A Petrographic Comparison of Sandstones from the Hibernia Formation, Mississauga Sands and the Avalon Formation

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SUMMARY

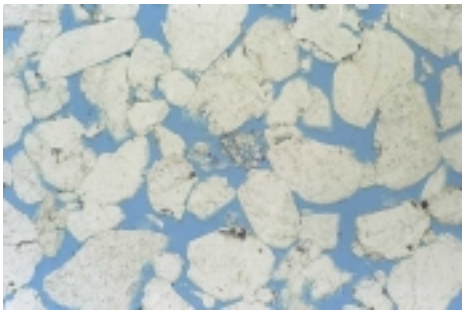
This report contains the results and comparisons of petrographic studies completed on early Cretaceous sandstones taken from the Hibernia Formation, the Mississauga Sands, the Avalon Formation and the Ben Nevis Formation, located in fault blocks off the east coast of Canada. Thin section descriptions were undertaken to clarify the relationship between depositional texture and diagenesis. The actual cores were not examined, however, core photographs were consulted.

The main controls on porosity and permeability of the sandstones in these petrographic studies include authigenic minerals/cements, degree of cementation, matrix clays, clay-rich sedimentary lithoclasts, in addition to textural characteristics (predominantly grain size).

HIBERNIA FORMATION

Petrographic analysis of the Hibernia Formation in one well shows it to be texturally immature, with poorly to well sorted, subangular to subrounded grains. The petrographic evidence, in conjunction with core gamma log responses and core log data, suggests a series of stacked perennially flowing fluvial interdistributary channel sandstones (higher energy) and shale/mudstone (lower energy) complexes.

The lower sedimentary sequence penetrated in another Hibernia well, characterized by a blocky core gamma profile, consists primarily of mature quartz arenites/sublitharenites, representing a high energy fluvial setting. In contrast, the upper sedimentary sequence of this same well consists of a series of stacked argillaceous quartz arenites passing upwards into sublitharenites capped by siltstones. A lower energy depositional environment, such as an interdistributary bay, is suggested based on mineralogy (marine and terrigenous influence) plus matrix clay content, common bioturbation, and sedimentary structures (?sandy tidal couplets, storm washovers).



The diagenetic sequence in the Hibernia sandstones includes, i) the precipitation of finely crystalline grain rimming siderite, grain rimming clays and pyrite as early

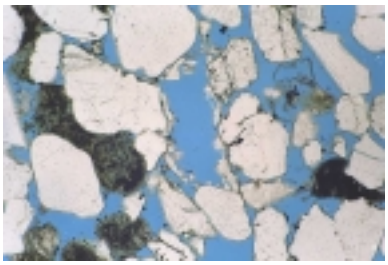
diagenetic phases, ii) precipitation of poorly developed quartz overgrowths, separated by thin dark (“dust”) rims of clay from the rounded detrital monocrystalline quartz “host” grains, partially filling primary intergranular pore spaces, iii) cementation of intergranular pore spaces by calcite and local patches of barite, iv) development of secondary porosity, and “oversized” pore spaces (larger than adjacent grains), as a result of partial to total leaching of calcite and feldspars. Evidence for leaching includes corroded remnants of calcite, honeycombed relict K-feldspar, and clays outlining former grains, embayment of quartz overgrowths and quartz grains aggressively replaced by calcite, subsequently leached to provide moderately well interconnected pore throats, v) kaolinite precipitation after dissolution (which released Al and Si ions into the pore system).

MISSISSAUGA SANDS

Samples selected for thin section analysis within the Mississauga Sands are similar in several aspects, including framework composition, matrix content, pore types, authigenic cements, textural characteristics, core log data and core gamma response. From petrographic analysis and core data integration the following comments can be made:

The sedimentary succession is characterized by an upward fining, bioturbated, poorly sorted, very fine to coarse grained, ferroan carbonate cemented argillaceous quartz arenites/sublitharenites. Matrix consists of abundant brown detrital clay and sideritized clay fines concentrated towards the upper portion of the lower zone, as delineated in the core gamma response. Diagenetic minerals include minor to abundant ferroan calcite, ferroan dolomite, common replacive pyrite, plus traces of vermicular kaolinite. Abundant carbonate cement is associated with samples of greater sideritized clay content.

From petrographic analysis the following paragenetic sequence can be speculated for the Mississauga sandstones: i) precipitation of finely crystalline grain rimming chlorite, sideritized clay fines, grain rimming clays and pyrite are early diagenetic phases, ii) volcanic lithoclasts probably supplied the Fe and Mg required for the precipitation of chlorite, iii) precipitation of poor to well developed quartz overgrowths, separated by thin rims of chlorite/other clays from the detrital framework “host” grains, iv) cementation of intergranular pore spaces by calcite and ferroan carbonates, v) development of secondary porosity and “oversized pore spaces”, as a result of partial to total leaching of carbonates and feldspars. Honeycombed relict K-feldspar and clays/chlorite outlining former quartz grains (moldic porosity) are characteristic of secondary grain dissolution.



AVALON FORMATION

The thick sedimentary sequence of sandstones penetrated in the Avalon Formation are mineralogically very similar and predominantly texturally mature. The sandstones are dominated by very fine to fine grained, predominantly very well sorted sublitharenites with lesser quartz arenites, subarkoses and litharenites, with massive to faint parallel laminae textures visible in thin section. Diagenetic minerals, distributed throughout the samples, include ubiquitous poor to well developed quartz overgrowths, epitaxial poorly developed to poikilotopic ferroan calcite, traces of pore-filling well developed ferroan dolomite, barite partially filling tension gashes, rhombic siderite, replacive pyrite and grain rimming chlorite.