Lacustrine Carbonate Lithofacies from Micrite to Grainstone and Microbial Boundstone— Hydrocarbon Play-Element Potential and Prediction Within a Lake-Basin-Type Framework

Bohacs, Kevin [1]; Demko, Timothy [1]; Guidry, Sean [2]; Trainor, Dwight [2] (1) ExxonMobil Upstream Research Co, Houston, TX. (2) ExxonMobil Exploration Company, Houston, TX.

Lake systems accumulate a wide variety of carbonate lithofacies that can provide effective hydrocarbon source, reservoir, and seal whose properties vary as a function of lake-basin type (*sensu* Carroll and Bohacs, 1995). Reservoir-prone facies include skeletal grainstone ('coquina'), microbial boundstone, and coated-grain and peloidal grainstone. Micrite, kerogenite, peloidal wackestone, and evaporite have source and seal potential.

Overfilled lake basins have well-developed skeletal, algal, and coated grainstone. Littoral zones accumulate beds of paleoheterodont and heterodont bivalves, prosobranch gastropods, or charophytic algae clasts. Ostracod grainstone occurs as cm-thick beds in sublittoral wackestone to mudstone. Hydrocarbon reservoirs in these facies have porosity of 9 - 26% and permeability of 1 - 2207 mD. Balanced-fill lake basins typically have the best developed microbial boundstone that occurs as isolated to laterally extensive bioherms in shallow sublittoral areas. They are associated with grainstone of wave-reworked microbialites, ooids, and oncoids. Littoral zones accumulate grainstone comprising peloids or pieces of dolomitic crusts eroded from supralittoral areas. Reservoir properties reported—porosity: 15 - 31%, permeability: 30 - 1200 mD. Underfilled lake basins accumulate carbonates that range from basin-margin grainstone and packstone to basin-center evaporite. Littoral zone facies include wave-reworked peloidal grainstone to wackestone along with rudstone ('flat-pebble conglomerate'). Reported reservoir properties—porosity: 14 - 28.5%, permeability: 16 - 430 mD. Evaporite beds contain such carbonate species as trona, nahcolite, natron, and magnesite.

Lake-plain lithofacies also range widely: calcretes and soil nodules are most commonly associated with balanced-fill and overfilled lake basins. Tufa (spring deposits) tend to be best developed along the margins of balanced-fill and underfilled lake basins. Travertine typically occurs in lotic settings associated with overfilled and balanced-fill lake basins.

<p>Each lake-basin type has distinct lithofacies associations that reveal their key controls: hydrologic-state history, drainage-basin provenance lithotypes, and basin shape. These factors influence composition and stability of water chemistry, lake-level-change history, shoreline stability, and wave fetch and effectiveness. Along with biological evolution, they also affect ecosystem structure and trophic-web complexity.