Ten Years After: The Expanding Utility of Lake-Basin-Type Approach from Conventional Source Rocks to Unconventional Resources

Bohacs, Kevin [1]; Carroll, Alan [2] (1) ExxonMobil Upstream Research Co, Houston, TX. (2) University of Wisconsin-Madison, Madison, WI.

The lake-basin-type (LBT) model of Carroll and Bohacs (1999), originally devised to guide exploration for lacustrine source rocks, has proven useful for explaining many aspects of continental depositional systems: siliciclastic and carbonate reservoirs, fluvial-system character, paleosols, and trace fossils, as well as the size distribution of lakes and biological evolution within them. This successful expansion resulted from integration of a wide variety of data, from plate tectonics and seismic through isotopic geochemistry within a process-based framework, along with substantial progress in establishing high-resolution chronostratigraphy, through such techniques as radioisotopic dating, magnetostratigraphy, and astrochronology. The model provides powerful tools for exploration and exploitation of conventional and unconventional hydrocarbon resources that have been valuable in the S. Atlantic, S. Caspian, China, and N. America. <p>The LBT model posits the key proximate controls to be rates of potential accommodation change relative to supply of sediment+water. These governing variables are not, however, simple functions of climate and tectonics, but of their non-linear interactions through hydrology, groundwater, landscape evolution, vegetation, catchment lithotypes, and volcanism. Tectonics acts most directly on potential accommodation through structural movement of the basin floor and spillpoint and through landscape development influence on spillpoint height. Climate has the most direct influence through nutrient and sediment supply, floral type and distribution, and water supply at the parasequence to sequence-set scale. Climate can change significantly without changing LBT and its record is strongly modulated by LBT. LBT changes are relatively abrupt events that occur over 10s to 100s ky and are expressed as sequence boundaries or flooding surfaces. They appear to be commonly due to regional drainage reorganization, based on stratal relations and isotope geochemistry

Overfilled LBTs are characterized by mixed oil-gas-prone sources and fluvial, deltaic and shoreline reservoirs, including skeletal, algal, and coated grainstone. Balanced-fill LBTs tend to have oil-prone sources and both carbonate (microbial boundstone, skeletal and coated grainstone) and clastic reservoirs, as well as the best developed oil shales. Underfilled LBTs typically have oil-prone sources, shoreline-carbonate and clastic sheetflood reservoirs, and significant evaporites.