Geophysical Research Abstracts
Vol. 17, EGU2015-2144, 2015
EGU General Assembly 2015

Petrological processes in mantle plume heads: Evidence from study of mantle xenoliths in the late Cenozoic alkali Fe-Ti basalts in Western Syria

Evgenii Sharkov

Institute of Geology of Ore Deposits, Petrograpgy, Mineralogy and Geochemistry RAS, Petrology, Moscow, Russian Federation (sharkov@igem.ru)

It is consensus now that within-plate magmatism is considered with ascending of mantle plumes and adiabatic melting of their head. At the same time composition of the plumes' matter and conditions of its adiabatic melting are unclear yet. The major source of objective information about it can be mantle xenoliths in alkali basalts and basanites which represent fragments of material of the plume heads above magma-generation zone. They are not represent material in melting zone, however, carry important information about material of modern mantle plumes, its phase composition and components, involved in melting.

Populations of mantle xenoliths in basalts are characterized by surprising sameness in the world and represented by two major types: (1) dominated rocks of "green" series, and (2) more rare rocks of "black" series, which formed veins in the "green" series matrix. It can evidence about common composition of plume material in global scale. In other words, the both series of xenoliths represent two types of material of thermochemical mantle plumes, ascended from core-mantle boundary (Maruyama, 1994; Dobretsov et al., 2001).

The same types of xenoliths are found in basalts and basanites of Western Syria (Sharkov et al., 1996). Rocks of "green" series are represented by Sp peridotites with cataclastic and protogranular structures and vary in composition from dominated spinel lherzolites to spinel harzburgites and rare spinel pyroxenites (websterites). It is probably evidence about incomplete homogenizing of the plume head matter, where material, underwent by partial melting, adjoins with more fertile material. Such heterogeneity was survived due to quick cooling of upper rim of the plume head in contact with relatively cold lithosphere.

Essential role among xenoliths of the "black" series play Al-Ti-augite and water-bearing phases like hornblende (kaersutute) and Ti-phlogopite. Rocks of this series are represented by wehrlite, clinopyroxenite, amphibole clinopyroxenite, hornbledite, etc. as well as megacrysts of Al-Ti-augite, kaersutite, ilmenite, sanidine, etc. Numerous vesicles often occurred in megacrysts, especially in kaersurtite.

Sp peridotites of the matrix are sharply different on their geochemical features from the "black series" rocks (in this case, megacrysts of kaersutite) which are the most close to composition of xenoliths-bearing alkali basalts. From this follows that geochemistry of plume-related basalts was determined by mantle fluids which occurred in magma-generation zone.

Very likely, that these fluids, enriched in Fe, Ti, LREE, alkalis, and incompatible elements, initially were parts of intergranular material of original mantle plume material and were released due to its decompression. Because their high mobility, the fluids percolated upwards and accumulated in the upper part of the mantle plume head, where promoted its melting by lowering of solidus of the matter. Excess of the fluids gathered beneath the cooled upper rim and penetrated in its rocks which led to appearance of centers of secondary melting (melt-pockets). Very likely, that these secondary melts formed rocks of the "black series" (Ismail et al., 2008;Ryabchkov et al., 2011; Ma et al., 2014).

According to geobarometric estimations, Sp peridotite xenoliths from Syria derived from depths 24-42 km (0.8-1.4 GPa) under temperatures 896-980oC; formation of melt-pockets, enriched in volatiles, occurred at the depths 21-27 km (0.7-0.9 GPa) under 826-981oC (Sharkov et al., 1996; Ismail et al., 2008; Ma et al., 2014). From this follows that plumeheads reached depths approximately 21-30 km which is in agree with

practically absence of lower-crustal xenoliths in the populations.

One of the problems of plume-related magmatism is coexisting of alkali and tholeiitic basalts, which origin often considered with different PT conditions. However, these basalt not rarely interlayered, especially at low and middle levels of LIPs or in single volcanoes (Hawaii, Etna, etc.) which is not in a good agreement with such idea. We suggest that the situation can be more likely explained by nonuniform impregnation of peridotite matrix with fluid components which composition and/or quantity can play essential role in composition of smeltings. It is especially important because even small differences in their ñomposition near to plane of SiO_2 saturation in “basalt tetrahedron” (Yoder and Tilley, 1962) lead to appearance of Ne-normative or Ne-free melts at practically similar PT conditions.

Thus, judging on composition of the mantle xenoliths in basalts of all occurrences in the world, quite possible that Sp peridotites (mainly lherzolites) together with intergranular geochemical-enriched fluid components represent the matter of the modern thermochemical mantle plumes. Origin of two major types of the plume-related magmas, probably, considered with fluid regime in the plume head.