Line scan methods for quantitative analysis of teeth, otolith, and banded Iron by LA-ICP-MS

MATT HORTON[1]*, SONALI GERA[2], ERIC FREEBURG[3], ASISH BASU[4] ANDROBYN HANNIGAN[3]

[1]CETAC Technologies, 14306 Industrial Rd., Omaha, NE 68144 (*correspondence: mhorton@cetac.com)
[2]Undergraduate Program in Biology, Arkansas State Univ., State University, 72467 (sonali.gera@smail.astate.edu)
[3]Envir. Sci., Arkansas State Univ., PO Box 847, State Univ., AR 72467 (eric.freeburg@smail.astate.edu, hannigan@astate.edu)
[4]Earth and Environmental Sciences, Rochester Univ., Rochester, NY 14627 (abasu@earth.rochester.edu)

Trace element maps give unique insight to homogeneity, enrichment, and spatial distribution of elements in solid samples. Depending on the sample type, a wealth of additional information can be gained from sample maps beyond what is available from single or multiple spot analyses or single lines/rasters. The focus of this study was to compile and interpret elemental maps for three distinct sample types. The first sample, banded iron formation (BIF) in shale, shows distinct hematite/quartz layers. Elemental mapping of the BIF sample not only reflects the distinct matrix element layers, but also the trace element and REE distribution between the banded Si and Fe mineral phases. This type of information can be used to gain insight about the underlying bedrock composition, as well as the oxygenation and elemental composition of seawater at the time the rock was formed 3.4 Ga. Human teeth were analyzed by LA-ICP-MS and cross-sectional maps were made to assess temporal variations in Pb and to monitor migration of Hg from dental amalgam into the teeth. Finally fish otolith elemental abundances were mapped to explore spatial and temporal distribution of trace elements within and across annuli providing deeper insight into environmental life histories. LA-ICP-MS is a powerful tool for elucidating the spatial, qualitative distribution of trace elements.

Mt Stuart amphibole: Intra-sample variation and Al-in-hornblende barometry reassessed

PAUL W.O. HOSKIN AND ADAR STEINITZ

Department of Geoscience, University of Calgary, Canada (hoskin@ucalgary.ca, asteinit@ucalgary.ca)

The Mt Stuart batholith has been key in demonstrating the use of the Al-in-hornblende (AH) barometer for estimating the crystallization depth for plutonic rocks. Previous studies have used the AH barometer to infer regional tilting, magma loading, and to restore paleomagnetic data.

Previous studies have, however, failed to fully consider the range of amphibole textures and compositions within the batholith and the significance of intra-sample variation on AH barometry. We have sampled across the different age and compositional zones of the batholith and have collected texturally-controlled major and trace element data for pyroxene, plagioclase and amphibole.

Amphibole textures indicate direct magmatic crystallization, growth from pyroxene + melt reaction, re-equilibration with a fluid phase, and the presence of xenocrystic amphibole. Of particular note is the common occurrence of re-equilibrated amphibole which occurs not just along cracks or near chloritized biotite as previously reported [*1*], but is common along the rims of most amphibole grains. Amphibole rims were analysed exclusively by [*1*] and it is likely that the pressure determinations are affected by the analysis of compositions that do not represent equilibrium magmatic growth.

Magmatic amphibole composition is distinct from fluid-reequilibrated rims. The latter, relative to unaltered magmatic compositions, are Al and REE depleted. On a $^{A}Na+^{A}K+^{A}Ca$ *vs* $^{T}Al–^{A}Na–^{A}K–2^{A}Ca$ plot, amphibole compositions lie along trend-lines connecting magmatic hornblende and fully-reequilibrated actinolite, indicating varying degrees of fluid-reequlibration. In terms of AH barometry, a range of calculated pressures are attained, even for a single thin section, ranging from magmatic crystallization pressures to lower pressures estimated from fluid-altered rims.

Data from the analyzed samples indicate that the Mt Stuart magma crystallized at pressures of 3–4 kbar at 730–810 °C and that fluid-reequilibration occurred at high temperatures not far below the wet-granite solidus. This result is consistent with a recent oxygen isotope study [*2*]. We conclude that AH barometry alone does not provide compelling evidence for batholith tilting.

[1] Ague & Brandon (1996) *GSA Bulletin* **108**, 471–488.
[2] Anderson, J. L. *et al*. (in revision) *J. Meta. Geol*.