

# A late episode of Ferrar magmatism? Geochemistry and preliminary $^{40}\text{Ar}/^{39}\text{Ar}$ results of high Fe (SPCT) tholeiites from Southern Victoria Land, Antarctica

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The Middle Jurassic Ferrar Magmatic Province extends along the proto-Pacific margin of Gondwana from Antarctica to Tasmania, Australia and New Zealand. This magmatism is part of the Mesozoic low-Ti Gondwana Province (Cox, 1988), but differs from the other Mesozoic Large Igneous Provinces, related to the break-up of Gondwana, by having high  $\text{SiO}_2$  content, LILE/HFSE ratios and Sr isotopic compositions ( $^{87}\text{Sr}/^{86}\text{Sr} > 0.708$ ). In Antarctica, the Ferrar magmatism is represented by the mafic layered intrusions of Dufek, the sills and dikes of the Ferrar Dolerite and by the lava flows of the Kirkpatrick Basalt. Geochemical and isotopic studies on the Kirkpatrick basalts from the Mesa Range (Victoria Land) revealed the occurrence of two geochemical types: the Mount Fazio (low-Fe; MFCT) and the overlying Scarab Peak (high-Fe; SPCT; Fleming *et al.*, 1995).

Ferrar sills and lavas from Prince Albert Mountains have been investigated for major and trace elements and Sr-Nd isotopic compositions. The studied rocks mainly belong to the low-Fe tholeiites (MFCT) and consist of tholeiitic-andesitic basalts and andesites, while the high-Fe tholeiites (SPCT) have been found only at Brimstone Peak. High-Fe (SPCT) rocks are represented by evolved (mg# 23–18) andesites characterized by relatively high  $\text{FeO}_t$  (>13.0 wt.%) and  $\text{TiO}_2$  (>1.8 wt.%) and low  $\text{SiO}_2$  (56–59) contents. Relative to the high-Fe (SPCT) rocks, the low-Fe (MFCT) rocks cover a wider range of mg# (54–23) showing lower  $\text{FeO}_t$  (<12.0 wt.%) and  $\text{TiO}_2$  (<1.4 wt.%) and, for similar mg# values, higher  $\text{SiO}_2$  (56–61) contents.

The  $\epsilon\text{Nd}$  and  $\epsilon\text{Sr}$  values of the low-Fe (MFCT) tholeiites range from  $-4.8$  to  $-5.7$  and from 85.8 to 112.1, respectively. The  $\epsilon\text{Sr}$  values are positively correlated with the degree of differentiation, (e.g. increase of  $\text{SiO}_2$  content and LREE/HREE ratios),

suggesting that crustal contamination may operated during the magmatic differentiation of low-Fe (MFCT) tholeiites. The high-Fe (SPCT) rocks exhibit less enriched Sr-Nd isotopic compositions ( $\epsilon\text{Nd} = -2.7$  to  $-3.9$ ;  $\epsilon\text{Sr} = 73.6$  to  $78.9$ ), with respect to the high-Fe (MFCT) indicating that the SPCT rocks can not derive from the MFCT magmas by fractional crystallization. This suggests SPCT and MFCT experienced different evolutionary processes, and may require distinct parental magmas.

Previous  $^{40}\text{Ar}/^{39}\text{Ar}$  data suggested that Kirkpatrick basalts and Ferrar dolerites were emplaced in a short time interval, less than 1 Ma (e.g. Heimann *et al.*, 1994; Fleming *et al.*, 1997).

We present new  $^{40}\text{Ar}/^{39}\text{Ar}$  data on an high-Fe (SPCT) andesite. The plagioclase separate of this sample yields an  $^{40}\text{Ar}/^{39}\text{Ar}$  plateau age of  $175.1 \pm 1.0$  Ma ( $1\sigma$  analytical precision; Fig. 1).

This plateau is defined by 21 contiguous steps and by c. 90% of released  $^{39}\text{Ar}$ . The isochron age ( $174.9 \pm 2.5$  Ma; MSWD = 0.95; intercept  $^{40}\text{Ar}/^{36}\text{Ar} =$

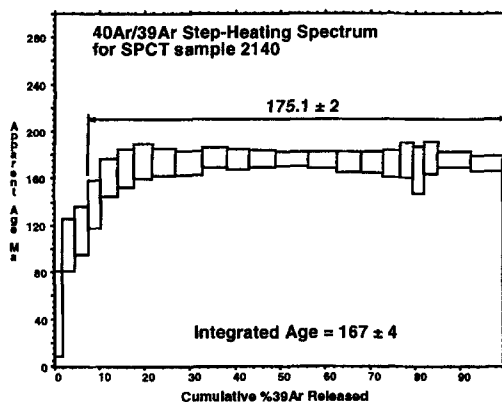


Fig. 1.  $^{40}\text{Ar}/^{39}\text{Ar}$  age spectrum of SPCT sample 2140.

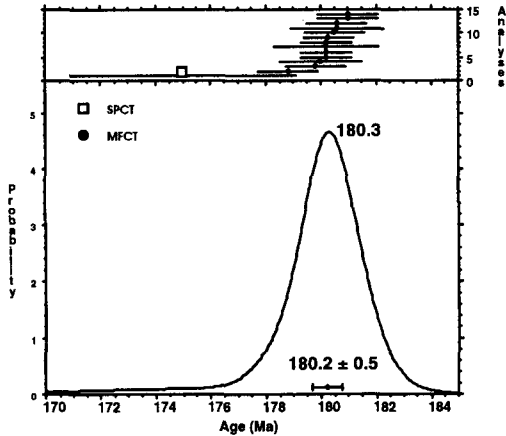


FIG. 2. Relative probability plot of  $^{40}\text{Ar}/^{39}\text{Ar}$  ages of Kirkpatrick basalts and Ferrar dolerites (see text for references). All ages recalculated on the basis of Mmhb-1 = 523.1.

$288.5 \pm 6.2$ ) is indistinguishable. The ages are calculated based on the age of 28.02 Ma for Fish Canyon sanidine (FCs), equivalent to 523.1 Ma for MMhb-1 standard (Renne *et al.*, 1988). Previous  $^{40}\text{Ar}/^{39}\text{Ar}$  ages determined for the Kirkpatrick Basalt

and the Ferrar Dolerite (Heimann *et al.*, 1994; Fleming *et al.*, 1997) were based on a different age of MMhb-1. Normalizing all to the basis defined by Renne *et al.* (1998), the Kirkpatrick Basalts (Heimann *et al.*, 1994) and the Ferrar Dolerites (Fleming *et al.*, 1997) range from 179 to 181 Ma (mean  $180.2 \pm 0.5$  Ma). The high-Fe (SPCT) age ( $175.1 \pm 1.0$  Ma) is significantly younger than the mean age of Ferrar magmatism, even at the  $2\sigma$  confidence level (Fig. 2), thus the SPCT andesites represent a late episode in Ferrar volcanism. Further  $^{40}\text{Ar}/^{39}\text{Ar}$  analyses of SPCT andesites are in progress.

## References

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