Late Jurassic – Earliest Cretaceous Stratigraphy, Depositional History and Petroleum Potential, Canadian Arctic Archipelago

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Abstract

The Late Jurassic to earliest Cretaceous (Oxfordian- Valanginian) strata of Sverdrup Basin and Banks Basin are up to one kilometre thick and consist of the Ringnes Formation (shale/siltstone- dominant), Awingak Formation (sandstone-dominant), Deer Bay Formation (shale/siltstone-dominant), and lowermost Isachsen Formation (sandstone-dominant). The strata comprise a single, second order sequence and are bound by the base Oxfordian, second-order sequence boundary below and the base Hauterivian, first order sequence boundary above. The Oxfordian-Valanginian sequence contains two, third order sequence boundaries of base Tithonian and late Berriasian age and these subdivide the sequence into three, third order sequences.

The margins of the Sverdrup Basin were uplifted in latest Middle Jurassic resulting in the formation of a widespread unconformity. The margins were transgressed in earliest Oxfordian with a basal transgressive sandstone developed in some areas. A wave-dominated delta prograded into the basin from the southeastern reentrant during the Oxfordian and Kimmeridgian. Delta front deposits are widespread over the eastern portion of the basin and along the southern margin to the west. Six 4th order sequences have been delineated in these strata and may be of eustatic origin. The basinward edge of these sand-rich delta front deposits is well defined and stretches southwestwards from northern Axel Heiberg Island to northwest Melville Island.

Rifting parallel to the Amerasia Basin began in early Oxfordian on Banks Island forming Banks Basin. A basal sandstone is present with the remainder of the persevered, Oxfordian-Kimmeridgian sequence consisting of offshore marine siltstone and shale.

Marginal uplift occurred in latest Kimmeridgian and a transgression in earliest Tithonian initiated the next sequence. Over most of Sverdrup and Banks basins the Tithonian to Berriasian 3rd order sequence consists of offshore marine shale and siltstone. Nearshore to shoreline sand deposits occur along the southern margin of Sverdrup Basin and did not prograde very far into the basin. Five 4th order sequences are recognized in these sand-rich deposits. Marginal uplift in late Berriasian terminated the sequence and isolated, very coarse grained sandstone deposits derived from rift shoulders occur along the northern margin of Sverdrup Basin.

A transgression occurred in earliest Valanginian and basin subsidence notably increased. This was followed by a major regression which culminated in nonmarine deposition in the central portion of Sverdrup Basin. The sequence was terminated by uplift over all of Sverdrup and Banks basins.

The Oxfordian-Valanginian sequence is interpreted to coincide with the final phases of rifting and hyper-extension of continental crust in the Amerasia Basin. The 1st order sequence boundary which caps the sequence is coeval with the initiation of MORB sea floor spreading in Amerasia Basin. The climate of the Oxfordian to Valanginian included very cool intervals as evidenced by the occasional presence of large drop stones and glendonites.

Major gas and oil fields have been discovered in Kimmeridgian sandstones which are excellent reservoirs. Significant potential exists for future discoveries especially in areas near the shale-out of the sandstones where combination structural-stratigraphic traps can be envisioned. Isolated late Berriasian sandstones along the northern margin also have potential and are analogous to the oil-bearing Alpine sandstone of Alaska.