

Hf, Nd, Sr isotopic insights into the Chaîne des Puys magmatic system, France

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This work is a combined Hf, Nd, Sr isotope/ trace element modelling of all Chaîne des Puys volcanics. We have analysed major (XRF) and trace elements including REE (ICP-MS), together with Sr, Nd (TIMS) and Hf isotopes (MC ICP-MS). This new data-set is complementary to existing data of former publications, and enables the development of a consistent model for Chaîne des Puys magmatic processes. Sampling of the volcanic rocks included lava flows and domes. Information on all possible crustal contaminants is gained from a complete crustal profile of the Limagne section including lower crustal xenoliths (Bournac and Maar de Beaunit), exposed gneisses of the Allier Valley and from meta-granitoids of the western Limagne escarpment representing the upper crust. With respect to alkalis and silica, volcanic samples comprise a sodic alkaline series ranging from basalts to trachybasalts, trachyandesites and trachytes. Possible contaminants are mafic to intermediate granulites, gneisses, mica shists and granitoids.

This volcanic suite reveals in the basalts $\epsilon_{\text{Nd}} +5$ and $\epsilon_{\text{Sr}} -13$, in the trachytes $\epsilon_{\text{Nd}} +1$ and $\epsilon_{\text{Sr}} +2$. Possible crustal contaminants show radiogenic Sr (+24 to +462 Sr) and unradiogenic Nd (-12 to 0). For the first time, Hf-isotopes are presented for this suite of quaternary volcanics. All ϵ_{Hf} are between +9 to +4 ϵ and correlate with ϵ_{Nd} and also with Hf concentrations. Within the crustal profile ϵ_{Hf} ranges from +3 to -16 in mafic and intermediate lower crust, from +2 to -11 in metasediments and granitoids.

Decoupling of incompatible elements from Sr and Nd isotopic ratios requires a young metasomatic event in the lithospheric mantle source with minor contributions of asthenospheric material. Hf isotopes clearly indicate a mixture of these components and give now direct evidence for carbonatitic metasomatism or carbonate melt components, although carbonatites have been described recently. These together with published Hf isotopic data on cpx from peridotite xenoliths and whole rock Hf-data on crustal xenoliths will give a detailed model for the evolution of the Chaîne des Puys mantle source as well as for the fractionation/contamination of primitive magmas.

Migrational properties of elements in the sulfide tailings and technogenic bottom sediment

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The given work is focused on the solving of a fundamental problem of environmental geochemistry connected with studying of element behavior in systems with the increased anthropogenesis loading. Such investigation was carried out by the example of old tailings (Talmovaya sand) of the lead-zinc concentration plant (Salair, Kemerovo region, Russia) and technogenic ground sediment of the M. Talmovaya River. Content of elements in sulfide tailings ranges in the following limits: Zn – 0.11-2.7%, Cd – 1.3-240 mg/kg, Pb – 0.01-0.81 mg/kg, Cu – 220-960 mg/kg, As – 15-970 mg/kg, Fe – 1.9-7.6%, Ba - 8-10%. Element concentrations in ground sediment are similar to content of sulfide tailings. Element speciations in the sulfide tailings and bottom sediments are investigated by modified sequential extraction procedure. Chemical forms of heavy metals in pore water and surface water are calculated by WATEQ4F software. In mine wastes and bottom deposits there is vertical substance structuring with formation of geochemical barriers. In old mine wastes the most important role have the following zones: 1. the evaporating barrier on which deposit secondary speciation of elements especially water-soluble species; 2. the lithological barrier inhibiting migration of elements, pore water and pore gases such as O₂ and CO₂. The given barrier consists of two layers: the first one is cemented by secondary ferruginous phases and gypsum where Pb, As, Mo are redeposited basically in the reducible species; the second one is a calcite-gypsum-bearing cemented layer where Zn, Cd and Cu are redeposited mainly in carbonate species; 3. the water-saturated layer in which the dissolved oxygen, arriving with waters from below, intensifies processes of sulphides oxidation, leaching of elements and redeposition of secondary solid phases. The top layer of ground sediment is the geochemical barrier. Metals are strongly bound by bottom deposit substance and practically do not cause secondary pollution of surface water (a share of water-soluble forms is less than 1%), but can be dangerous for bottom dweller and plants. Optimal ways of area decontamination have been offered from results of experiments.

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