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Occlusion of Porosity in Carbonate Reservoirs by Dickite

Significant amounts of the clay mineral dickite have been found in Lower Cretaceous carbonate rocks of the Maverick basin and in Middle Permian (Guadalupian) carbonate rocks of the Permian basin. Dickite was precipitated in secondary cavities within limestones and dolostones, and in many intervals porosity has been massively occluded. In most voids, precipitation of dickite was preceded by calcite or dolomite cements. In both the Maverick and Permian basins, dickite occurs in carbonate rocks that contain abundant anhydrite. Because dickite is associated with early stages of carbonate diagenesis, it is inferred to have been emplaced near the surface or at shallow depths.

In Permian carbonate rocks of the Permian basin, individual dickite crystals are very large (for clay), ranging up to 180μ in diameter. Dickite crystals occur in large hexagonal platelets. In thin sections most dickite platelets have been transected perpendicular—or at some angle other than parallel—to basal crystal faces; thus individual crystals appear as fibers, and platelets appear as fan-shaped or polygonal fibrous aggregates which closely resemble chalcedony. "Fibrous aggregates" of dickite are length-slow and are easily misidentified as length-slow chalcedony. In Middle Permian carbonate rocks of the Permian basin, much of the material identified as length-slow chalcedony probably is dickite.

When fluids are artificially forced through dickite-bearing carbonate rocks, individual layers can be disaggregated from the platelets and interconnected pores may be blocked by dislodged dickite crystals. In well-stimulation methods, great care must be taken to prevent this migration of fines.

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Precipitation of Authigenic Minerals in Artesia Group (Middle Permian) Sandstones of Permian Basin

Middle Permian Artesia Group sandstones of the Northwestern shelf and Central Basin platform of the Permian basin contain some interesting authigenic minerals (cements) which include clays, sulfates, dolomite, halite, quartz, and orthoclase. To a large degree, diagenetic minerals reflect environments of deposition, although the relation is not always one of cause and effect.

Red-brown and red sandstones were deposited in continental depositional environments which include coastal and continental sabkhas and brine pans, eolian plains, and wadis. Deposition of illuviated clay on grain surfaces formed optically oriented cutans (ferriargillans). The red and red-brown coloration reflects iron oxide pigmentation of clay cutans. Formation of ferriargillans was followed by precipitation of sulfates (anhydrite, gypsum, and hemihydrate), dolomite, and halite. The predominant cements are anhydrite and halite which form large crystals that poikilotopically enclose many sand grains. These poikilotopic cements form a very dense matrix which precludes any accumulation of hydrocarbons.

Most tan, gray, and white sandstones were deposited in peritidal marine environments. In these sands the following succession of diagenetic minerals was precipitated: (1) quartz overgrowths on quartz grains and orthoclase overgrowths on orthoclase grains, (2) dolomite, and (3) sulfates (anhydrite, gypsum, hemihydrate, celestite, and barite). All effective porosity and permeability are in dolomite cements which consist of tiny rhombic crystals. Anhydrite is the predominant sulfate cement and, as in continental sandstones, occurs in large crystals and very dense poikilotopic fabrics which preclude migration of hydrocarbons. The critical factor which controls the economic potential of these sands is the relative proportion of porous, permeable dolomite cements to nonporous anhydrite cement.

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Correlation and Timing of Platform-Margin Megabreccia Deposition, Cow Head and Related Groups, Western Newfoundland

The allochthonous Cow Head Group of Cambrian-Ordovician age is a well-exposed but laterally discontinuous succession of continental-margin deposits. Spectacular megabreccias that punctuate the succession at discrete levels can now be correlated throughout the proximal Cow Head region to the more distal Humber Arm area, and tentatively into the metamorphic terrane of the Fleur-de-Lys, far to the east.

The oldest breccia is of latest Early Cambrian age (Irishtown Formation). It is composed of shallow-water limestone and sandstone (Labrador Group) as well as Precambrian basement clasts in a quartz-sand matrix. Deposition coincides with progradation of supermature quartz arenites out to and over the edge of the shelf margin (Hawke Bay Formation).

The main pulses of megabreccia deposition after the Early Cambrian produced carbonate-rich units. They occurred in the medial Middle Cambrian, near the transition between Cambrian and Ordovician time, and at the transition between the Early and Middle Ordovician. These breccias contain a mixture of clasts, predominantly from the shelf margin and upper part of the slope.

The youngest carbonate megabreccia, lying above the Middle Ordovician Table Head Formation, is autochthonous; it records a massive rearrangement of the continental margin during ophiolite obduction.

Normal platform-margin sediments in this succession, periplatform ooze (ribbon limestone), carbonate turbidites, breccia deposits (of ribbon-limestone clasts and some platform-margin clasts), and shales coincide with flooding of the platform. Megabreccias coincide with major changes in shelf sedimentation or regression, now apparent as formation boundaries.