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Mafic Dykes in Rauer Islands and Vestfold Hills (East Antartica): A Geochemical and Nd Isotopic Comparison Arguing Against Their Correlation

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Mafic dykes have been long considered possible tectono-stratigraphic markers in East Antarctica because they are largely confined to Archaean–Early Proterozoic cratonic blocks but are absent from mid- to late Proterozoic or Cambrian mobile belts (e.g., Sheraton et al., 1987). However, the mobile belts may also locally contain deformed and metamorphosed mafic dykes which may correlate with those occurring within the cratonic blocks. We address geochemical and Nd isotopic compositions of such "pared" mafic dyke complexes by comparing deformed dykes exposed in the Rauer Islands, a region underlain by reworked Archaean and Proterozoic crust, with undeformed dykes exposed in the Vestfold Hills, a region underlain by basically unaltered Archaean crust. Both blocks have been heavily intruded by mafic dykes, dated in Vestfold Hills between ca 2450 Ma and ca 1250 Ma (Lanyon et al., 1993). Based on detail structural observations in the north-eastern Rauer Islands and geochemical data Sims et al. (1994) correlated the dyke emplacement/deformational histories in neighboring but geologically different Rauer Islands and Vestfold Hills.

We analyzed 50 dykes for major and trace elements, 7 of those for Sm–Nd isotopic composition from Rauer Islands, and 10 dykes from Vestfold Hills for Sm–Nd isotopic composition, geochemical data published elsewhere.

Structural observations in central and northern Rauer Islands (Hop, Filla, Efremova, and Scherbinina islands) allowed eight generations of deformed dykes to be distinguished, two pre-date a ca 1400 Ma magmatic episode, the other generations post-date either the ca 1400 Ma event, or a subsequent 1150–1000 Ma magmatic episode (unpublished U–Pb zircon data by NLA). All dykes are deformed and metamorphosed in Cambrian.

The older generations (d1–d2) are low-SiO_2 (47–50%), low TiO_2 (1–2.5%) evolved (mg = 57–40, MgO = 5–8.5%) tholeiitic rocks. In a spiderdiagram they display smooth unfractionated patterns albeit all elements show strong concentration variations from 4–5 to 10–30 primitive mantle (PM) values. These rocks show relatively high $^{147}Sm/^{144}Nd$ values of 0.160 to 0.177 and high TDM model ages up to 3.8 Ga. The oldest (ca 2450–2250 Ma) dykes in Vestfold Hills are largely represented by high Mg (MgO = 10–12%) and low TiO_2 (0.5–0.7%), somewhat elevated LILE (30–80 values PM), and a prominent Nb trough. These features not observed in d1–d2 dykes. Nd isotopic composition of high-Mg dykes from Vestfold Hills indicate their derivation from an enriched mantle source with eNd (2.25) = -2. The younger ca 1800–1250 Ma tholeiitic dykes from Vestfold Hills are very similar to d1–d2 dyke generations in Rauer Islands in terms of major and trace element compositions and display similar spiderdiagram patterns. They also show similar $^{147}Sm/^{144}Nd$ values (0.163 –0.194) although yield much lower TDM model ages of 2.5 Ga to 2.1 Ga, and $\varepsilon_{Nd}(1.3) = 0–+4$. This suggests that these rocks, although outwardly chemically similar in whole rock and trace element datasets, are likely derived from isotopically different mantle sources.

The younger dyke generations from the Rauer Islands (d3–d8) were sampled from Hop, Filla, and Efremova islands. These dykes comprise two geochemical groups. Dykes from Efremova Island and a few dykes from Filla Island are chemically indistinguishable from low-LILE d1–d2 dykes, while the majority of dykes from Filla Island and Hop Island are composed of LILE-enriched rocks. In terms of major elements they are similar to d1–d2 compositions, but differ from them being strongly enriched in LREE, LIL elements and Th, U (up to 100–2000 values PM). In a spiderdiagram these rocks display strongly fractionated patterns with very deep Nb troughs. These rocks show low $^{147}Sm/^{144}Nd$ values of 0.070 to 0.083 and TDM model ages between 1.8 Ga and 1.5 Ga, and $\varepsilon_{Nd}(1.0) = -5–-7$. No

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chemically or isotopically similar dykes can be found in Vestfold Hills.

Proterozoic metamorphosed tholeiitic dykes of several generations and geochemical groups are also widespread in Archaean to Palaeoproterozoic Ruker Complex in the southern Prince Charles Mountains (Mikhalsky et al., 2013). There the youngest (presumably <1300 Ma) NNE-trending dykes are very similar to post-1400 Ma low-LILE dykes in Filla Island, but their Nd isotopic compositions indicate derivation from a primitive mantle source with $\varepsilon_{Nd} > 0$. Older ENE-trending dykes in southern Prince Charles Mountains, especially those characterized by lower LILE concentrations, are very similar to d1–d2 dykes from Scherbinina Island both in terms of spiderdiagram patterns and Nd isotopic compositions. – I would not mention this either as it drifts a bit too far from the key point of the paper, which is to compare the dykes from the adjacent Rauer and Vestfold regions.

Our data argue against direct correlation between mafic dyke swarms in Rauer Islands and Vestfold Hills, in spite of common tholeiitic whole rock chemistries and a similar degree of dyke invasion. A tentative correlation with older generations of dykes in the southern Prince Charles Mountains any be alternatively suggested. The presence of younger (<1400 Ma) and geochemically specific high-LILE dykes in western Rauer Islands (Hop, Filla) lacking from other areas may indicate basic magmatism in post-orogenic or back-arc environments during terminating episode of the Rayner orogeny.

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