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Neutron and photon activation analyses of anomalous phonolites from Lusatian Mountains in Bohemian Massif, Czech Republic

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The studied phonolites from the Lusatian Mountains in northern part of the Czech Republic are tertiary, highly evolved alkaline volcanic rocks associated with continental interplate magmatism with anomalous contents of incompatible and volatile components. From the geochemical point of view, these rocks are residue of parent magma concentrating many incompatible and volatile elements. Phonolites solidified at relatively low temperature similarly to other residue liquids, and thus during ascent of magma towards the Earth surface such rocks consolidated in shallow depths (less than one kilometer) in the upper bed. Therefore, phonolites can be classified among the so-called subvolcanic (or hypabyssal) rocks. The studied anomalous phonolites are strongly depleted by compatible elements as Mg, V, Cr, Fe, Ni, Sr, whereas contents of Al, alkaline elements Na, K, Rb, and incompatible elements such as Zr, Nb, REE, Hf, Ta, Th, U reach extremely high values. Contents of halogens (F and Cl) are also very high. For a detailed geochemical study, various modes of non-destructive neutron (including the epithermal and fast neutron mode) and photon activation analyses were utilized. Combination of these modes allowed assaying major elements as well as most trace elements (48 elements in total). The study has been aimed at elucidation of source materials and processes leading to formation of these anomalous phonolites (partial melting and contamination by crust materials). Potential host accessory minerals for some abundant elements such as F (up to 1800 ppm, possibly hainite or apatite), Cl (up to 5700 ppm, possibly sodalite), Zr and Hf (up to 3000 ppm Zr, possibly zircon or hainite), Nb (up to 900 ppm), and rare earth elements (up to 700 ppm for their sum, possibly apatite or perovskite) have been suggested. This study has been supported by the project IAA300130902 of the Grant Agency of the Academy of Sciences of the Czech Republic.

Author: Dr ŘANDA, Zdeněk (Nuclear Physics Institute ASCR)

Co-authors: Mrs KRAUSOVÁ, Ivana (Nuclear Physics Institute ASCR); Dr MIZERA, Jiri (Nuclear Physics Institute ASCR)

Presenter: Dr ŘANDA, Zdeněk (Nuclear Physics Institute ASCR)

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