Development of U-Series baddeleyite geochronology for young low-Si lavas

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Baddeleyite with its high U concentrations and low initial Pb [1] is an extremely valuable geochronometer for mafic-intermediate igneous rocks which often lack other datable minerals. However, the difficulties in retrieving small baddeleyite grains from fine-grained lavas by conventional mineral separation techniques has hampered potential applications of baddeleyite geochronology. Here we report progress on developing a novel accessory mineral chronometer based on in-situ baddeleyite dating in young silica-undersaturated lavas using U-Series Secondary Ion Mass Spectrometry (SIMS).

Campi Flegrei (Naples, Italy) is an active caldera complex with silica-undersaturated potassic alkaline pyroclastic rocks and lavas. Campi Flegrei lavas are dated by ^{14}C and K-Ar ($^{40}Ar/^{39}Ar$) methods at ~150 ka to historic times, which permits a direct comparison between the baddeleyite ages and those of other geochronological techniques. Lava samples from two domes, Accademia and Punta Marmolite, were processed. They represent intra-caldera and pre-caldera lava flows, respectively. Individual baddeleyites were identified in polished rock billets (2.5 x 4 cm^2) using back-scatter and energy dispersive X-ray analysis using a Leo 1430VP. On average 41 (Accademia) and 10 (Punta Marmolite) baddeleyite crystals between ~7 and 15 μm were logged under 250× magnification per billet. In both lavas, baddeleyite crystals frequently occur within vesicles. Targeted domains were then drilled and epoxy-mounted along with Phalaborwa standards for SIMS analysis.

SIMS (using a CAMECA ims 1270) revealed remarkably high (^{238}U)/(^{232}Th) activities ranging from ~30 to 160 for most baddeleyites. Twenty-four and eleven baddeleyite grains from Accademia and Punta Marmolite lavas define preliminary isochron ages of 3.3 ± 0.78 ka and 53.3 ± 2.49 ka, in comparison to previously published K-Ar eruption age of 4 and 47 ka, respectively. These preliminary results are promising regarding the potential of micro-baddeleyite as a Quaternary eruptive geochronometer for low-Si lavas.

[1] Heaman & LeCheminant (1993). *Chem. Geol.* **110** (1-3). 95-126.