# FLUID INCLUSION MICROTHERMOMETRY AND RAMAN ANALYSIS IN PERMO-CARBONIFEROUS HAUSHI GROUP SANDSTONES, SULTANATE OF OMAN

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A microthermometric study of fluid inclusions in diagenetic quartz has been performed in the Late Westphalian to Early Sakmarian glaciogenic Al Khlata reservoir sandstone, located in the lower part of the permo-carboniferous Haushi Group, Interior Oman Sedimentary Basin.

Owing to a differential subsidence history of the Oman Sedimentary Basin, the depth of the sandstones ranges from outcrop at surface in the Southeast to almost 5000 m in the Northwest. These present-day depths represent the maximum burial of the sediments. The wide depth range sampled by drill cores provides a favourable geological setting to study the genesis of authigenic quartz.

Fluid inclusion microthermometric studies have been carried out in multiphased, growth-zoned authigenic quartz that crystallized on detrital quartz. In samples from 0 to 4000 m depth, primary, water-rich liquid + vapour fluid inclusions are located on the boundaries between cement overgrowths and detrital grains, and rarely within the cement itself.

The homogenisation and final ice-melting temperatures of fluid inclusions have been measured. At any given depth, fluid inclusions within the quartz cement have higher homogenisation temperatures ($T_h$(LV→L) = 127.5 to 159.0 °C, $T_m$(IceLV→LV)= –10.0 to –23.4 °C) than those on the boundaries of detrital quartz ($T_h$ (LV→L) 72.5 to 127.5 °C, $T_m$(IceLV→LV) –5.1 to –22.8 °C. In each drillhole, the $T_h$ values increase with depth. Shallow samples (1424 m) show $T_h$ from 72.5 to 88.8 °C, whereas the $T_h$ values of intermediate (2752 m) and deep samples (3970 m) vary from 84.5 to 147.5 °C.

Under the assumption that the homogenisation temperatures are equal to the trapping temperatures of the fluid inclusions, it appears that the quartz cement precipitated during a phase of increasing temperature, promoted by progressive burial and/or increasing heat flow.

The salinities deduced from final ice-melting temperatures show an increase with increasing precipitation temperature. Samples from shallower depths in the Southeast show generally lower values (6.4 to 11.5 wt% NaCl eq.) than those from the deeply buried samples in the Northwest (9.5 to 23.6 wt% NaCl eq.). This difference is ascribed to the influence of meteoric water during shallow burial of these sandstones in the Southeast, and to the increasing influence of highly saline brines derived from the Ara Salt Formation during deep burial in the Northwest. Within individual highly-cemented samples from the central and Northwest parts of the basin, however, salinity is observed to have decreased during quartz precipitation and continued burial.

The temperature–time–depth history of the sampled sandstones is known from independent studies. Combining this information with the inferred trapping temperatures of the fluid inclusions allows preliminary dating of two generations of quartz cementation. Thus precipitation of quartz-I cement apparently initiated basinwide at 68 Ma. Its occurrence is independent of temperature or depth. The volumetrically more important quartz-II cement appears to have precipitated between 58 and 50 Ma, accompanied by dilution of the pore-fluid.

Ongoing Raman analyses of the fluid inclusions will be used to test our assumption that homogenisation temperature equals trapping temperature. Depending on the outcome of this test, the above timing of cementation may have to be revised to slightly younger ages.