Accessory mineral dating by ims-1270 ion microprobe

R.W. HINTON

Edinburgh Ion Microprobe Facility (EIMF), Grant Institute of Earth Science, University of Edinburgh, West Mains Road, Edinburgh, EH9 3JW, UK;
(Richard.Hinton@.ed.ac.uk)

A number of accessory minerals concentrate small amounts of U and Th and if they (initially) contain very little Pb they will be amenable to ion microprobe analysis. Each mineral presents different analytical problems not the least of which is the identification of well characterised standards. Changes between analyses in the ionisation and detection of Pb^+ relative to U^+ ions (i.e. in the Pb^+/U^+ ratio) do occur but can be shown to correlate with measured UO^+/U^+ ratios and corrections applied. At the EIMF we believe that measurement of a second molecular species e.g. UO_2^+ or ThO_2^+ can improve the correction procedures or, at least, be simply used to give confidence in the correlating ratios. Routinely, Pb, U, UO, ThO and UO_2 are all measured.

In monazite the high Th/U ratios make it possible to utilise both U and Th decay systems. Corrections are applied using a combination of Pb, Th, ThO and ThO_2 peaks. In the work to date monazite has given good reproducibility in the Pb/Th system but some open system behaviour has been observed in the Pb/U system.

Rutile, like zircon, gives good correlations for Pb/U vs UO/U or UO_2/UO ratios. However, this phase discriminates so strongly against Th that in some cases no Th signal can be detected and any ^{208}Pb+ signal can be assumed to be common Pb. The total background common Pb, either that originally incorporated in the mineral or that added to the surface during sample preparation, can be shown to be less than 1 ppb (and ^{204}Pb less than 0.03 ppb). This increases the confidence that dating rutile with relatively low U content (<5 ppm) should be possible.

Baddeleyite is the only mineral analysed so far where variations in the Pb/U ratio have been shown to be dependent on crystal orientation (Wingate and Compston, 2000). Similar effects have been observed in baddeleyite analyses made on the Edinburgh ion probe. Future EBSD work will be used to study the effects of crystallographic orientation and whether corrections can be systematically applied.

Reference

Wingate M.T.D. and Compston W., (2000), *Chem. Geol.* **168**, 75-97.

The origin of compositional variation of mafic magma and genesis of associated silicic magma in the Shirataka volcano, NE Japan: Constraints from Sr isotopic compositions of mafic inclusions and their hosts, with detailed petrologic features of the mafic inclusions

SHIHO HIROTANI[1], MASAO BAN[2] AND MITSUHIRO NAKAGAWA[3]

[1]Graduate School of Science and Engineering, Yamagata University, Japan (ss073@kdw.kj.yamagata-u.ac.jp)
[2]Department of Earth and Environmental Science, Fuculty of Science, Yamagata University, Japan (ban@sci.kj.yamagata-u.ac.jp)
[3]Graduate School of Science, Hokkaido University, Japan (nakagawa@mail.sci.hokudai.ac.jp)

Eruptive products of Shirataka volcano (0.9-0.7 Ma) in NE Japan are calc-alkaline andesite-dacite (57-66% SiO_2), and are divided into six petrologic groups (G1-6). Mafic inclusions, basalt-andesite (48-58% SiO_2), are always observed in G1, G2, G5 and G6.

All rocks are mixing rocks formed by mixing/mingling between mafic and silicic end-members judging from many petrologic aspects, such as linear trends defined by hosts and inclusions in variation diagrams and coexistence of mafic and silicic magmas origin phenocrysts in each group. The mixing trends defined by hosts and inclusions are divided into high- and low-Cr Ni types, and both types coexist in G1, G2 and G5. Cr and Ni contents of the high type show some variation. Estimated mafic end-members are high-Cr·Ni (1120-1150°C, 47-52% SiO_2, Fo-rich olv±Mg-rich cpx±An-rich plg) and low-Cr·Ni type magmas (ca.1100°C, 48-52% SiO_2, Mg-rich cpx±An-rich plg), while the silicic end-members of both types have similar petrologic features in the same petrologic group (790-840°C, 63-68% SiO_2, hbl±qtz±Mg-poor px+An-poor plg). The high-Cr·Ni type mafic end-member magma is richer in compatible elements and poorer in incompatible elements than the low type one. Besides, ^{87}Sr/^{86}Sr data of all rocks show broad ranges (0.70377-0.70537), but the compositional range of each group is restricted. In each petrologic group, the high-Cr·Ni type mafic and associated silicic end-members have lower values in ^{87}Sr/^{86}Sr ratio than the low type ones, indicating that mafic and silicic end-members in the same type have co-genetic relationships. The MELTS and trace element model calculations suggest that the low-Cr·Ni type mafic end-member magma can be produced through <25% fractional crystallization (olv±cpx±plg) from the high-Cr·Ni type mafic end-member magma accompanied with the assimilation of basement plutonic rocks (r=0.03-0.07). In terms of associated silicic magmas, the trace element model calculations indicate that the silicic magmas can be produced through <30% partial remelting of corresponding solidified mafic magmas leaving a gabbroic residue.