Noble Gas in Basin Centred Gas: Sampling techniques and preliminary results

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Noble gas have become a powerful tool to constrain the origin of fluids as well as the rates of fluid migration in sedimentary basins and have found applications in environmental and petroleum research [1]. The aim of this study is to apply some of these concepts to understand the genesis and evolution of Basin Centred (Hydrocarbon, HC) Gas (BCG) systems, which are abnormally pressured pervasive accumulations of gas in tight reservoirs. Poor understanding of HC gas-water interaction in the subsurface and the mechanism of gas transport make the inert noble gasses ideally suited for the geochemical investigation of these systems' dynamics. Natural lab for this study is the Deep Basin of the Western Canadian Sedimentary Basin (WCSB) in Alberta (Canada) where HC gas is being produced from tight Cretaceous sandstones [2].

Twenty wells were selected in the Deep Basin including a transect from the deep southwestern part of the basin to shallower regions in the northeast. Samples were collected in 500cc stainless steel cylinders using two different sampling techniques: (1) collection in pre-evacuated cylinders without purging ('vacuum technique'), and (2) collection in cylinders that were purged for 15 seconds ('purged technique'). All samples were analyzed for He, Ne, Ar, Kr and Xe concentrations and selected isotopes.

Noble gas concentrations in HC gas from the Deep Basin are extremely low and large differences were observed between 'purged' and 'vacuum' samples from individual wells. These inconsistencies are believed to be largely the result of contamination of the vacuum samples by dead volumes in the sampling line. Lab experiments demonstrate that purging cylinders for 15 seconds is sufficient to eliminate potential mass fractionation artefacts. Despite some remaining uncertainties related to the sampling protocol, the preliminary noble gas data of Deep Basin natural gas show some interesting trends which may provide new insights into gas-water interactions in the subsurface.

[1] Gilfillan *et al*. (2008) *GCA* **72**, 1174–1198. [2] Hiyagon & Kennedy (1992) *GCA* **56**, 1569–1589.

Coexistent aqueous fluid phase and melt in lherzolites from Bultfontein, South Africa

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The transfer of aqueous fluid and melt at high pressures is an essential mechanism in the creation, evolution and dynamics of terrestrial planets like Earth's. Volatiles control the density and viscosity of magmas generated in the Earth's interior and have an important effect of melt segregation processes. The densification of melt under high pressure conditions and the general density between the melt and solid components are very important to understand the heterogeneities of the Earth's mantle. Experimental studies show coexisting aqueous fluid and melt phases at high pressure and temperature conditions. Therefore, the current paradigm in geosciences is if aqueous fluid and melt can be coexist in natural peridotites formed at P-T conditions of 5GPa and 1300°C. Aqueous fluid and initially formed melt moves preferably along grain boundaries. The problem to detect aqueous fluid along grain boundaries is that H_2O has a higher solubility in the melt as in anhydrous nominally minerals. Thus, the aqueous fluid will partitioning in the melt during the uplift of the peridotite xenoliths to the Earth's surface. We have overcome this problem by using high-resolution synchrotron based FTIR images of higher dimensional defect structures within garnet revealing a strong variation of aqueous fluid and melt concentration at all length scales. Our analysis has three major ramifications: *i)* it shows aqueous fluid around monomineralic grain boundaries in the lithospheric mantle; *ii)* it shows coexisting aqueous fluid and melt under P-T conditions of 5GPa and 1300°C; *iii)* it shows fundamental reassessment of the dynamics of aqueous fluid transfer within the lithospheric mantle. This research was supported by the Mid-career Researcher Program through an NRF grant funded by the MEST (No. 3345-20100013) and is a contribution to UNESCO IGCP 557.