Processes of heavy metals immobilization in mires

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Long time mining and smelting activities have produced a widespread regional anomaly in Pb, Zn and Cd concentration in soils of Silesia region, southern Poland. Two mires: Bagno Bruch (BB) and Bagno Mikołeska (BM), located within the anomaly, were chosen to study processes of heavy metals immobilization in acid, water-logged and peat accumulating ecosystems.

The chemical analyses of peat were conducted using ICP-MS method. The solid samples (inorganic particles and peat) were investigated using FESEM.

A narrow peat layer, highly enriched in Pb, Zn and Cd, were detected at depth between 9 and 27 cm below the mires surface. The contaminated layer contained 460-1190 mg/kg of Pb, 1037-2371 mg/kg of Zn and 11.92 - 62.6 mg/kg of Cd. Above and below the layer, metal concentrations were several times lower, reaching values of 0.3-8.0 mg/kg Pb, 22-73 mg/kg Zn and 0.1-0.5 mg/kg of Cd in the deeper (below 50 cm), pre-industrial peat layer.

The study shows that an important part of the contaminants are immobilized in inorganic particles. In the contaminated layer, the fly-ash particles, originated from dust deposition, comprise up to 1.7% by volume of dry peat. The formation of authigenic (Zn, Cd)S (up to 1.1% by vol.), barite (~0.5% by vol. in BB, not found in BM), and traces of PbS, indicates the importance of secondary processes, like microbial activity, in metals distribution and immobilization.

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Deformation of garnet in eclogite: Dominant mechanisms and the active role of fluids

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The response of subducting rocks to stress under different physicochemical conditions is crucial to predicting the evolution of slab strength and the generation of earthquakes. Experiments on mafic rock rheology [1, 2] suggest that prograde metamorphism to eclogite should not significantly change bulk-rock viscosity. Yet, field evidence demonstrates a dramatic, but temporary competence loss as a result of such reaction [3]. This discrepancy underscores the need for further study into the relationship between fluid-flow, mineral reactions, and rheological properties of eclogite.

Garnet fabrics are particularly enigmatic features that sometimes indicate very efficient deformation of this mineral under conditions where it is expected to remain rigid. To investigate this, we compared the textural and microstructural characteristcs of garnet in an eclogite mylonite (Caledonian eclogites, Norway) to those of garnet that crystallized statically in a high-pressure seismic melt (Zambian eclogites).

In contrast to the static garnet crystals, mylonite garnet is flattened parallel to the main foliation. The grains exhibit foliation-perpendicular fractures, random crystallographic orientations, and abundant dissolution features, indicating mass transfer away from the grain boundaries. The grains accomodated large strains by intergranular pressure solution in the presence of fluid at high pressure.

This study shows that fluid-wetted grain boundaries occur in eclogite at depth and that these play a crucial role in the rheological weakening of such rock. Seismic imaging monitors the slab depth at which such weakening occurs as a distinct perturbation, beyond which slab coherrence is strongly reduced [4]. Even though fluid invasion may be only short-lived [5] and eclogites should rigidify when fluids exit the system, the temporary competence loss of these rocks could have a great impact on slab dyanmics.

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