

THE STRUCTURE, CHARACTER AND EVOLUTION OF MANTLE KAROO – MAUD SUPERPLUME IN ANTARCTICA

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Continental flood basalts known from western Dronning Maud Land and Transantarctic Mountains are regarded as manifestations of the Karoo – Maud mantle superplume activities at about 180 Ma ago, which enabled subsequent Gondwanaland break-up [1]. Unlike well-studied Karoo basalts in Africa, Antarctic large igneous province is hardly accessible and therefore much less studied. Superplume development in space and time, its geochemical character and nature, magma generation and crystallization conditions are most important issues in understanding superplume general evolution features.

We studied the mineral phase compositions of dyke rocks from Schirmacher oasis situated onshore central Dronning Maud Land. Olivine-bearing dolerites and gabbro-dolerites most likely represent Jurassic trapp activities in Antarctica [2]. Our research includes petrological modelling, and enables initial magma composition and generation conditions being assessed. About 400 olivine grains for studied by micro probing. Olivine shows a wide composition range between Fo_{91,5} to Fo₅₅, which proves strong influence of accumulation processes during melt differentiation. Most common are olivine compositions Fo₈₈ – Fo₈₉, which closely corresponds to some olivine compositions reported from less-evolved Jurassic basalts in Vestfjella (western Dronning Maud Land) [3]. The latter likely represents an initial stage of the Karoo – Maud superplume development. The findings of high-Mg olivines commonly lacking from continental flood basalts and dykes reflect fast magma ascent to middle-crust magma chambers, and reveals a peculiar feature of the Karoo – Maud superplume development in Antarctica.

Mostly olivine entrains spinel inclusions which compositions are typical of mantle melts (Fig.1).

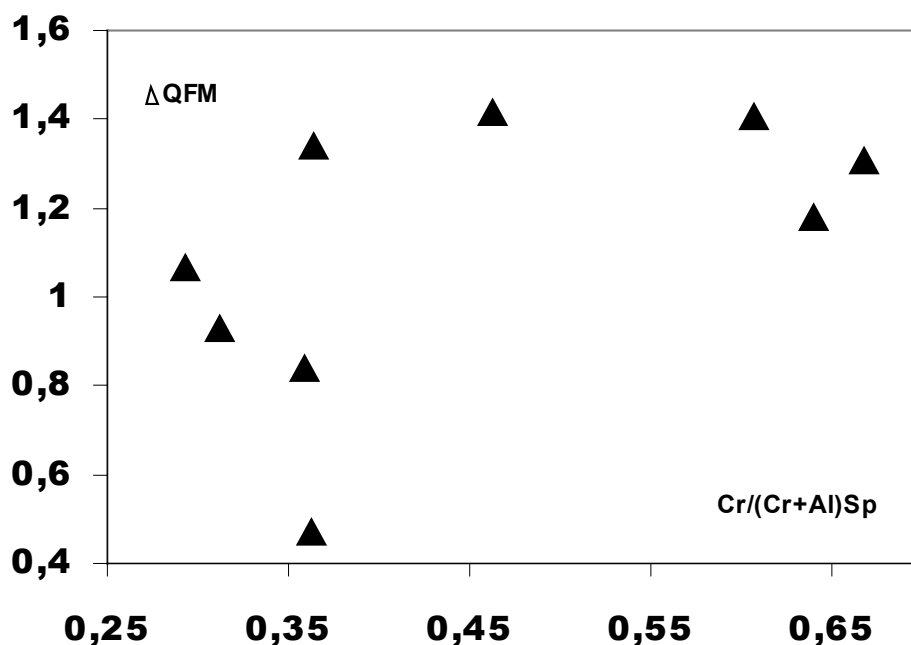


Fig. 1. Spinel Cr index versus Δ QFM plot for Schirmacher Oasis dyke dolerites

Relative deviations from the QWM buffer (ΔQWM as $-\lg(fO_2)$) are about 1–1,2. Clinopyroxene crystallization followed precipitation of olivine and plagioclase. Clinopyroxene has wide *mg#* variation range between 81 to 69 (Fig. 2) and low Cr/Al (0,01–0,14) and Na/Al (0,1–0,15) ratios.

