Reservoir Architecture and Spatial Recognition of Stratal Packages of the Lower Grand Rapids Formation, Taiga Project, Cold Lake, Alberta

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The Taiga Project is a thermal recovery scheme in eastern Alberta within the Cold Lake oil sands region hosted, in part, within Albian Lower Grands Rapids Formation sandstones. The Lower Grand Rapids ranges in thickness from 54 to 69 m within the project area and has a complex reservoir architecture. Linkage of reflector geometry from 31.5 km2 3D seismic with information obtained from cores and logs within 58 wells was used to map the spatial relationships between six stratal packages (SP1-SP6) and delineate the reservoir.

The main reservoir, SP1 is a coarsening-up shoreface sandstone with a rooted paleosol at the top and ranges in thickness from 3-40 m. SP1 displays high amplitude internal reflections parallel to the base that are truncated at the intersection with SP2 in the east. SP2 and SP3 are muddy heterolithic strata with the inclined seismic reflectors of SP2 truncating the nearly flat, semi-parallel reflectors of SP3. SP4 caps the SP1-SP3 package and is thin and widely correlatable with parallel internal reflectors. Thin interbeds of sandstone and mudstone with restricted trace fossils, ripples and thin coal beds form SP4. SP5 is a channel-like feature, formed of medium-grained cross-bedded sand with mud clasts and a high oil saturation, that nestles within the SP1 to SP4 succession. The reflection geometry of SP5 varies from highly chaotic to inclined. The upper stratal package, SP6, caps the Lower Grand Rapids and is very similar to SP4.

SP1 thickness variation is attributed to a 30-35 m thick succession, formed of SP2 to SP5, that was deposited subsequent to erosion of the main reservoir interval. The erosional surface was filled in by fluvial (SP2) and estuarine (SP3) sediments as the area was transgressed. SP4 and, by analogy, SP6 were deposited within areally extensive accommodation space and display sediments analogous to those found within tidal flats. SP5 is interpreted to be a significant channel fill lense encased within tidal flat sediments.

The integration of high-resolution seismic data with well control has demonstrated the systematic reservoir variability of what promises to be a significant new thermal recovery target within Canada's heavy oil resources.