Hydrocarbon migration and thermal history of reservoir sandstones deduced from fluid inclusions, Scotian Basin, offshore eastern Canada

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Fluid-inclusion studies of Lower Cretaceous reservoir sandstones of the Scotian Basin provide constraints on the fluid migration history. The presence of primary fluid inclusions in different cements in the diagenetic sequence is evidence for entrapment of fluids at more than one time. 237 primary and secondary fluid inclusions were analysed from 11 samples from the Glenelg and Venture fields and the Thebaud I-93 and Chebucto K-90 wells. Homogenization temperatures in the primary aqueous inclusions hosted in late carbonate cements range from 122 to 137 °C, whereas in quartz overgrowths are slightly lower (110 to 124 °C). The ice melting temperatures from primary inclusions in both cements indicate high fluid salinities (18.3 to 22.8 wt.% NaCl equivalent). Secondary inclusions with liquid hydrocarbons have similar homogenization temperatures to primary inclusions, but the melting temperatures indicate dilute fluids (3.2 to 8.5 wt.% NaCl equivalent). In Venture wells, primary and secondary aqueous inclusions have lower homogenization and ice melting temperatures than in the other wells. They also contain a different type of secondary CO_2 inclusion, with CO_2 melting temperatures (avg. -57.6 °C) indicating the presence of hydrocarbons and homogenization temperatures (avg. -10.2 °C) indicating a high density carbonic phase. These data show that hydrocarbon migration postdates the late carbonate cementation and the gas reservoir was charged by saline and dilute fluids. The temperatures determined from the studied wells are higher than present temperatures, implying a thermal maximum at an unknown time in the past. There is no evidence for basin inversion in these wells, suggesting the involvement of hot fluids and a higher geothermal gradient than the present ~30 °C/ km. The fluid inclusion and published apatite fission-track data are consistent with a geothermal gradient of ~80 °C/ km in the Mid Cretaceous or ~50 °C/ km near the K/T boundary.

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