Evaluation of the possibility of uranium 238 series dating for the Pliocene-Holocene basalt

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Evaluation of the degree of disequilibruim of the isotopes of U-series (U^{238}) in recent basalts of Central Mongolia was carried out by means of inductively coupled plasma mass spectrometry (ICPMS).

The basalts of Taryat areal (Khangay, Mongolia) are conventionally dated as belonging to the Quaternary on the basis of paleomagnetic investigations, K/Ar dating and stratigraphic data [1,2]. However, the development of novel procedures of absolute dating of these recent vulcanites is urgent.

Measurements of the isotope ratios U^{238}/U^{234}, U^{238}/Th^{230}, U^{238}/Th^{232} and U^{238}/U^{235} were performed with a high-resolution mass spectrometer ELEMENT Finnigan MAT after leaching uranium and thorium from a weighed portion (0,1g) of the crushed rock with concentrated nitric acid under heating. Measurements were carried out in medium mass resolution mode ($M/\Delta M=4000$). This mode allowed ion counting for all the mentioned isotopes, which resulted in a decreased interference of low-abundant U^{234}, Th^{230} with abundant U^{238}, Th^{232}, the concentrations of which differ by 5 orders of magnitude.

The results show that the degree of modern disequilibruim of Th^{230} with U^{238} in the investigated samples is 0,7 to 1,2 for the Pliocene and Holocene basalts.

The observed deviation from the U^{234}/U^{238} equilibrium, exceeding the measurement error, can be explained by different leaching of uranium isotopes in post-eruptive processes.

The achieved arrucary of measurements allows one to determine isochronous age of these basalts with the relative error of about 15% as a mean.

References

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The role of zoisite in trace-element distribution in subduction zones

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Melting of eclogite-facies oceanic crust is traditionally thought to give rise to adakites - melts with high Sr/Y ratios. The lack of adakite signatures in most arc volcanics has been used to argue that melting of oceanic crust is of limited importance. Here we use crustal eclogites as an analogue for subducted oceanic crust to show that dehydration melting of zoisite-bearing eclogites may provide significant amounts of LREE, Th, U, Pb to the overlying mantle wedge without any high Sr/Y signature typical of adakites.

Investigated eclogites come from the Pohorje Mountains in the Eastern Alps where the metamorphic grade of Cretaceous metamorphism reached ultrahigh-pressure conditions. The eclogites occur as boudins and lenses in both continental rocks (gneisses, micaschists) and a serpentinited harzburgite body of ca. 4x1 km with some garnet peridotites.

Zoisite eclogites are MgO rich and TiO_2 poor, having positive Sr anomalies and REE patterns characteristic of MOR gabbros, commonly with positive Eu anomalies. Permian rift-related gabbros emplaced into the continental crust are thought to be the precursors of eclogites. *Kyanite* eclogites are confined to the ultramafic body and are similar to zo-eclogites except that they have strongly LREE-depleted patterns and lower Th, U and Sr contents. They are probably derived from zo-eclogites by dehydration melting according the reaction *zo* + *qz* = *ky* + Ca-*gt* + melt. REE patterns indicate that melting occurred in the garnet stability field, *i.e*. after eclogitisation. Zoisite in zo-eclogites has high levels of LREE, Sr, Th and U, whereas residual zoisite in ky-eclogites is strongly depleted in LREE, Th and U, having a pronounced positive Sr anomaly. Consequently, we assume that LREE, Th and U were stored in the melt, having a Sr/Y ratio much lower than typical adakites, which can be released in the overlying mantle wedge during subduction.

Thermodynamic models suggest that zoisite is a common constituent of subducted oceanic crust, and may undergo dehydration melting beneath the volcanic arc. As even small amounts of zoisite ($\geq$1 vol%) will dominate eclogite LREE, Th, U and Sr budgets, melting of zoisite-bearing eclogite may be an important contributor to mantle wedge metasomatism.