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Vertical and Lateral Distribution of Dolomitized Reservoirs within a Sequence Stratigraphic Framework, Madison Formation, Wyoming and Montana

Regional cross-sections of the Mississippian Madison Formation in Wyoming and Montana show that most porous dolomite occurs in laterally extensive mud-dominated intervals at the bases of composite sequences and in pervasively dolomitized mud- and grain-dominated carbonates restricted to the middle part of the ramp. The cross-sections were constructed from 14 detailed measured sections of outcrops and cores. More than 2000 plugs were drilled from the outcrops and measured for porosity and permeability, and logs constructed with the porosity data closely resemble porosity logs from nearby oil and gas fields.

Madison reservoirs are vertically partitioned at different scales within a hierarchy of sequences and cycles. The Madison is composed of a single second-order sequence, which is composed of two composite sequences. The composite sequences are composed of two to four third-order sequences, which are in turn composed of numerous higher frequency cycles.

Outcrops from different positions on the ramp can be correlated with cores and logs from nearby oil and gas fields using the sequence stratigraphic framework. The outcrop sedimentology, porosity logs and structural observations help to better understand heterogeneity within the fields.

Composite porosity-permeability plots constructed from plug data show a progressive increase in average permeability from mudstone to grainstone for a given porosity. The dolomitized grainstone fairway in the middle part of the ramp trends parallel to the Transcontinental Arch. We propose a model of focused transgressive reflux dolomitization in which dense dolomitizing brines are concentrated in the middle part of the ramp between the Arch and downdip shoals.