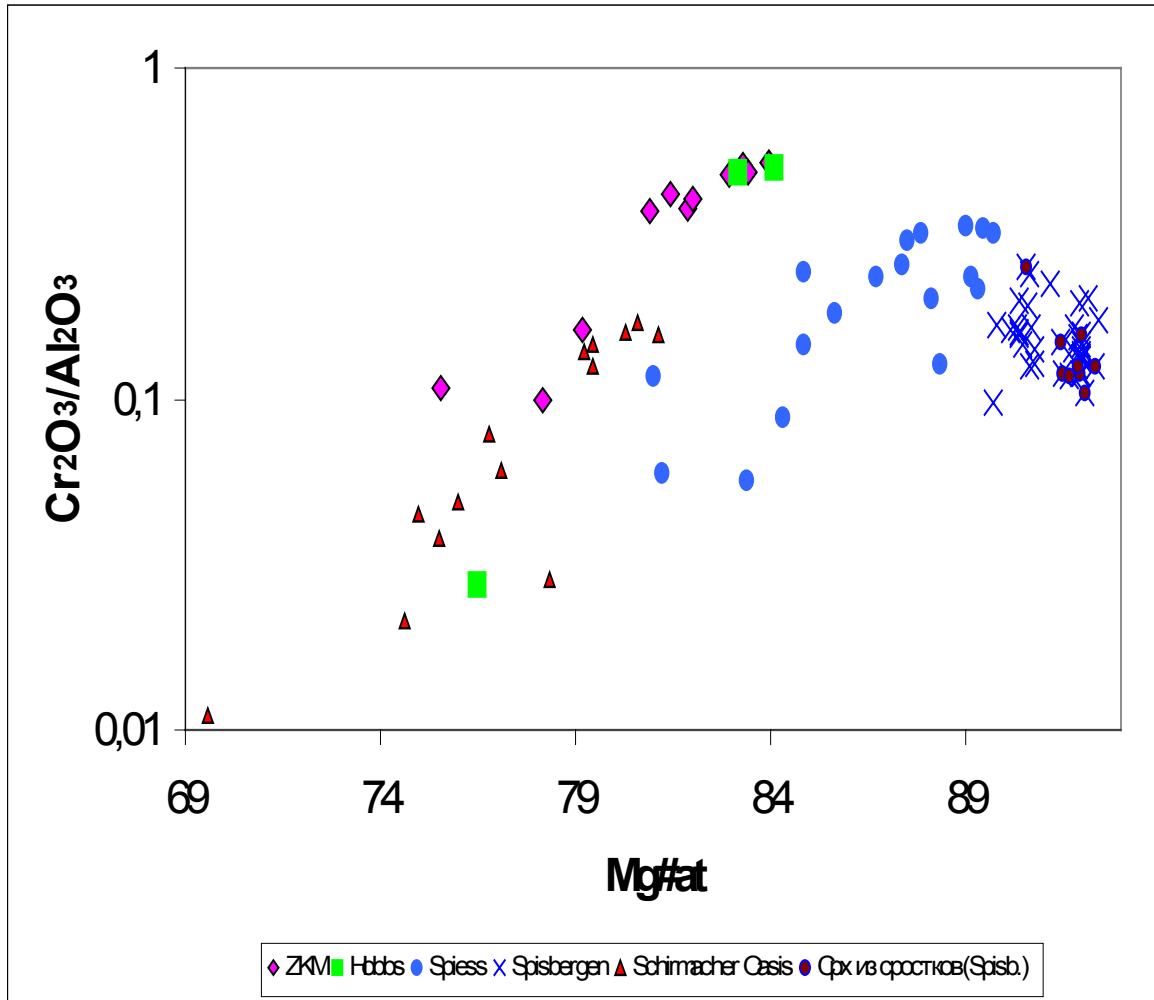


Fig. 2. Clinopyroxene *mg#* versus Cr₂O₃/Al₂O₃ ratio plot for Schirmacher oasis dyke dolerites and basalts of the Dronning Maud Land (ZKM), in comparison with Antarctic Cenozoic alkaline basalts (Hobbs), Spitsbergen Quaternary alkaline basalts (Spisb.), and spreading center tholeiites (Spiess).

These features along with lithophile element abundances resemble the composition of clinopyroxene from Vestfjella basalts [4].

Clinopyroxene composition provides a mean for pressure estimation [5]. Using this approach Schirmacher oasis dyke samples yields pressure estimates at 1–2 kbar (calculated at mean temperature T °C= 1100), which points out to a fairly shallow crystallization. Similar crystallization pressure interval was also calculated for western Dronning Maud Land magmas, which is evident from model pressure histograms (Fig. 3).

Thus, the composition and evolution of mafic magmas in Schirmacher oasis are similar to mildly enriched trapp rocks in Vestfjella which are related to initial superplume magmatism in Antarctica. That reflects eastward migration of plume-related magmatic activities.

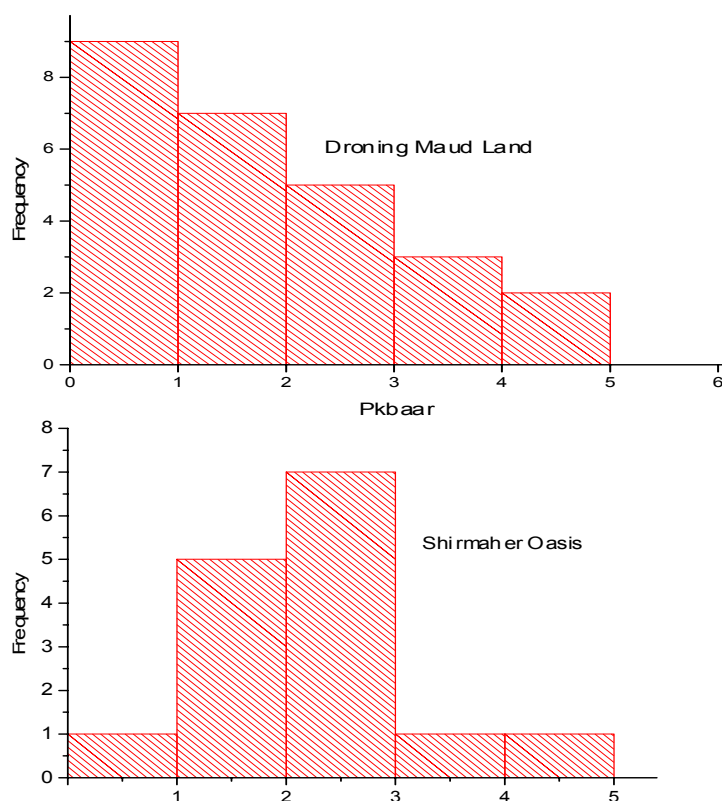


Fig. 3. Crystallization pressure interval histograms for mafic rocks in Schirmacher Oasis and Dronning Maud Land [4]. Pressure estimation after Nimis & Ulmer [5]; uncertainties not exceeding 1,7 kbar.

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