Carbonate mineralised fractures and sandstones of the Eromanga and Surat basins

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Carbonate cemented sandstone and vein mineralisation was taken from state core library material sourced from fifty wellbores, sampling twenty two geological formations across the Mesozoic Eromanga and Surat (Great Artesian) basins of central and eastern Australia. Analytical tests included XRD, partial leaching for carbonate elemental composition, carbonate stable isotopes, strontium isotopes, fluid inclusion stage micro-thermometry and salinity analyses.

Most of the carbonate samples collected are calcite, with Fe more abundant than Mg, and Mn either greater or of similar abundance to Fe in several samples. A quarter of the tested samples have Sr, Na and/or Al concentrations of the same order of magnitude as Mg. All of the carbonates with more than four relatively concentrated ICP-MS/OES measured elements relative to Ca contain elevated Na, and no sample with elevated Na has less than three elements of relatively high abundance relative to Ca. Similarly, all samples with elevated K have four or more measured elements of relatively high abundance relative to Ca.

Similar REEY patterns were found for veins and/or cements in different formations of given wells, up to 500m apart (vertically), irrespective of whether samples contained “pure” calcite or mixed carbonate species. The majority of the cement and vein carbonates plot within the field of hydrothermal veins on a variation diagram of Yb/Ca versus Yb/La [1], regardless of the paleoenvironment of deposition of the host formation. The carbonate $^{87}Sr/^{86}Sr$ of most samples ranges from 0.7032 to ~0.707.

The main population of carbonates probably precipitated at close to 80°C from high latitude meteoric groundwater when Australia was positioned much closer to the South Pole. A subset of samples formed at ≥120ºC, with calculated oxygen isotopes of the mineralising fluids consistent with mixing between groundwater of meteoric origin and evolved waters possibly sourced from the underlying basins, which is supported by the variable salinities of up to 14.7 wt.% NaCl-equivalent in some fluid inclusions.

[1] Möller (1983), *NATO ASI Series C,* 109, 561-616.