Rate of Reflux Dolomitization Based on Hydrodynamic Modeling of a Glen Rose Dolostone, Austin, Texas

Shawn M. Fullmer[1] and F. Jerry Lucia[2]

[1]ExxonMobil Upstream Research Company, Houston, Texas

[2]Bureau of Economic Geology, The University of Texas at Austin, University Station, Box X, Austin, Texas 78713-8924

ABSTRACT

Recent advances in the knowledge of dolomitization have been made by constructing hydrodynamic models of reflux dolomitization. These flow models have demonstrated the efficiency of density-driven flow to deliver the large volumes of dolomitizing water needed to form large bodies of dolostone. However, only large regional carbonate systems have been studied and unreasonable permeability values of two to ten darcies were used. To examine a system with more geological and petrophysical constrains we constructed a flow model for a single high-frequency tidal-flat-capped cycle that contains a 1.3 m thick (4.3 ft) reflux dolostone exposed in a road cut along Texas State Highway 360 in Austin, Texas. The permeability profile before dolomitization, which was reconstructed by relating rock fabrics to modern carbonate petrophysical values, resulted in an effective vertical permeability of 297 md (millidarcies). Results of the hypersaline reflux model, using this low-permeability value, showed that the 1.3 m (4.3 ft) thick dolostone body could have formed within a period of 500 yr.

These results demonstrate that density flow is an efficient hydrodynamic process and that large quantities of evaporated seawater, containing a high magnesium concentration, can flow through young carbonate sediments with permeabilities of less than one Darcy in a short period of time. The conclusion that the carbonate body could have been dolomitized in 500 yr suggests that density flow was not continuous during the time interval of evaporate tidal-flat deposition but was periodic. This result raises the question as to the periodicity of the occurrence of density flow in a tidal-flat environment. Density flow may only exist only during times of extreme tidal-flat flooding.

Fullmer, S. M., and F. J. Lucia, 2010, Rate of reflux dolomitization based on hydrodynamic modeling of a Glen Rose dolostone, Austin, Texas: Gulf Coast Association of Geological Societies Transactions, v. 60, p. 291-300.