Isotopic composition of the felsic rocks of the Mt Read Volcanics, Western Tasmania

Pete Hollings[1], Tony Crawford[1] and Dave Whitford[2]

[1]Centre for Ore Deposit Research, University of Tasmania, [2] CSIRO Division of Petroleum Resources

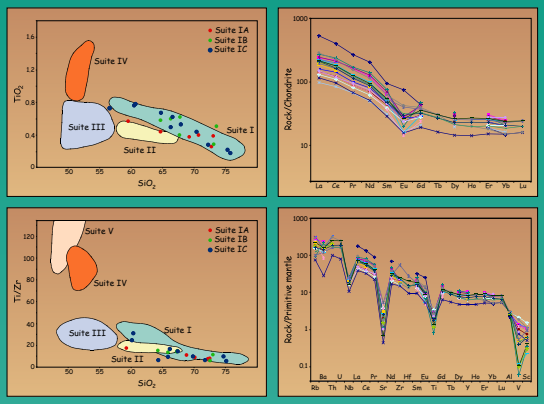
CODES SRC

Introduction

Crawford et al. (1992) used geochemical criteria to subdivide the Cambrian Mount Read Volcanics (MRV) into five distinct suites, irrespective of stratigraphy. Suite I, comprising medium- to high-K calc alkaline rocks, is the most voluminous of the five suites and includes rocks from the Eastern sequence, the Central Volcanic Complex (CVC) and the Tyndall Group. Rhyolitic and dacitic samples selected for isotopic analysis are all from Suite I.

Chondrite and primitive mantle normalised trace element diagrams demonstrate that all 30 samples analysed have very similar trace element systematics, comparable to the variably prospective FII suite defined by Lesher et al. (1986) for felsic volcanic rocks of the Superior Province, Canada.

Crawford et al. (1992) suggested that the majority of Suite I rocks were erupted in a post-collisional setting, as andesites associated with Suite I are typical of orogenic andesites found in continental margin arcs. The late Tyndall Group lacks rocks of andesitic composition and consequently was interpreted as being derived entirely from melting of Proterozoic lower crust. Isotopic analyses have been undertaken in order to further evaluate these models and better constrain the tectonic setting of the MRV.



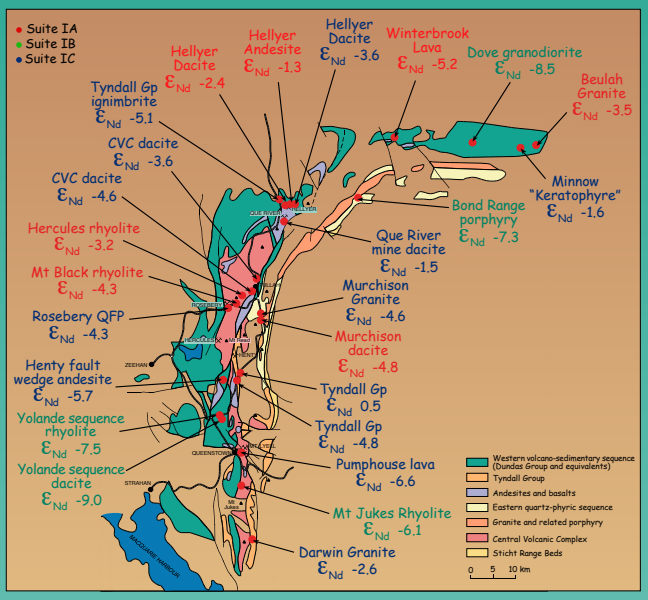
Regional geology

For the purposes of this study volcanic rocks of the MRV can be broadly subdivided into the three lithostratigraphic associations:

1) the basal felsic volcanics and volcaniclastics of the Eastern sequence, interpreted to have erupted through and onto Precambrian basement

2) the CVC comprising feldspar porphyritic rhyolitic to dacitic lavas that are interpreted to be coeval with the Eastern sequence

3) the Tyndall Group which overlies both the CVC and the Eastern sequence is predominantly volcaniclastic but includes some quartz- and feldspar porphyritic rhyolitic and dacitic lavas.

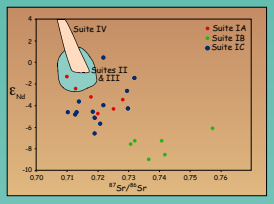


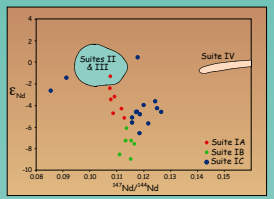
Regional correlations

The adjacent map illustrates that the ε_{Nd} values do not display a strong temporal or geographic correlation across the MRV. However, samples from the younger Tyndall group tend to have somewhat higher ε_{Nd} values.

Based on the isotope systematics discussed below the Suite I rocks can be subdivided into three distinct suites, which do not appear to display any pronounced geographic or stratigraphic correlations.

Samples associated with known deposits (Hellyer & Que River) have higher ε_{Nd} values of -1.3 to -2.4. This is consistent with a study of the Snow Lake VHMS deposit in Canada, where volcanic rocks in the immediate footwall to the deposit are isotopically more primitive than those lower in the stratigraphy (Bailes and Galley, 1999). This was interpreted to reflect extension within an arc allowing the sourcing of more primitive magmas.





Isotope systematics

Although Suite I samples are characterised by very similar trace element systematics, Sr and Nd isotope systematics can be used to divide the suite into three distinct subsets, illustrated on the adjacent plots. The three suites provide evidence for at least three isotopically distinct source regions below the MRV.

1) The evolved ε_{Nd} values of the Suite Ib rocks are best explained as the result of mixing with significantly older, isotopically evolved crust, possibly Precambrian basement material.

2) Suite Ia rocks appear to lie on a mixing trend between the relatively primitive compositions of Suites II and III and the highly evolved Suite Ib. This is best interpreted as contamination of the mantle source of Suites II and III by older crustal material.

3) Suite Ic rocks lie on a mixing trend between the evolved crustal component and Suite IV compositions. Suite IV has been interpreted by Crawford et al. (1992) to be typical rift tholeiites erupted in suprasubduction zone settings during the early phases of rifting of a magmatic arc.

Implications

Isotopic data for the MRV is consistent with the tectonic model of Crawford et al. (1992) which interpreted the MRV as post-collisional volcanics in a region of arc-continent collision. There is evidence for the existence of three distinct mantle source components throughout the relatively brief time span over which the MRV erupted. The association of isotopically primitive compositions with VHMS deposits may offer a useful exploration vector.

Acknowledgements

Keith Corbett and Lance Black provided a number of samples utilised in this study. Analyses were undertaken at LaTrobe University by Roland Mass. This study was funded in part by a research grant from the Centre for Ore Deposit Research, an ARC Special Research Centre at the University of Tasmania.

References

Bailes, A. & Galley, A. (1999). Evolution of the Paleoproterozoic Snow lake arc assemblage and geodynamic setting for associated VHMS deposits, Flin Flon Belt, Manitoba, Canada. Canadian Journal of Earth Sciences, 36, 1789-1805.

Crawford, A., Corbett, K. & Everard, J. (1992). Geochemistry of the Cambrian VHMS-rich Mount Read Volcanics, Tasmania, and some tectonic implications. Economic Geology, 87, 597-619.

Lesher, C., Goodwin, A, Campbell, I. & Gorton, M. (1986). Trace element geochemistry of ore-associated felsic metavolcanic rocks in the Superior Province, Canada. Canadian Journal of Earth Sciences, 23, 227-237.