20th International Sedimentological Congress (ISC), 13-17 August, 2018, Quebec City

The Sverdrup Basin of Arctic Canada: Canada's Top Sedimentary Laboratory

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About half of Canada's landmass is covered with sedimentary rocks that can be found in dozens of onshore and offshore basins. Of these, none comes close to the Sverdrup Basin of the Canadian Arctic Archipelago for its exceptional exposures of the widest and thickest varieties of sedimentary rocks that accumulated in environments ranging from fluvial to deep marine during various tectonic episodes of basin development. Spectacular vegetation-free outcrops in the eastern Arctic (Ellesmere and Axel Heiberg islands) resulted from major uplift during the Paleogene (Eurekan Orogeny) and subsequent glacial erosion, providing the surface mirror of a subsurface succession to the west which has been successfully explored for oil and gas. The Sverdrup Basin is 1300 km long, some 400 km wide and contains up to 13 km of upper Paleozoic, Mesozoic and Paleogene strata in addition to volcanic rocks. The basin is a known petroleum province with 19 oil and gas field discovered in the 1970s, including Canada's two largest gas fields, Drake and Hecla, on Melville Island. While the Mesozoic and Cenozoic succession is entirely clastic-dominated, the Carboniferous and Permian succession comprises nearly the entire spectrum of sedimentary rocks and thus constitutes an open text-book of depositional environments and their deposits.

This talk is an overview of the Carboniferous and Permian Sverdrup Basin as viewed through the prisms of four different sedimentary rock types—clastics, evaporites, carbonates and cherts. Each rock type tells a story that relates to various episodes of basin evolution. Clastics: Late Mississippian and Early Pennsylvanian pebble to boulder conglomerates provide a rich record of fluvial and alluvial fan deposition in a series of half-grabens at a time of rifting. Evaporites: Early and Late Pennsylvanian subaqueous evaporites (anhydrite, gypsum, halite) are indicative of marine incursions in sub-basins that were not yet fully connected with the world's oceans. Carbonates: A rapid Early Permian shift from photozoan warm-water to heterozoan cool-water carbonates at a time of global warming calls for an oceanographic explanation that involves closure of the Uralian seaway with the Tethys Ocean several thousands of kilometres to the east. Chert: The Early to Late Permian deep to shallow water expansion of spiculitic chert contemporaneous with the eradication of biogenic carbonate factories on shallow shelves is explained by ocean acidification, shoaling of the calcite lysocline and upwelling along the western margin of Pangea. These four sedimentological vignettes provide but a glimpse of the extraordinarily rich mosaic of facies and environments that can be found in Canada's High Arctic. Thanks to the exceptional quality of its outcrops, the wide spectrum of its sedimentary facies and the large variety of environments they represent, not to mention its location perched in the northernmost islands of Canada, the Sverdrup Basin is without much of a doubt Canada's top sedimentary laboratory.