SIMS in-situ micro-baddeleyite U-Pb method for dating mafic rocks

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We report an *in-situ* method to date micro-baddeleyite grains whose exposed dimensions are less than 20 μm in length using secondary ion mass spectrometry (SIMS) U-Pb isotopic analysis [1,2]. We've successfully dated grains as small as 3 microns using the CAMECA *ims*1270 at UCLA. The method is ideal for samples that contain baddeleyite crystals that are too small to separate physically, such as fine-grained tholeiitic dikes and lavas, or samples that are too rare and precious to crush for mineral separation, such as meteorites, drill cores and samples from remote regions. Baddeleyite is common as a magmatic phase in tholeiitic and (less commonly) alkaline mafic rocks where it is not known to nucleate metamorphically, thus baddeleyite dates can generally be regarded as magmatic ages. We have occasionally documented zircon overgrowths on baddeleyite, however. The method requires only portions of polished thin sections and is relatively non-destructive, as it preserves the analyzed sections largely intact and still suitable for additional types of analyses. X-ray mapping, energy-dispersive spectrometry and backscattered electron imaging (BSE) are used to locate and image the grains and have added benefits of identifying alteration-free grains, armoring relationships, and mineral growth mechanisms. Coexisting zircons can also be dated in the same sections, if present, and often yield metamorphic ages. Analytical precision is practically limited by presence of common Pb (e.g., present at grain boundaries or crystal imperfections), and can be enhanced by averaging multiple crystal analyses. From our experience, precisions obtained by averaging 8 to 10 spot analyses range from 0.5 to 1% for $^{207}Pb/^{206}Pb$ dates from rocks that are >1000 Ma, and 3 to 8% for $^{238}U/^{206}Pb$ dates from Paleozoic to Mesozoic rocks. Recent case studies include lunar, Martian and eucritic meteorites, tholeiitic dikes and sills from 2.7 Ga to 0.4 Ga, Mesoproterozoic volcanic rocks and Caribbean intrusive rocks.

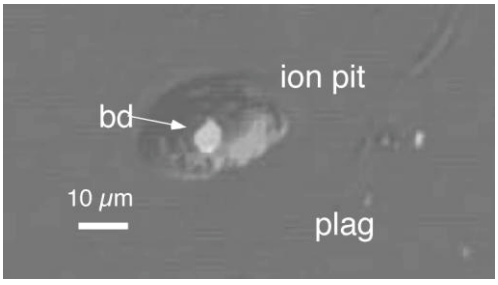

Figure 1: Post-analysis BSE image of micro-baddeleyite (bd).

[1] Schmitt et al. (2010) *Chemical Geology* **269**, 386-395. [2] Chamberlain et al. (2010) *Precambrian Research* **183**, 379-387.

CHALLENGES OF CELL-MINERAL CONTACT DURING MINERAL FORMATION AND DISSOLUTION BY FE AND S-OXIDIZING BACTERIA

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Microbial Fe and S redox transformations commonly involve mineral formation and dissolution, which presents challenges due to spatial issues. During mineralization, cell-mineral contact is ideally minimized to prevent encrustation. During dissolution, cell access to mineral surfaces can be limiting. We are studying mineral dynamics and cell-mineral interfaces in chemolithotrophic Fe oxidizers and phototrophic S-oxidizers. The Fe-oxidizers cultured from Rifle, CO groundwater produce Fe oxyhydroxides; the phototroph *Chlorobaculum tepidum*, a well-characterized model organism with a genetic system, oxidizes sulfide to solid elemental S(0) and once sulfide is exhausted, oxidizes the S(0) to sulfate. Real time dynamics of cell-mineral interactions are observed by time lapse light microscopy of live cultures. Higher resolution images are obtained by scanning and transmission electron microscopy, including cryo-techniques to preserve delicate cell-mineral spatial relationships. *C. tepidum* appears to require biogenic S(0) for growth and direct cell contact with S(0) during dissolution, but only a subset of cells appear to be firmly attached. Current efforts are aimed at dissecting the molecular components mediating cell-S(0) interactions in *C. tepidum* using a variety of microscopic, proteomic, and analytical chemistry tools.