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AN INTEGRATED STUDY OF POROSITY DISTRIBUTION IN THE UPPER TENSLEEP FORMATION, NATRONA COUNTY, WYOMING

by

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ABSTRACT

Core and log studies of 28 wells in the Casper arch area, Natrona County, Wyoming, indicate that the upper part of the Pennsylvanian Tensleep Formation consists of several regressive-transgressive cycles of eolian to nearshore sandstones and subtidal to coastal marine dolomites. The eolian cross-bedded sandstones are interbedded with interdunal ponds of sandy dolomites and wavy-bedded sandstones.

Porosity logs were normalized for lithology and porosity determination by using an assumed limestone matrix in porosity calculations. Neutron-density logs have the best performance among the logs for porosity determination of the Upper Tensleep Sandstone. All wells that were logged with only a density or a sonic log have been normalized to the neutron-density logs by using the reduced major axis statistical method (RMA). Porosity determinations were made of the Upper Tensleep using core and well log data. Core data were used to calibrate sonic, neutron, and density logs from which porosity values were calculated in 28 wells in the area of study. Core and log analyses indicate that the porosity variation of the Upper Tensleep is a function of lithofacies and tectonics. In general, the eolian dune sandstone facies are more porous and permeable than the marine and interdune carbonate facies. Porosity tends to decrease in lithofacies that record a relative sea level rise due to dolomite content increase. Porosity is enhanced in lithofacies that recorded a relative sea level

fall. In the eolian cross-bedded sandstone, porosity tends to be better developed in grain flow facies than in wind ripple facies.

Tectonics is the second main factor that influenced the Upper Tensleep porosity variation. Structural map and cross sections indicate that the study area was extensively faulted due to the Laramide Orogeny. This extensive faulting facilitated primary dolomite cement dissolution. Cementation subsequently occurred within the Upper Tensleep along the Casper arch area. Maps of average porosity, maximum porosity and total thickness of strata with porosity more than 8, 15, and 20 percent indicate that porosity generally decreases with burial and subsea depths.

Regional correlations show that the Upper Tensleep is unconformably overlain by the Permian Phosphoria Formation. The progressive thinning of the Upper Tensleep towards the north is attributed to the uplift that developed north of the study area after Tensleep deposition. This uplift exposed the Upper Tensleep to more erosion in the northern areas than the southern areas.

Relative sea level changes combined with low-relief of the Wyoming shelf resulted in widespread regressive-transgressive cycles that provide the basis for regional correlations.

A second unconformity may have developed on the Tensleep surface as a result of a dendritic drainage pattern that developed due to the southern tilting caused by the northern paleo high.

Truncation and valley fill trapping mechanisms may have developed in the Upper Tensleep due to relative sea level, tectonic and climatic influences. A truncation trapping mechanism may have developed as a result of the Upper Tensleep thinning towards the north. The possible presence of incised valleys due to a dendritic drainage pattern on the Upper Tensleep surface, which could have formed as a result of two regional unconformities may provide another trapping mechanism. However, the paucity of control impeded somewhat the mapping of this trapping mechanism.

Four orders of heterogeneity were recognized in the Upper Tensleep: First, between dune and extra-dune systems; second, between dune and interdune facies; third, due to the internal arrangement of stratification types within the individual dune facies; and fourth, due to the texture of the dune facies sediments.

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