Petrography and diagenesis of reservoir sandstones, Hibernia oil field, Jeanne d'Arc Basin

Iftikhar Abid and John Harper
Department of Earth Sciences, Memorial University of Newfoundland, St. John's, Newfoundland A1B 3X5, Canada

Reservoir sandstones of the Hibernia oil field (1600-5000 m subsurface depths) were investigated to establish paragenetic sequences of diagenetic events and to evaluate the effects of burial on reservoir porosity with increasing depth.

Major early to late diagenetic sequences in sandstones are summarized as: thin chlorite rims, siderite (δC^{13}-7.66PDB and δO^{18}-5.26PDB), quartz overgrowths, early pyrite, early ferroan calcite (δC^{13}-1.64 and δO^{18}-6.66), dissolution (dominantly of calcite) and generation of secondary porosity, late ferroan calcite (δC^{13}-10.92 and δO^{18}-8.85)/ late ferroan dolomite (δC^{13}-5.06 and δO^{18}-7.31), late quartz overgrowths, kaolinite, late pyrite, migration of hydrocarbons. Late ferroan dolomite with curved cleavages and sweeping extinction resembles saddle dolomite (common in carbonates) and has not previously been reported from sandstones.

Porosity in the fine-grained, loosely packed, diagenetically immature Barremian-Albian Avalon/Ben Nevis Sandstone is mainly primary. The fraction of the total porosity which is secondary in origin increases gradually with depth from 20% in the Avalon/Ben Nevis Sandstone to >80% in the diagenetically mature Tithonian-Berriasian Hibernia Sandstone. Aggressive pore fluids required for dissolution are inferred to have been provided by multiple complex reactions in organic-matter rich Kimmeridgian shales and shales interbedded in the reservoir sandstones of the Jeanne d'Arc Basin.