U-Th/He dating of basalt

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Determining ages and/or time scales for Quaternary (<1.8 my) basaltic eruptions still remains a challenge. Despite considerable progress in the fields of C-14, Ar-Ar, and cosmogenic nuclide dating, no single method with wide applicability has emerged and those methods that have been used often do not overlap in time or type of applicable material. We have investigated the use of the U-Th/He system as a method for dating the eruption age of volcanic rocks. Our first step was to assess the viability of using this dating technique on young samples (Aciego et al, 2003). The second step is to apply this technique to a system that has some age constraints, but that could benefit from direct age measurements. For this purpose we have chosen to focus on two areas: (1) a set of basalt samples from the Snake River Plain of Idaho and (2) a suite of post-shield alkalic basalts from the Big Island of Hawaii. Both sets of samples have upper and lower bounded age constraints, but individual flows have not been dated.

One of the drawbacks associated with using the U-Th/He technique on olivine has been the different sources of error. First, the olivine typically has low U,Th concentrations, making measurement of U,Th and He difficult. In the absence of improvements in mass spectrometer sensitivity, one way to overcome this is to measure larger amounts. The low concentrations of parent and daughter products also necessitates measuring the parent and daughter on the same aliquot, as small variations in parent or daughter between separate aliquots would produce large erros in the calculated age. For this purpose, a furnace was designed capable of heating 1-2 g of sample then retrieving the melted sample for U, Th determination. Second, the basalt matrix has more U and Th than the phenocrysts leading to a He implantation effect. Modeling of the injection-ejection effects indicate that the corrections are small. Ages have been measured for several basaltic lavas ranging from 100 to 350 kyr. The ages are consistent with geological constraints and have 1-sigma errors of ±6%.

Reference

[1] Aciego et al. (2003) *EPSL* **216**, 209-219

Study of the $^{40}Ar/^{39}Ar$ age and Ar isotope distribution of phengite in high pressure orthogneiss (the surrounding rock of the Qinglong-shan eclogite, East China)

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The conventional $^{40}Ar/^{39}Ar$ ages of phengite in high pressure metamorphic orthogneiss, the surrounding rock of the Qinglongshan eclogite, East China, are from 211.4Ma to 219.5Ma. This ages range is not only in concordance with the $^{40}Ar/^{39}Ar$ age (217.9Ma) of K-feldspar which is extracted from the same rock sample, but also identical with the Rb-Sr age (219Ma) and Sm-Nd (224Ma) of eclogite [1].

We use laser spot-fusion techenique to analyze the $^{40}Ar/^{39}Ar$ age in a single grain of phengite. The minimum age is 218.2±2.3Ma and the biggest one is 220.4±4.3Ma. These ages are concordant with the classical $^{40}Ar/^{39}Ar$ ages of bulk-sample of phengite, which shows that the argon isotope has been fairly well-distributed in the phengite.

Therefore the fundamental conclusion is: (1) phengite in the high pressure metamorphic orthogneiss does not contain excess argon and can be used as the object of $^{40}Ar/^{39}Ar$ dating. (2) phengite in Qinglongshan eclogite contains large amounts of excess argon [1] while phengite in its surrounding rock, high pressure orthogneiss, does not contain excess argon. This fact proves that the excess argon of phengite in the eclogite does not come from its country rock but from its inheritance.

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Reference

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