Combined noble gas-halogen study of mesothermal Au fluid origin, Alpine and Otago Schists, NZ

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The origin of gold in mesothermal gold systems remain poorly understood but involves fluid mixing and unmixing and differing contributions from meteoric, metamorphic and possibly magmatic fluid sources. One hypothesis is that gold deposition occurs through meteoric water mixing with metamorphic-derived fluids. Study of recent or active mesothermal systems allow us to address this issue. Pliocene-recent gold bearing quartz veins occur in the Alpine Schists of the Southern Alps, NZ. Uplift along the Alpine fault has exposed veins of varying depth of formation down to the brittle-ductile transition containing fluid inclusions from a variety of P-T conditions.

Noble gases from the atmosphere, mantle and crust, have unique resolvable noble gas isotope fingerprints enabling their contribution to any crustal fluid, and therefore the source of fluid, to be quantitatively resolved. Halogens can be acquired from the same suite of samples by irradiation of halogens to form noble gases. We present a combined noble gas- halogen study of fluid inclusions from the NZ Alpine schists. Microthermometrically determined fluid salinities enable the determination of halogen-linked noble gas concentration of the fluids. These will enable us to quantify meteoric vs metamorphic fluid contributions and any fluid unmixing. Initial results show no significant mantle ^{3}He confirming the absence of a magmatic fluid component. Non-radiogenic Ar, Kr and Xe isotopes are atmospheric in value while elemental Xe/Ar and Xe/Kr show xenon excess, probably sourced from the host sediments. Fluid inclusion salinities typically range from 3-6 wt% NaCl. Br/Cl show ratios higher than seawater values and rule out any evaporite contribution. I/Cl are all orders of magnitude greater than seawater typical of I excess from organic sediment contributions. Excess I is consistent with the sedimentary Xe contribution demonstrating a genetic link between the noble gases and halogens.

Core Formation of the Earth: A coherent view from short-lived and long-lived radioactivities

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The kinetics of the accretion of the Earth and the timing of the Earth's core segregation are presently highly debated [1-3]. One way to approach this question is to compare the records of the decay of the short-lived ^{182}Hf and $^{238-235}$U radioactivities in the Bulk Silicate Earth. Based on lead isotope systematics a mean age for the differentiation of the core that is ~10^2 myr younger than the isolation of the Solar system at 4,57 Ga has been calculated. While the ^{182}W excess in terrestrial material relative to the isotopic composition in primitive solar material was initially interpreted as evidence for an early differentiation of the Earth's core within the first 30 - 40 myr years.

We consider that the segregation of the major part of the Earth's core occurred late in respect to the ^{182}Hf decay. In this model the ^{182}W excess in BSE does not have a chronological meaning but it points out an incomplete isotopic re-equilibration between primitive metal and silicate components during the accretion of the planetary embryos. In contrast, this significant however incomplete metal/silicate re-equilibration only slightly affects the U-Pb chronometer. This coherent interpretation of the two isotopic systems argues in favor for a major differentiation of the Earth, ~10^2 myr later than the isolation of the Solar system at 4,57 Ga. This model is in agreement with the reappraisal of the timing of the moon formation [4]. It is also in agreement with the timing calculated by simulations of the final stages of accretion of the terrestrial planets using nearby circular and coplanar orbits of Jupiter and Saturn [5].

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