Source-to-Sink Sediment Volumes Within a Tectono-Stratigraphic Model for a Laramide Shelf-to-Deep-Water Basin

Carvajal, Cristian [1]; Steel, Ronald J.[2] (1) Exploration Technology Company, Chevron, Houston, TX. (2) Jackson School of Geosciences, The University of Texas, Austin, TX.

Sediment facies and volume partitioning analysis is integrated into a new tectonic-stratigraphic model of a shelf-to-deep-water Laramide basin and its source-to-sink system. In the Maastrichtian Lewis-Fox Hills shelf margin of the Washakie and Great Divide basins (S. Wyoming), subsurface correlation of logs from about 500 wells allows the quantification of sediment facies and volume partitioning at a basin scale and at high resolution within 15 shelf-margin clinothems, each about 100 ky.

Analysis of volumes and clinothem architecture through the basin succession suggest a two-stage tectono-stratigraphic model for basin infill. During stage 1, clinothems prograded into deepening basinal-waters and developed a marked aggradational architecture with wide marine topsets, which suggest a high and rising rate of relative sea level interpreted to result from increasing rates of tectonic subsidence due to thrust-driven uplift and crustal loading. Stage 1 clinothems show increasing sediment volumes and average rate of sediment supply reflecting margin growth and the inferred uplift respectively. During stage 2, clinothems of the shelf margin accreted into relatively stable to slightly deepening water depths and developed progradational architectures with wider terrestrial topsets, which indicate lower rates of sea level rise and of tectonic subsidence, pointing to diminishing thrust loading. Stage 2 clinothems show decreasing sediment volumes, but higher average supply rate possibly reflecting continued hinterland uplift through isostatic rebound. Through stages 1 and 2, average catchment area, river load to the ocean, sediment yield and denudation rates are estimated at approximately 23,000 km2, 11 x 109 kg/y, 500 ton/km2/y, and 0.15 mm/y respectively. Continuous uplift of hinterlands, estimated at a few mm/y, resulted in a sandier sediment supply through time increasing the sand/mud ratio of the basin deposits. Average maximum hinterland relief is estimated at ~1600 m and absolute maximum relief at 2000-3000 m.