

Extra-sedimentary fluids in petroleum systems: Evidence of subducting slab degassing

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Evidence of mantelic fluids has been demonstrated in several petroleum systems in the literature, located either in extensional basins, or in forearc basins. The origins of these fluids are assessed mainly through the isotopic ratios of associated noble gases, even if lead isotopes associated with the oils allow also more recently the tracing of mantle influence. This implies that the contamination of the sedimentary fluids, as petroleum systems with deeper sourced fluids, is not a diffusive marginal process, but that advection of extra-sedimentary fluids occurs from deep horizons such as the upper mantle to the sedimentary piles. However, the concentrations patterns of fossil noble gas isotopes as ²⁰Ne, ³⁶Ar, ⁸⁴Kr and ¹³²Xe are not compatible with a mixture between a crustal and an upper mantle endmembers. The main problem is a significant enrichment in light elements as neon compared to any known terrestrial noble gas reservoir including the mantle. Even if the upper mantle signature presents also a relative enrichment in neon compared to heavier noble gases, this is far insufficient to explain our data. In order to explain such a chemical fractionation between light noble gases and heavy ones, we suggest a different source of noble gas impregnating the sedimentary sequence, issued from the degassing of the subducting oceanic crust. The main fluid degassing from this slab comes from the sea water trapped in the subducting sediments, whose composition is well identified as an atmosphere equilibrated sea water. The partial degassing of these sediments during the subduction process will fractionate the noble gas molecules, favoring the light molecules like neon, as the heavy ones are more adsorbed on the surface of the minerals than the light ones. A simple modelling of the assumed composition of this new endmember gives very conclusive mixing trends for various geological locations in the world, including oil and gas accumulations in sedimentary sequences, CO₂ natural accumulations, and gases emitted through mud volcanoes.

Inclusion fluid chemistry of sparry magnesite mineralizations in the Eastern Alps

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Carbonate hosted sparry magnesites of the “Veitsch Type” are by far the most common and economically most important type of magnesite mineralizations. The magnesites exhibit irregular bodies and stocks enveloped by a dolomitic alteration halo hosted generally by epicontinental platform carbonates of Precambrian and Paleozoic age.

In this paper the “crush-leach method” was used to characterize and pinpoint the original signature of the mineralizing fluids. Because of the incompatible behaviour of Br, the molar ratios of Na/Br and Cl/Br in fluids are very sensitive to evaporation processes. Fluids that have acquired their salinity through evaporitic concentration of seawater show Na/Br vs. Cl/Br values that are lower than seawater.

The chemical composition of the fluids forming the Veitsch Type sparry magnesite deposits are characterized by very low Na/Br (< 250) and Cl/Br (< 200) ratios indicating that the fluids and the source of salinity were the product of evaporitic concentration predominantly of seawater and not of halite dissolution. In the latter case, ratios higher than seawater (Na/Br 564 and Cl/Br 655) are expected. The fluid compositions of both, the magnesites and their dolomitic haloes clearly plot on an evaporation trend. The regional carbonate hostrocks exhibit normal marine characteristics.

The metasomatic contacts of the orebodies to the hostrocks, the dolomitic alteration zones, the overall high salinity, the special chemical composition (e.g. high Br-contents) and the Sr and Nd isotope composition of the magnesites and their dolomitic haloes indicate an epigenetic origin of the “Veitsch Type” mineralizations of the Eastern Alps. Sm-Nd dating of magnesites from the Breitenau mine indicates an upper Triassic formation age of the mineralization [1]. The mineralizing fluids were residual “bittern” brines which were formed in Permian (to Lower Triassic) times. Deposition of thick series of evaporites is widespread in the Permian strata of the Upper Austroalpine unit.

[1] Henjes-Kunst *et al.* (2008) *GCA*, this volume.