Facies and Stratal Geometries in Upper Paleozoic Algal Mounds of the Western Orogrande Basin, New Mexico: Preliminary Observations

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ABSTRACT

Phylloid algal mounds form significant hydrocarbon reservoirs within the Paradox and Permian basins; analogous mound systems produce internationally. Mound reservoirs are challenging production targets, however, owing to complex facies and diagenetic attributes that affect porosity and permeability trends. Outcrop analog studies remain the most effective and accurate means for characterizing and modeling these reservoirs. Phylloid algal mound systems of the western Orogrande Basin (Hembrillo Canyon, San Andres Mountains) are exceptionally well exposed and reservoir scale (100 m thick), but have remained relatively understudied owing to their location within the U.S. Army White Sands Missile Range. The purpose of this project is to gather detailed field and analytical data on facies and diagenetic attributes, stratal geometry, and petrophysical properties in order to construct a three-dimensional reservoir simulation model. Here, we present preliminary observations based upon recent field and petrographic work.

Mound systems of the western Orogrande Basin consist of composite multiple mound growth events, punctuated by exposure surfaces (high-frequency sequence boundaries) typically marked by pronounced dolomitization. Mound core facies consist of massively bedded boundstones and cementstones characterized by a dominance of either phylloid algae, dasycladacean algae and/or peloids and cement. Cementstones invariably occupy base-of-cycle (transgressive) positions, whereas other boundstone types grade into one another within a given cycle. Flanking strata consist of thick to medium-bedded peloidal, foraminiferal, and skeletal packstones and grainstones that are locally dolomitized. Preliminary observations suggest that dolomitization trends partly control porosity/permeability trends. Individual mound-growth events (high-frequency sequences) reach thicknesses in excess of 30 m, and composite mounds reach 100 m thick. The studied mounds are erosional remnants, however, and regional relations suggest that intact composite mounds likely exceeded 150 m in thickness.

An outcrop-based reservoir characterization model may be useful for hydrocarbon exploitation of analogous productive mound systems. In the western Orogrande mounds, dolomitization appears to partly control porosity enhancement proximal to paleo-subaerial exposure surfaces (high-frequency sequence boundaries). Such porosity enhancement significantly influences migration pathways and recovery factors in productive systems. Future work on this project will include: (1) detailed petrographic analyses for facies and diagenetic characterization; (2) petrophysical analyses (porosity and permeability measurements) for delineation of flow pathways; and (3) outcrop wireline logging (gamma and sonic) to aid comparison of this outcrop dataset to subsurface analogs. Ultimately, all data will be integrated to create a 3-D reservoir model (e.g., StrataModel) and reservoir simulation (e.g., StrataSim) of this outcrop system.