

Zircons in magmatic-hydrothermal ore deposits: An experimental study of vapor-phase crystallization and alteration at $T > 650$ °C

MARION LOUVEL¹ AND JOHN MAVROGENES¹

¹Research School of Earth Science, ANU, Canberra, Australia
marion.louvel@anu.edu.au, john.mavrogenes@anu.edu.au

U/Pb and trace element signatures of zircons occurring in mineralized veins have frequently been used to reconstruct the source and timing of ore fluids in magmatic-hydrothermal environments [1,2]. These ‘hydrothermal’ zircons are believed to form from aqueous fluids at $T < 650$ °C and are generally distinguished from those of magmatic origin on the basis of petrological association, shape, texture and geochemical signature. Yet, ‘hydrothermal’ zircons from the Sn-W Mole Granite (Australia) or the Gidginbung high-sulfidation deposit (Australia) could not be conclusively distinguished from magmatic ones, neither from their HFSE and REE signatures nor their isotopic signature [3,4].

Here, we report experimental evidence for the crystallization of zircons from high temperature gas mixtures ($T > 650$ °C) that further questions the origin of zircons in magmatic-hydrothermal systems. ZrO_2 powder and zircon grains have been subjected to high temperature gas mixtures under a thermal gradient (800 to 600 °C) to identify the conditions at which gas transport of Zr can occur, to simulate vapor-crystallization of zircons and to model the effect of magmatic gas alteration on zircon geochemistry. 1-10 μ m euhedral bipyramidal zircons formed within a few days in H_2O -FeBr-NaF gas mixtures. Other experiments further demonstrate that Zr is efficiently transported over a wide range of gas compositions involving H_2O , Cl, F (+Si). Gas-altered zircons become transparent but do not show significant evidence of alteration by CL imaging. LA-ICMPS analysis of altered versus non-altered zircons are used to discuss the likeliness of HFSE, REE, U or Pb scavenging by high temperature gases and the possible resetting of zircon geochemical signatures in magmatic-hydrothermal environments.

References:[1] Kerrich and Kyser, 1994. *Geology* **22**, 1131-1134. [2] Pelleter et al., 2007. *Chem. Geol.* **245**, 135-161.[3] Pettke et al., 2005. *Chem. Geol.* **220**, 191-213. [4] Fu et al., 2009. *Chem. Geol.* **259**,131-142.