

Upper Pennsylvanian Incised-Valley & Shelf-Edge Delta Systems in the Eastern Shelf of the Permian Basin

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ABSTRACT

Multiple incised-valley and shelf-edge delta systems record relative sea level cycles during the Late Pennsylvanian and Early Permian on the Eastern Shelf of the Permian Basin (ES). The Lower Cisco Group (LCG) consists of eight cycles and represents the latest Pennsylvanian episode of progradational siliciclastic and aggradational carbonate environments. The LCG ranges from 198 m (650 ft) in updip areas up to 427 m (1,400 ft) along the shelf margin. Although there is a general consensus about the regional stratigraphic framework, this detailed study documents a complex depositional history in each cycle, with implications for successful field extension and identification of new exploration targets. This study identifies fluvial incised-valley systems, delineates their regional extent, and links them spatially to shelf-edge deltas in the southern ES. A dataset of >3,300 wells in an area of 7,500 km² (2,900 mi²) is the basis for detailed correlations and subsurface maps for each system. Four cores and eight thin sections in these fluvial systems reveal the vertical lithologic succession, mineralogy, and diagenetic framework. By applying a sequence-stratigraphic approach, a one-cycle paleogeographic succession is: (1) TST carbonate ramp, (2) HST carbonate ramp and deltas, (3) FSST incised-valleys, (4) LST shelf-edge deltas. The Lower Hope Sandstone is a representative fluvial system in the study area. This unit and two others have the generic name of King Sandstone; however, they have different ages and depositional trends. Each sandstone represents an independent cycle of fluvial incision and later shelf-edge delta progradation that constructed up to 155 km² (60 mi²) of new shelf. Both processes are co-related and together constitute significant lateral and vertical facies variations. This mechanism explains the formation of the ES through time, creating a predictive approach to explore for underdeveloped fluvial sandstones in the Eastern Shelf of the Permian Basin.

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