

Lower Upper Triassic (Carnian) Stratigraphy and Depositional History, Sverdrup Basin, Canadian Arctic Islands

Ashton F. Embry*

Geological Survey of Canada, Calgary, AB

aembry@nrcan.gc.ca

Carnian (Lower Upper Triassic) strata occur throughout the Sverdrup Basin and are up to 1500 m thick. The strata outcrop in the Eurekan fold and thrust belt of the Eastern Arctic Islands and are confined almost exclusively to the subsurface in the western portion of the Sverdrup Basin. The strata consist mainly of siliclastics and the main sediment source area was Crockerland, a low lying land area which lay to the north of the basin. The Greenland and Canadian cratonic areas, to the east and south respectively, also contributed sediment. Notably, carbonate units were also deposited in the Carnian and this was the only time in the Mesozoic when carbonate sedimentation was widespread and long-lasting.

On the basin flanks, the Carnian succession is bound above and below by major unconformities and it comprises a second order sequence. The unconformities are everywhere unconformable shoreline ravinements which formed when previously developed, subaerial unconformities were transgressed and eroded. The sequence boundaries can be traced basinward where they consist of prominent, maximum regressive surfaces. Significant depositional and tectonic shifts occurred across both the lower and upper sequence boundaries and both were formed by tectonic uplift followed by collapse and rapid transgression. The relatively brief, tectonic episodes which resulted in the formation of these major, 2nd order sequence boundaries appear to be related to plate tectonic readjustments, given that similar age, tectonically-driven, sequence boundaries occur in basins throughout the world, including the WCSB.

The 2nd order Carnian sequence contains two, 3rd order sequence boundaries which can be correlated throughout the basin and allow the delineation of three 3rd order Carnian sequences. These boundaries consist of unconformable shoreline ravinements on the basin flanks and maximum regressive surfaces farther basinward. Depositional and/or tectonic changes across these smaller magnitude boundaries are subtle. They are of tectonic origin as demonstrated by tilt geometries on the basin flanks. These 3rd order boundaries appear to also be related to mantle-driven, plate tectonic activity, given their occurrence in basins on different continents.

The basal 3rd order Carnian sequence (early Carnian) consists of a thin, limestone-dominant transgressive systems tract and an overlying, thick regressive systems tract (RST) (maximum thickness 600 m). The RST consists of a basinward-thickening, progradational, outer shelf to slope shale and siltstone unit (upper Murray Harbour Fm) gradationally overlain by inner to mid shelf, silty limestone (Gore Point Member). In the northwestern part of the basin, sandstone units derived from Crockerland form the upper portion of the

RST. The unconformity which caps this sequence extends quite far basinward and the sequence is sometimes absent on the basin flanks.

The middle 3rd order Carnian sequence (Mid-Carnian) consists of a thin, transgressive limestone unit which is overlain by a diverse RST. In the eastern Sverdrup Basin, the RST consists of offshore shelf to slope shale and siltstone (lower Hoyle Bay Fm) overlain by shallow shelf sandstone (lower Pat Pay Fm) on the basin flanks. The clastics were derived from both Crockerland to the north and the Greenland craton to the east. In the western Sverdrup Basin, where subsidence was less and the area was a broad marine shelf, the RST consists mainly of a southward-prograding succession of outer shelf shale and siltstone overlain by thick, inner to mid shelf sandstone and minor limestone. On the southwest flank of the basin, the RST consists of bituminous shale overlain by mid to inner shelf limestone (Eden Bay Mbr).

The facies distribution in the upper 3rd order sequence (Upper Carnian) in the eastern Sverdrup Basin is very similar to the underlying sequence with northerly and easterly derived sandstones on the basin flank giving way to thick outer shelf to slope shale and siltstone basinward, In the western Sverdrup Basin, the Crockerland-derived sands (upper Pat Bay Fm) prograded southward across almost the entire basin to merge with southerly-derived sediment.

The Carnian succession contains potential reservoir units and excellent petroleum source rocks. Potential traps are associated with unconformities, facies changes, salt domes and swells, and Eureka structures.