Interactions between glassy materials and metallophyte plants: Application to the remediation of polluted soils

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The contamination of soils by heavy metals has become a really important problem, especially in some highly industrialized areas such as north of France. One of the ways of treatment is the remediation using metallophyte plants able to trap pollutants from soils. The aim of this work was to follow the evolution of a plot of polluted land in the presence of metallophyte plants (*Arabidopsis halleri*) and of a phosphated amendment. This amendment consist of a glassy matrix (Ca-Si-P) in order to increase the phosphorus concentration into the soil. Moreoever the alteration of this glass produces the development of crystallized secondary phases (hydroxyapatite) which can trap heavy metals.

The contents in metals observed in plants after culture are about 2 % for cadmium and of 4 % for lead. Moreover, the contents in metals contained in the superior parts are much more important than those determined in the absence of amendment (5 and 8 % respectively for Cd and Pb). Samplings of ground were besides realized and prepared in order to observe root / soils contacts by ESEM. To try to understand the impact of this amendment on the behaviour of metals contained in the sediment, elementary mappings were made on these polished sections. These observations tend to prove that the zinc seems diffuse and integrated within the root. In the case of a stake in culture in the absence of amendment, we observe a gradient of rather weak concentration with only the presence of a zone more concentrated in periphery. In the presence of amendment, the cartography brings to light a more important concentration, with a gradual increase towards the heart of the root. A very clear border rich in lead is set up in external border, whereas this element is absent in the heart of the root. Besides, the lead distribution on the edge of the root seems to be correlated to the type of substratum of culture. So in the presence of amendment this border appears more continuous and thicker.

This study has permitted to show a great capacity of *A. halleri* to mobilize specifically zinc from solid phases of soil.

Metasomatism in the Dora Maira whiteschists investigated by SHRIMP oxygen isotopes and U-Pb geochronology

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The coesite and pyrope-bearing ultra-high pressure (UHP) metamorphic whiteschists from the Dora Maira unit, Western Alps underwent pervasive metasomatism. However, the timing and setting of the metasomatism are still disputed. We analysed U-Pb and oxygen isotopes in zircon and monazite with the SHRIMP ion-microprobe, and trace-elements by Laser-Ablation ICP-MS in the major REE-bearing phases, in order to better constrain the timing of the fluid influx and its relationship to UHP metamorphism.

Zircons cores with oscillatory-zoning are dated at ~265 Ma and have a $\delta^{18}O$ of ~ 9-10 ‰. They are interpreted as magmatic relics recording the age and oxygen signature of the granitic protolith, before metasomatism. Zircon rims and the monazite grains yield an Alpine age (35-34 Ma) and a significantly lower $\delta^{18}O$ of ~ 6-7‰. for a prograde to peak metamorphic temperature of ~700-730°C, the $\delta^{18}O$ of Alpine zircon and monazites indicate equilibrium with the major metamorphic phases [1]. The core-rim $\delta^{18}O$ offset in zircon is interpreted as a shift in bulk-rock $\delta^{18}O$ corresponding to the metasomatic event that altered the granitic protolith. The zircon rims are composed of up to 4 concentric domains, different in CL emission but identical in oxygen composition and age: $\delta^{18}O$ ~6‰ and ~34 Ma. The trace-element patterns of these rims show variations from HREE-rich to HREE-depleted, which mirror the compositional variation in the garnet. This indicates zircon growth before and during progressive garnet growth. A similar record is present in monazite. According to previous petrological studies [2], garnet growth started at 25 to 30 kbar and 650°C and continued until the metamorphic peak at 45 kbar.

Thus, the granitic protolith underwent metasomatism at pressures lower than 25 kbar before the onset of garnet crystallisation, either during seafloor alteration or early prograde subduction. Prograde (25 kbar) to peak (45 kbar) metamorphism occurred over a short time-interval of 1-2 Ma corresponding to minimum burial rates of 3 to 4 cm/y.

[1] Sharp *et al* (1993), *Contrib Min Petrol* **114**, 1-12; [2] Hermann (2003), *Lithos* 70, 163-182

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