

Stratigraphy and Hydrocarbon Potential of the Mesozoic Strata of the Sverdrup Basin, Canadian Arctic Archipelago

Ashton Embry*

Geological Survey of Canada-Calgary
3303 33rd St NW, Calgary, AB, T2L 2A7
aembry@nrcan.gc.ca

Mesozoic strata in the Sverdrup Basin of the Canadian Arctic Archipelago are up to 9 km thick and cover an area of about 300,000 km. All stages are represented and the succession consists almost entirely of siliciclastic strata. The main source areas for the sediments lay to the east and north of the basin and encompassed mainly Paleozoic sediments. Precambrian rocks may have become exposed and contributed sediment by Cretaceous. A secondary source area lay to the northwest but its contribution was relatively minor. Sediment supply varied markedly throughout the Mesozoic from high rates of supply characterized by thick deltaic sediments to low rates characterized by thin, reworked shelf deposits.

Major changes in base level, due mainly to tectonic movements, affected the basin and resulted in the generation of twelve second order sequences. Each of these sequences is bound by widespread unconformities on the basin margins with the sequence boundaries becoming conformities further basinward. Halokinetic salt structures, originating from deeply buried Carboniferous halite, also affected Mesozoic sedimentation and stratigraphy. A variety of structures including circular diapirs, long linear ridges, salt-cored anticlines and lag domes deform the Mesozoic succession. The salt structures started growing in Early Triassic. The Mesozoic succession is also intruded by diabase dikes and sills which were emplaced in Early to early Late Cretaceous. The volume of intrusive material decreases from northeast to southwest.

The Mesozoic strata were uplifted and deformed in Eocene during the Eureka Orogeny. In the east the strata are highly deformed by thrust faults and high amplitude folds. Deformation decreases westward with only a few broad folds being present in the southwestern portion of the basin.

The hydrocarbon potential of the Mesozoic succession is rated as excellent with numerous reservoir and seal intervals being present throughout the basin. Rich source rocks occur in the Middle and Upper Triassic sequences over much of the basin and TOCs up to 15% have been recorded. The organic matter is mainly of marine origin (type 2). These source strata are mature along much of the basin margin and over large areas of the southwestern portion of the basin. They are mainly overmature over the central and eastern portions of the basin. There can be little doubt that very large volumes of oil and gas were generated from these strata in the Cretaceous and Tertiary and it is likely that a substantial amount remains trapped within the basin.

About 120 wells have penetrated the Mesozoic succession and seventeen oil and/or gas fields have been discovered. Natural gas dominates the hydrocarbons discovered so far and recoverable reserves are estimated to be over 17 TCF (500 million cubic metres). Four fields contain in excess of 1 TCF with another five containing between .5 and 1 TCF. Recoverable oil is estimated to be between 300 and 500 million barrels (50-80 million cubic metres).

Prospective plays include Tertiary anticlines and a wide variety of structural-stratigraphic traps associated with sequence boundaries and/or salt structures. The most prospective horizons include sandstones within the Bjerne Formation, the Schei Point Group, the Heiberg Group and the Avingak Formation. Ultimate recoverable reserves for the Mesozoic strata of the Sverdrup Basin may be 5-10 times that which has already been discovered by the first 120 wells in the basin.