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Please fill in your abstract title.	Modelling Early Carbonate Diagenesis for Reservoir Quality Prediction: Constitutive Relations from Recent Marine Sediments

Please fill in your author name(s) and company affiliation.

Given Name	Surname	Company
Shuo	Zhang	Aramco Services Company: Aramco Research Center – Houston
Peng	Lu	EXPEC ARC, Saudi Aramco

Abstract

Objectives/Scope: Carbonate diagenesis is intrinsically more complicated to model than sandstones due to the fast reaction kinetics of carbonate minerals. Chemical reactions, fluid flow and deposition of carbonate sediments occur at comparable time scales and therefore cannot be decoupled from each other. Forward depositional and diagenetic modeling is a promising approach for predicting carbonate reservoir quality, especially in undrilled basins or targets.

Methods, Procedures, Process: Recent marine sediments represent a rich natural laboratory for the study of diagenetic processes. The sediments and associated pore fluids have accumulated slowly on the ocean floor over millions of years. Chemical interactions such as dissolution and precipitation of primary and secondary minerals are reflected in the chemical and isotopic composition of the pore fluids. In this study, we first developed a model of the initial depositional porosity, microporosity, and grain fraction from mud content using an empirical dataset from the literature, where porosities of modern carbonate sediments with varying amount of mud content are reported. We then investigated the pore fluid geochemistry of 384 marine sites from the Deep Sea Drilling Program (DSDP) and Ocean Drilling Program (ODP), and evaluated the rates of compaction, cementation, and recrystallization.

Results, Observations, Conclusions: We found that compaction (strain rate) is closely related to recrystallization rate, indicating that pressure-solution is a possible driver for dissolution of calcite. We also found that the precipitation rate of carbonate cement has a linear relationship with sulfate reduction rate, which produces extra alkalinity in the pore fluid and drives carbonate precipitation. Depositional rates of the sediments and the fractions of carbonate minerals in the sediments are identified as primary controls on the sulfate reductions rates.

Novel/Additive Information: The relationships developed in this study provide key constitutive equations for forward depositional and diagenetic modeling.