Diagenetic cements in sandstones of the Scotian Basin: a record of fluid circulation and thermal evolution

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Diagenetic minerals in Jurassic–Cretaceous sandstones of the Scotian Basin preserve a record of its fluid geochemistry and thermal evolution. Diagenesis starts at the seabed, in concentric coated grains that now include chamosite, francolite, siderite and pyrite, and berthierine forms from terrestrial clay or volcanic ash coatings on sand grains. Early carbonate cement formed in transgressive or highstand firmgrounds. Where marine lowstands allowed circulation of meteoric groundwater, kaolinite and minor titania cement formed. Silica cement is widespread as overgrowths on quartz framework grains, except where quartz grains have chlorite rims, which probably developed from coats of volcanic ash or soil. Widespread ferroan calcite cement postdates silica overgrowths.

Thick sandstones commonly have pervasive secondary porosity resulting from dissolution of framework quartz and feldspar and early cements, which is partly filled by ankerite and by fibrous illite and chlorite. The last phase of diagenetic cementation includes barite, sphalerite, kutnohorite, and a titania mineral. Fluid inclusion studies show that hydrocarbon charge postdates the main phase of silica and ferroan calcite cementation and may be synchronous with the widespread dissolution. The high salinity of some fluid inclusions, S isotope data, and the presence of sphalerite all indicate an important role for brines from the Late Triassic Argo Formation evaporites, and outgrowths on zircon suggest zirconium mobility in hot sub-salt strata. The complex thermal history of the basin results from (a) high regional Aptian–Albian heat flow manifested by Aptian volcanism, and (b) episodic Cretaceous–Paleogene up-dip migration of hot brines from the deeper parts of the basin. Changing fluid chemistry and thermal conditions had a strong influence on the diagenetic evolution of the basin and hence reservoir quality.

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