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Porosity Partitioning in Sedimentary Cycles: Implications for Reservoir Modeling

Sedimentary cycles are often considered the smallest flow units within a reservoir. Facies and diagenetic partitioning, however, produce variations in primary and secondary porosity between the transgressive and regressive hemi-cycles and intervals of sequences. Partitioning also influences the fracture pattern and fracture porosity of cycles and sequences. Therefore, the recognition of transgressive and regressive porosity trends in reservoir modeling improves the prediction of flow behavior in reservoirs. In the Mississippian Madison Formation, for example, the transgressive hemi-cycle is commonly mud-rich while the regressive hemi-cycle is grain-dominated. Down dip on the ramp, more than 90% of the mud-dominated strata and less than 5% of the grain-dominated strata is dolomitized. The highest porosity is in the dolomitized transgressive portions of the sequences. In addition, dolomitized transgressive hemicycles show the highest fracture density. In contrast, in the largely undolomitized strata of the Cretaceous Natih-E Formation the best porosity occurs in the regressive portions of cycles and sequences that are dominated by rudist build-ups. Furthermore, mud-rich transgressive hemi-cycles and intervals in the Natih-E Formation are less fractured than the regressive portions of the sequence. Although different in their expression, facies and diagenetic partitioning result in different porosity trends in the transgressive and regressive parts of both formations. The partitioning of primary and secondary as well as fracture porosity occurs on all scales from hemicycles to sequence intervals. Porosity partitioning therefore requires subdividing the strata and the logs into transgressive and regressive intervals in reservoir modeling to accurately capture the porosity distribution.