AAPG Search and Discovery Article #90007©2002 AAPG Annual Meeting, Houston, Texas, March 1-13, 2002

AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

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Cement Geochemistry of Photozoan Carbonate Strata (Upper Carboniferous-Lower Permian), Finnmark Carbonate Platform, Norwegian Barents Sea

Stable-isotope, petrographic, microprobe, and fluid inclusion analyses have been carried out on calcite and dolomite cements from well cores covering the 300-m-thick lower stratigraphic portion (upper Moscovian-lower Sakmarian) of the Finnmark carbonate platform. Cathodoluminescence petrography and microprobe profiling show 3 stages of cement growth in phylloid algal-*Palaeoaplysina* buildups: (1) eogenetic (fine; <0.1 mm) marine and meteoric cements, showing gradual transition to (2) mesogenetic (coarser) calcite and dolomite, and (3) saddle dolomite and anhydrite.

Fluid inclusion data show that high-salinity brines replaced earlier marine to meteoric pore waters throughout the entire section prior to precipitation of the mesogenetic cements, possibly resulting from a series of brine reflux episodes during successive stages of platform deposition. Free hydrocarbon phases were absent during mesogenetic cement growth.

Carbon isotopic variations are mainly determined by proximity of shale-rich beds, from which isotopically negative organic carbon was released during burial diagenesis to mix with isotopically positive marine-carbonate carbon. Shale proximity also determines whether or not late carbonate cements show significant enrichment in Fe and Mn, supplied by burial diagenesis of clay minerals. Absence of negative $\delta^{13}C$ excursions at cycle tops probably does not indicate absence of subaerial exposure, but may reflect limited soil development in an arid climate. Variations in $\delta^{18}O$ are interpreted as reflecting the variable effects of: (1) localized evaporative enrichment of seawater; (2) meteoric diagenesis; and (3) late cementation at elevated temperatures.

The above results support the scenario of a photozoan platform succession undergoing eogenetic stabilization with variable marine, evaporitic, and meteoric waters, followed by gradual mesogenetic cementation during progressive burial in a refluxed, hypersaline brine. This model may be characteristic of shallow-water carbonate shelf sequences deposited in arid climates, but contrasts with alternative scenarios of extensive early calcite cementation of carbonate platforms affected by either a gravity-driven meteoric aquifer system or pervasive marine cementation.