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Trace element and isotopic information for the evolution of the Chaîne des Puys magmatic systems, Massif Central, France

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This work is a combined multi-isotopic/trace element modelling of all Chaîne des Puys volcanics. We have established a complete database of major elements, trace elements including REE, Sr, Nd, Hf and O isotopes of 95 samples. This data set is also complementary to existing data of former publications, and enables the development of a consistent model for the Chaîne des Puys volcanic processes. Sampling of the volcanic rocks included lava flows, necks, domes and pyroclastics. To get information on all possible contaminants, a complete section of the Limagne crust was samples from Moho depths to middle and upper upper crust. Information on crustal contaminants is gained from: i) lower crustal xenoliths, ii) exposed gneisses (lower Allier Valley) and iii) meta-granitoids (Limagne Graben escarpment). All samples were analysed for their whole rock major and trace element chemistry (TU, Clausthal), for Sr and Nd isotope ratios (GZG, Göttingen). Hf-isotopic composition was analysed in Hannover (Institute for Mineralogy).

With respect to total alkalies and silica, volcanic samples comprise an alkaline series ranging from basanite, basalt, trachybasalt, trachyandesite to trachyte and rhyolite. The xenoliths are mafic to intermediate granulites with calculated in-situ P-wave velocities between 6.9 and 7.0 kms^{-1} ; thus, they represent the crust at depths of 18 to 28 km (Moho). Two felsic xenoliths and the outcropping gneisses and meta-granitoids reveal calculated in-situ P-wave velocities of 6.1 to 6.9 km^{-1} thus representing the middle and upper parts of our crustal section.

The Sr-isotopic composition of primitive rocks (basalt, basanite) ranges from -13 ε to -6 ε and the related εNd data range from +2 to +5 ε. Evolved (trachyandesites to trachytes) range from -1 to +4 ε Sr to +1 to +3 ε Nd. Possible crust show radiogenic Sr (+24 ε to +119 Sr) and unradiogenic Nd (-9 to 0) for these xenoliths.

Unambiguous, the decoupling of Sr and Nd concentrations from Sr and Nd isotopic ratios requires a young metasomatic event in the lithospheric mantle source. In order to distinguish between different types of metasomatic fluids, we analysed Hf isotopic ratios. 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. Hf isotopic data of the unevolved and slightly evolved Chaîne des Puys volcanics range from +9 to +6.