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Dating Multiple Hydrocarbon Charges from Diagenetic Evidence, United Kingdom North Sea Sandstones

Cementation sequences for reservoir sandstones from the UK North Sea normally show hydrocarbon filling as a single diagenetic event. However, chemical evidence shows that reservoirs often fill in multiple stages, sometimes from multiple sources. Also, as some 'dry' wells have evidence of a previous oil charge, it is clear that reservoirs sometimes lose their petroleum, presumably due to seal failure. Combining these observations, we conclude that many reservoirs may have had one or more 'cycles' of filling and emptying. Such a history should be recorded in diagenetic minerals grown within the reservoir. Here we present diagenetic evidence for multiple episodes of reservoir filling and emptying from two North Sea sandstones.

Kaolin cement from the Cormorant Field (Brent Group, UK North Sea) shows a correlation between oxygen isotopic composition and depth, interpreted as kaolin growth synchronous with hydrocarbon charging. The hydrocarbons subsequently leaked off, allowing diagenetic activity to recommence. Arrival of the present day hydrocarbon charge was a comparatively recent event.

Fibrous illite in UK well 29/10-2 (Fulmar Formation) has K-Ar ages which young downwards; interpreted as recording oil-filling during early burial. That hydrocarbon pre-dated the dissolution of K-feldspar and formation of quartz overgrowths and ankerite. These cements grew when the reservoir was water filled, so the early charge must have leaked off. However, the ankerite and authigenic quartz are themselves overgrown by bitumen, implying a second phase of hydrocarbon filling. As the reservoir is dry at present day, this second hydrocarbon must also have leaked off due to seal failure.