Granite Alteration Processes Determined by Sr- Pb-Isotopes and Th/U Disequilibria

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The aim of the project is to study the nature of fluid/rock interaction across a faulted rhyolite-granite contact by investigating the isotope and element distributions. Rb/Sr -, U/Pb-isotopes and U/Th disequilibria are used on the same study area to investigate the isotopic changes which occur during old and recent weathering processes. The studied granite is situated on the eastern Rhine Graben shoulder, close to Heidelberg (SW-Germany). This granite provides a good study material because of a complex history of polyphase fluid/rock interaction following Permian volcanic extrusion, particularly during Jurassic thermal activities, and Tertiary/Quaternary formation of the Rhine Graben.

All the samples have undergone a strong leaching of U ($^{230}Th/^{234}U > 1$), probably due to recent or sub-recent weathering. However, some U appears to be acquired from the aqueous phase ($^{234}U/^{238}U > 1$) in the cataclase samples. This U exchange is higher on the sides than of the middle of the cataclase.

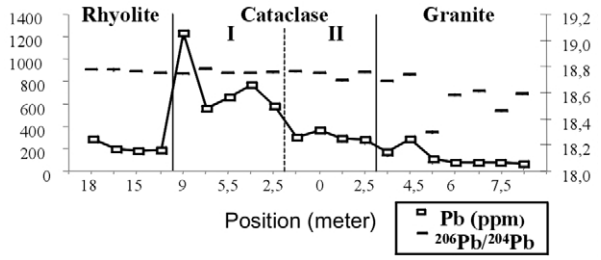

Figure 1: Fault lead profile

The cataclase samples (fig. 1) are notably enriched in lead (up to 1220 ppm). The lead isotope composition (fig. 1) differs significantly from the lead isotope composition of less altered granite at distant from the cataclase area; providing evidence for a strong recent alteration event that increased the lead content and that has set up a new lead isotopic composition.

The Rb-Sr data of the granite samples forms a whole rock isochron that is in good agreement with the well-known Jurassic hydrothermal event which induced widespread formation of illite (sericite) in the regional basement.

Apparent long-term cooling of the sea surface in the northeast Atlantic and Mediterranean during the Holocene

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Reconstructions of upper ocean temperature (T) during the Holocene (10-0 ka B.P.) were established using the alkenone method from seven, high accumulation sediment cores raised from the northeast Atlantic and Mediterranean Sea (36ºN-75ºN). All these paleo-T records document an apparent long-term cooling during the last 10 kyrs. In records with indication of a constant trend the apparent cooling reaches –0.27ºC kyr^{-1} to –0.15ºC kyr^{-1}. Records with indication of a time-variable trend show peak-to-peak amplitudes in apparent T of 1.2-2.9ºC. A principal component analysis shows that there is one factor which accounts for a very large fraction (67%) of the total variance in the biomarker paleo-T records and which dominates these records over other potential secondary influences. Two possible contributions are (1) a widespread surface cooling, which may be associated with the transition from the Hypsithermal interval (about 9-5.7 ka B.P.) to the Neoglaciation (about 5.7-0 ka B.P.); and (2) a change in the seasonal timing and/or duration of the growth period of alkenone producers (prymnesiophyte algae). The first contribution is consistent with many climate proxy records from the northeast Atlantic area and with climate model simulations including Milankovitch forcing. The second contribution is consistent with the divergence between biomarker and summer faunal paleo-T from the early to late Holocene observed in two cores. Further work is necessary, and in particular the apparent discordance between biomarker and faunal T records for the relatively stable Holocene period must be understood, to better constrain the climatic and ecological contributions to the apparent cooling observed in the former records.

References

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