A new model for emerald mineralisation and boiling as a mechanism for emerald zoning and colouration.

DAN MARSHALL[1]*, LARA LOUGHREY[2], MEGHAN HEWTON[3] AND GABRIEL XUE[4]

[1]Earth Sciences, Simon Fraser University, Burnaby, BC, Canada (correspondence: marshall@sfu.ca)
[2]Teck Resources Ltd., 550 Burrard St, Vancouver, BC, Canada (laraloughrey@gmail.com)
[3]Teck Alaska Inc., Red Dog Mine Anchorage, AK, USA(mlhewton@gmail.com)
[4]Callinex Mines Inc., Vancouver, B.C., Canada (gabe@callinex.ca)

Emerald forms in a number of geological environments [1] from a wide variety of fluids, dominated by water, generally comprising a variety of salts, and compressible gases [2]. Geological environments are variable but unique in that they offer mechanisms that allow for the combination of berrylium-rich fluids to interact with chromium- and vanadium-bearing fluids or rocks. Our more recent work has concentrated on a relativey new occurrence of emerald in the Northwest Territories of Canada. Emerald from this deposit has precipitated from saline brines via inorganic sulphate reduction.

Figure 1. Zoned emerald from the Byrud deposit.

Zoned gem emerald occurs in a number of deposits worldwide. The best known occurences of zoned emerald are the Emmaville-Torrington in Australia, Erongo in Namibia, and the Byrud deposit in Norway. Recent fluid inclusion studies indicate that the zebra striping or zoned emerald (Fig. 1) is related to alternating precipitation of clear beryl and emerald in the vapour and liquid conjugates of (two-phase) boiling systems respectively.

[1] Groat *et al*. (2008) Ore Geol. Rev. 34, 87-112.
[2] Roedder (1972) U.S.G.S. Prof. Paper 440 JJ, 164 p.

Crustal evolution during granite emplacement: inheritance and development of heat-producing element enrichment

V. MARSHALL[1,2]*, K. KNESEL[2], S. E. BRYAN[3], C. M. ALLEN[4] AND I. T. UYSAL[1]

[1]Queensland Geothermal Energy Centre of Excellence, v.marshall@uq.edu.au (*presenting author)
[2]School of Earth Sciences, The University of Queensland
[3]Earth, Environmental & Biological Sciences, Queensland University of Technology
[4]Institute of Future Environments, Queensland University of Technology

The Big Lake Suite (BLS) granite in central Australia is one of the most prospective hot-dry rock geothermal resources worldwide. We have undertaken LA-ICP-MS $^{206}Pb/^{238}U$ dating of ~500 spots in 431 zircons across two plutons to shed new insights into petrogenesis and the relationship between emplacement age and elemental enrichment; heat-producing element (HPE) enrichments vary from 144–28 ppm Th and 30–8 ppm U between plutons.

New emplacement ages were obtained for drill holes Big Lake 1 (299 ± 6 Ma, MSWD 1.6, n=33) and Moomba 1 (324 ± 5 Ma, MSWD 0.71, n=42) in the southwest pluton, and Habanero 1 (315 ± 5, MSWD 1, n=38), Jolokia 1 (319 ± 13, MSWD 0.75, n=5) and McLeod 1 (306 ± 5 Ma, MSWD 1.8, n=74) in the northeast pluton. $^{206}Pb/^{238}U$ ages suggest protracted magmatism ~325–300 Ma, reinforcing the idea of piecemeal accumulation of granitic bodies.

Inherited 427–414 Ma ages for igneous zircons were identified in all wells (except Jolokia 1) indicating a recycled Silurian magmatic component in the BLS. Although there is overlap, inherited zircons have (on average) lesser trace-element enrichment (~250 ppm U) than emplacement-aged zircons (~870 ppm U). This suggests the emplacement-aged magma had undergone a greater degree of differentiation, thereby enriching it in HPE relative to magma compositions from which the inherited zircon population crystallised.

Protracted magmatism over ~25 Myr, and differences in emplacement history, can help explain variations in U and Th enrichment across the two plutons. Samples from the southwest pluton exhibit a difference in emplacement age of ~25 Myr, yet exhibit similar maximum Th and U enrichment implying initial elemental composition and differentiation controls allowed the magma to differentiate to the same level. Comparatively, in the northeast pluton, greater variability in final Th and U enrichment suggests slight differences in source controls over the crystallisation history of the pluton.

DOI:10.1180/minmag.2013.077.5.13