbons filling in porosity created by calcite dissolution, 5) ''hard'' overpressure development from smectite dehydration, and 6) development of a shallow freshwater lens during the Pleistocene lowstand.