FACIES, DIAGENESIS, AND POROSITY DEVELOPMENT IN A LOWER CRETACEOUS BANK COMPLEX, EDWARDS LIMESTONE, NORTH CENTRAL TEXAS

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ABSTRACT

An Edwards carbonate bank complex developed on the structurally positive Belton high in north central Texas. Mobile carbonate sand bars, rudist reefs, and beaches of the shallow-water bank differ strikingly from time-equivalent deeper water muds of the Tyler basin to the north, and supratidal dolomites and evaporites of the central Texas platform to the south.

Early stages of bank development are well-exposed near Belton, Texas, and exhibit the following progradational vertical facies succession: open marine basin, shallow grain shoal, rudist reef, exposed beach, subtidal lagoon, and intertidal-supratidal mud flats. Paleocaliche, desiccation cracks, and algal boundstone suggest subaerial exposure of the uppermost unit.

The major diagenetic changes occurred early, and predate regional exposure of the bank complex at the end of Edwards time. Most calcite cementation is early, and associated with local meteoric water tables, where fine crystalline bladed crusts, syntaxial overgrowths, solution-cavity fill, and medium to coarse crystalline equant calcite were precipitated. Early Mg-calcite bladed crusts also formed in the marine or mixing zone environments. Late-stage calcite cementation was limited to coarse crystalline equant calcite.

Most of the dolomite is of multi-stage fresh water mixing origin. Dolomitization of lime muds and calcite cements occurred early, in association with local meteoric water tables, and late, as the result of a meteoric ground water system. Fine crystalline anhedral dolomite in lagoonal and tidal flat facies is of hypersaline origin.

The shoreface and foreshore facies of the beach complex have up to 35 percent (thin section estimated) moldic and interparticle porosity as a result of (1) high original interparticle porosity, (2) early cementation to reduce compaction, (3) aragonite allochem dissolution to produce moldic porosity, (4) subaerial exposure to reduce further cementation, and (5) an early seal to retard fluid migration. The lagoonal and tidal flat facies have up to 20 percent (estimated) moldic and intercrystalline porosity due to (1) dissolution of aragonitic allochems, and (2) partial dolomitization and subsequent dissolution of the lime mud.

HYDROGEN AND OXYGEN ISOTOPIC COMPOSITION OF CHERT FROM THE EDWARDS GROUP, LOWER CRETACEOUS, CENTRAL TEXAS

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ABSTRACT

Oxygen isotopic composition of nodules and beds of replacement chert of the Edwards Group, from outcrop and subsurface of Central Texas, ranges between +30.2 and +33.9 o/oo relative to Standard Mean Ocean Water (SMOW). D/H ratios vary between -26 and -86 o/oo relative to SMOW. Although only 8 samples from the subsurface (maximum depth 3,400 m) and 25 from outcrop have been completely analyzed to date, burial to approximately 3.5 km (approximately 130°C) does not appear to have affected the D018, but may have affected slightly the D of these microquartz cherts. Other forms of silica from both outcrop and subsurface, including megaquartz filling molds resulting from the dissolution of evaporite nodules, replacement megaquartz, and replacement chalcedony, are depleted in D18 relative to the chert nodules, with values as light as +25.5 o/oo.

Microquartz chert probably formed from opal C-T precursors and replaced carbonate sediments which formed and were altered in a variety of environments ranging from hypersaline through meteoric. The variation in the oxygen isotopic composition of waters responsible for diagenesis of these rocks must have exceeded by at least a factor of 2 the observed 4 o/oo range in D018 of these cherts. Possible contamination of chert by later generations of silica (depleted in D18) cannot be excluded as contributing to the observed range and, if present, would further limit the possible range in isotopic composition of water forming the chert. In addition, the D018 of Edwards chert is virtually identical to that of Cretaceous chert from European chalk which formed on open marine shelves. On this basis, silicification under a wide variety of salinity-temperature conditions is ruled out. Contemporaneous silicification under evaporitic conditions is ruled out by calibration with all available silica-water temperature scales. Silicification must have occurred either contemporaneously from solutions having a D018 close to SMOW or in the shallow subsurface at elevated temperature and from D18 enriched water.

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