Paleohydrological communication between Baksa Gneiss and overlying Carboniferous sediments

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The investigated area the Baksa Gneiss Complex (BC) and its overlying Téseny Sandstone formation (TS) are located at the SW part of the Pannonian Basin near to the low and medium level nuclear waste disposal site (Mórágy Granite Formation) of Hungary. Quartz-carbonate veins of the BC and TS were analyzed by fluid inclusion micothermometry and stable isotope geochemistry in order to reveal the paleohydrological relationship between them.

Veins show rather similar features. In BC qtz→dol→cal1→cal2 is characteristic while in TS qtz→dolC→dolMn→dolFe sequence is typical. Results of microthermometry are also very similar. Quartz phases contain aqueous inclusions exhibiting H_2O-NaCl-$CaCl_2$ model composition. Calculated salinity varies within 20-25 wt% NaCl and 1-7 wt% $CaCl_2$, while T_h values are within 50-130 °C range. Primary inclusions in dol and dolC phases show H_2O-NaCl-$CaCl_2$ composition and high salinity is presumable from low T_m(Ice) data (-20 – -25 °C). T_h values are in a 90-180 °C range. Fluid captured in dolFe phase exhibiting different character with H_2O-NaCl composition and low 2.5 -5 wt% eq. NaCl salinity, T_h values are in a short 80-110 °C range.

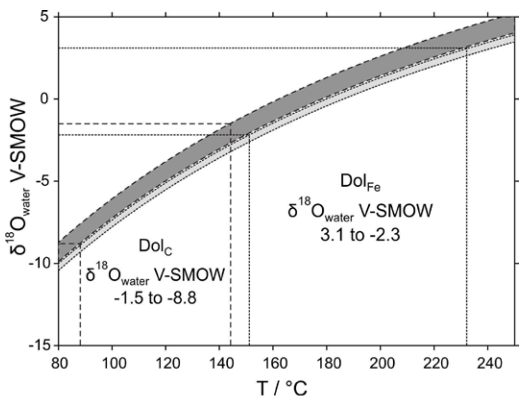

Figure 1. δ^{18}O signatures of pore fluids

The calculated δ^{18}O signature of the mineralizing fluid (Fig. 1.) (dolC: 3.1 – -2.3 δ^{18}O V-SMOW; dolFe: -8.8 – -1.5 δ^{18}O V-SMOW) together with fluid chemistry indicating paleohydrological communication between crystalline basement and sedimentary cover.

Evidence of water degassing in Archean Komatiites

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Komatiites are ancient volcanic rocks, mostly over 2.7 billion years old, which formed through >30% partial melting of the mantle [1]. Establishing the volatile content of komatiites is crucial to constraining the thermal evolution of the Early Earth and its primordial atmosphere. The Agnew-Wiluna greenstone belt of Western Australia contains three co-genetic komatiite units that 1) display laterally variable volcanological features, including thick cumulates and spinifex-textured units, and 2) were emplaced as both lava flows and intrusions at various locations. 500m-thick komatiite sills contain widespread occurrence of hydromagmatic amphibole in orthocumulate- and mesocumulate-textured rocks, which contain ca. 40-50 wt% MgO and $\leq$3 wt% TiO_2. Conversely, komatiite flows do not contain any volatile-bearing mineral phases: ~150 meter-thick flows only contain vesicles, amygdales and segregation structures, whereas <5-10 meter-thick flows lack any textural and petrographic evidence of primary volatile contents.

Existing models on the thermal evolution of the Early Earth are mainly based on data from komatiite flows rather than intrusions [1]. In the Agnew-Wiluna greenstone belt, we hypothesize that the original volatile content of the flows was lost, but that of the sills was partially retained. Accordingly, evidence from komatiite flows in the Agnew-Wiluna greenstone belt does not necessarily reflect the total volatile content of parental komatiite magmas, because the flows, irrespective of their initial water content, have degassed upon emplacement and crystallization. Therefore, we suggest that evidence from komatiite intrusions worldwide should be considered along side with data from lava flows to evaluate the thermal architecture of the Early Earth and the complex chemo-physical zonation that occurred at the interface between water and seafloor in the primordial oceans.

[1] Arndt, N. T., Barnes, S. J. and Lesher, C. M. (2008). *Komatiite*. Cambridge: Cambridge University Press.