Mineral composition of sediments of the Southern Baltic Sea and their heavy metals content

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Samples of sediments were collected from eight cores in three areas of the southern Baltic Sea (the Gulf of Gdańsk, Bornholm Deep and the Odra Bank) from three different depths (0-3cm, 25-28cm and 35-38cm).

Mineral and chemical composition of sediments was studied using XRD, SEM-EDS, ICP-MS, and ICP-AES methods. Chemical composition of leachates from sequential extraction was also determined.

Samples from the Gulf of Gdańsk are dominated by silty fraction, samples from the Odra Bank represent fine to medium sands with abundant shell fragments, sediments from Bornholm Deep are mainly clay. Quartz predominates in all samples. In silty samples framboidal piryte is present; halite and gypsum occurs only in few of them. Clay minerals occur in low amount in silty samples. Ilmenite, zircon and Fe compound are common in sand, but appear sporadically in silt samples.

Geoaccumulation index (Igeo = ln (Cn/1.5×Bn); Cn- measured concentration, μg/g, Bn - geochemical background value, μg/g) indicates strong to very strong Cd pollution in three surface samples. Other factors revealed pollution by As, Cd, Mo and Hg. Variation of concentration of heavy metals occurs in profiles, e.g. Hg and Cd are concentrated in uppermost samples but As and Mo concentration increase downward. Results of sequential extraction suggest significant diversity of metals speciation in sediments.

Crustal recycling: New findings and challenges

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Since Hofmann and White's paper [1] crustal recycling via subduction and convection is a widely accepted explanation for the heterogeneity of OIB sources. Recycled crust has been recognized even in the sources of MORB (e. g [2, 3]). However, there are still no common view on the amount, composition and ages of recycled materials in both parts of the mantle.

In this paper I review recent approaches for estimating the contents and ages of recycled crust in the sources of OIB, LIP and MORB. In particular, I discuss the ability of olivine phenocrysts to record the magma source mineralogy in their concentrations of Ni, Mn, Fe, Zn, Co, Sc and Ca. I show that adiabatic decompression of deep-sourced mantle magmas and the presence of garnet in their sources do not compromise the ability of olivine to register olivine-free source lithologies.

Large datasets of new olivine compositions and published high-precision analyses [3, 4] suggest the common presence of olivine-free pyroxenite produced by melting and reaction of oceanic crust in the sources of OIB, LIP and MORB. The proportions of pyroxenite-derived melt commonly correlate with trace element and isotope data from bulk rocks [5, 6] indicating binary mixing of melts from peridotitic and pyroxenitic sources. High amounts of recycled oceanic crust are associated with high excess mantle temperatures and high depths of melt generation, in agreement with the high density and melt productivity of a garnet-rich source [3].

The ages of recycled oceanic crust estimated from correlation of bulk-rock $^{187}Os/^{188}Os$ ratios and the proportions of pyroxenite-derived melt [5] or from the $^{86}Sr/^{87}Sr$ of ancient recycled seawater [7] are in the range of 1.0-0.2 Ga. This implies a time-scale of general mantle circulation of a few centimetres per year.

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