

Sedimentology and Diagenesis of Hondo Evaporites within the Grosmont Giant Heavy Oil Carbonate Reservoir, Alberta, Canada

Mary L. Borrero and Hans G. Machel
University of Alberta, Edmonton, AB, Canada.

The Hondo Member is an evaporite-carbonate unit deposited during Givetian-Frasnian time near the top of the Grosmont Formation, which is a giant carbonate heavy oil/bitumen reservoir in Alberta with an estimated 318 billion barrels of bitumen in place. The Grosmont/Hondo is located at depths ranging between 35-1200m. At present the reservoir is not under production due to its sedimentological and diagenetic complexity, the high bitumen viscosity (>1 million cP), and the high production-development costs. Nevertheless, several in-situ recovery schemes are under consideration.

Evaporite minerals in the Hondo are represented by gypsum and anhydrite, which are grouped into two categories: primary and secondary. The first group shows depositional features and five lithofacies where sulfate and fine-crystalline dolomite are intimately associated, as defined in the type section well: lamination of anhydrite and dolomudstones; mosaic anhydrite with cyanobacterial mats; displacive anhydrite; nodular anhydrite; and breccias. Secondary sulfates were formed by precipitation from diagenetic solutions and are represented by anhydrite nodules and cement in molds or in fractures throughout the Grosmont, but especially in the upper part. Rare halite pseudomorphs indicate that the brines reached or exceeded halite saturation at least occasionally during Hondo times. Generally, however, the Hondo brines appear to have had salinities between mesohaline and less than halite saturation. Based on strontium, sulfur, oxygen and carbon isotope data, the Hondo brines were of marine parentage.

Important aspects of the diagenesis in the Hondo sulfates have been established as anhydritization-gypsification, syndimentary dissolution forming breccias, and several epigenetic processes, including karstification, cementation, recrystallization, and dolomitization. As a result, the porosity and permeability distributions are remarkably heterogeneous within the Grosmont and Hondo.

The spatial distribution of the primary Hondo sulfates has been reconstructed based on core, cuttings and log interpretation. It appears that the Hondo was deposited in a series of small shallow subaqueous-salina ponds or in an extensive lagoon with a probably depth from 2 to 5 meters (within the photic zone). Modern analogs for the Hondo sulfates are the Abu Dhabi coast and the carbonate platform in the Andros Island in the Bahamas, which is perhaps the best recent analog for the Grosmont/Hondo.