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Sandstone and Shale Compaction Curves Derived from Sonic and Gamma Ray Logs in Offshore Wells, North Slope, Alaska—Parameters for Basin Modeling

Representative compaction curves for the principal lithologies are essential input for reliable models of basin evolution and thermal history. To determine porosity-depth (compaction) functions for the sandstones and shales in the Colville basin, we examined the sonic and gamma ray logs from 25 offshore wells where significant erosion is least likely to have occurred. Our data are primarily from the Cretaceous-Tertiary Brookian sequence and are less complete for older sequences.

For each well, the fraction of shale (Vsh) at a given depth was estimated from the gamma ray log, and porosity was computed from sonic travel time. By compositing porosities for the near-pure sand (Vsh < 15%) and shale (Vsh > 85%) endmembers in individual wells we obtained data over sufficient depth intervals to define sandstone and shale 'master' compaction curves. Preliminary results yield the following constants for the Athy (1930) porosity-depth equation for the sandstone and shale curves, respectively: initial porosity=0.47, 0.49; compaction coefficient (1/km)=0.29, 0.59. Log-derived porosities for sand/shale mixtures (0.15 < Vsh < 0.85) are reasonably well represented by harmonic averages of porosities from our endmember curves. These empirically derived 'master' compaction curves appear valid for offshore North Slope wells from ANWR to NPRA. Where erosion was significant, comparison of measured porosity-depth profiles with the 'master' compaction curves allows estimates of maximum burial and erosion. Typical erosion estimates in NPRA range from 1500' in north to 10,000' in the foothills. Future work will use these 'master' compaction curves to model burial/thermal histories throughout the Colville basin.