The oldest rocks in Greece: Geochronological evidence for remnants of a Precambrian basement within the central Hellenides

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The Hellenides form a major segment of the Alpine orogenic belt in the eastern Mediterranean region. Within the central Hellenides the Pelagonian Zone constitutes the largest crustal entity. The dominant rock types are granitoids and granitoid gneisses, metasediments, ophiolites, and sedimentary cover rocks. The Pelagonian Zone has been described as a Permo/Carboniferous magmatic arc in an active continental margin setting (Reischmann et al. 2001, Anders et al. 2002). However, there was no direct evidence for a pre-existing crust, on which the volcanic arc emerged. Only sparse K-Ar ages from the northern continuation of the Pelagonian Zone in S Albania of ca. 411-447 Ma (Most et al. 2001) could be taken as indication for an older basement in Greece as well. We therefore concentrated on the gneisses of W Macedonia and Thessaly and dated them using single zircon Pb/Pb evaporation and U/Pb methods.

The rocks of this study are variably deformed ortho-gneisses of granitic composition showing a slight peraluminous affinity. Trace element analysis indicates a volcanic arc or syn-collisional environment as tectonic setting. The prevailing ages of the region are ca. 300 Ma providing further evidence for the importance of the Permo/Carboniferous magmatic event. However, we were able to identify two gneisses with Precambrian ages, one west of Florina and one near Fotino. Both rock units yielded ages of ca. 690 Ma and therefore are the oldest rocks from Greece known so far. These late Precambrian basement exposures within the Pelagonian Zone can be taken as remnants of the pre-existing continental margin, at which the Permo/Carboniferous arc formed. This basement cannot be correlated with neighbouring zones of the Hellenides. The origin of this late Precambrian basement is therefore still an open question, however, a relation to N Africa is not unlikely.

References

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Distribution of trace elements and REE fractionation trends in BIOS as compared to host rocks, fracture fillings and fluids.

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Background

Bacteriogenic iron oxides (BIOS) are often present where reduced groundwater encounters an oxygenated atmosphere. BIOS consist of amorphous to weakly structured iron precipitates with nucleating organic structures. The predominant organic constituent is often *Gallionella ferruginea*, which is an iron oxidising chemolithotrophic microorganism.

Gallionella ferruginea biofilms were cultured in situ in an artificial channel (2000 x 300 x 250 mm) using groundwater sourced from a borehole 220 m below sea level in the Äspö Hard Rock Laboratory, Sweden. Cell number, stalk length and iron concentration was measured for each sample and trace metal concentration was measured by ICP-MS (inductively coupled plasma mass spectrometry).

Results

The pH of the groundwater in the channels was between 7.4 and 7.7 with oxygen saturation below 1.5 mgl^{-1} and Eh between 100 and 200 mV. Distribution coefficients (K_d values), calculated as the ratio between BIOS and dissolved metals, increase over time being related to increasing stalk length (organic matter) and iron. After three months rare earth element (REE) plots indicate that BIOS can enrich metals up to 1 x 10^4 fold higher than the groundwater and fractionate HREE over LREE.

Conclusions

In partially oxidsed groundwater trace elements are rapidly partitioned to the BIOS phase. Rapid REE and actinide absorption requires a nucleating organic structure for iron oxides and trace metals. HREE are fractionated by BIOS.