Regional-scale metasomatism in the Fortescue Group volcanics and a link to Australia's iron ore

A. J. R. WHITE*, R. E. SMITH, M. LEGRAS AND P. NADOLL

[1]CSIRO Mineral Resources Flagship, 26 Dick Perry Avenue, Kensington, WA 6151, Australia (*correspondance: alistair.white@csiro.au)

Mafic to intermediate volcanic rocks of the Fortescue Group in the Hamersley Basin of the Pilbara Craton, Western Australia, represent one of the oldest (2.8-2.7 Ga) known continental flood basalt sequences [1]. The Fortescue Group has been subjected to intense regional-scale metasomatism, superimposed on a sub-greenschist facies regional burial metamorphic gradient, resulting in the formation of pumpellyite- and epidote-quartz assemblages and significant depletions in alkalis, Mg and the heavier first transition series metals (Mn–Zn), with addition of Si [2]. The observed mineralogical and geochemical associations are directly comparable to documented examples [3] of hydrothermal circulation of highly saline fluids, possibly derived from sea water.

Thermodynamic modelling of alteration assemblages indicate metasomatism occurred uniformly across the Hamersley Basin at conditions of approximately 275°C, 2.5 kbar [4]. The consistent P-T estimates and geochemial data suggest a common hydrothermal event, acting on length scales of hundreds of kilometres, occurring coevally with regional folding during the Ophthalmian Orogeny. We interpret that this folding generated tectonic and gravitational driving forces behind north-directed fluid flow.

Banded iron formations (BIF) of the Hamersley Group, which host world-class iron ore deposits, directly overly the Fortescue Group volcanics. Hypogene models of iron ore deposit genesis invoke the action of highly saline, base metal-charged, moderate temperature fluids coincident with Ophthalmian deformation [5-7]. We therefore propose that the metasomatic event recorded in the Fortescue Group is also responsible for hypogene upgrading of BIF to iron 'proto-ores' through leaching of Fe from the volcanics, which also provide a sink for Si removed from the BIF. Ultimately, the Fortescue Group volcanics represents a 100,000 km^2 footprint to the world's most important iron ore province.

[1] Arndt *et al*. (1991) *Aust. J. Earth Sci*. **38**, 261-281. [2] White *et al*. (2014) *J. Pet*. **55**, 977-1009. [3] Hannington *et al*. (2003) *Miner. Deposita* **38**, 393-422. [4] White *et al*. (2014) *J. Met. Geol*. **32**, 417-433. [5] Barley *et al*. (1999) *Miner. Deposita* **34**, 784-789. [6] Powell *et al* (1999) *Geology* **27**, 175-178. [7] Dalstra and Guedes (2004) *Econ. Geol*. **99**, 1793-1800.