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Geochemical characteristics of Antarctic magmatism connected with Karoo-Maud and Kerguelen mantle plumes

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Emplacement (130-115 m.y. ago) of dikes and sills of alkaline-ultrabasic composition within Jetty oasis (East Antarctica) is suggested as a later appearance of plume magmatism within the East-Antarctic Shield [Andronikov et al., 1993, 2001; Laiba et al., 1987]. This region is located opposite Kerguelen Islands and possibly could be properly connected with activity of the Kerguelen-plume [Foley et al., 2001, 2006]. Jurassic-Cretaceous dykes, stocks and sills of alkaline-ultrabasic rocks, relatively close to kimberlite-type, are exposed within Jetty oasis and on the southern shore of the Raddock Lake. This alkaline-ultrabasic magmatism has appeared to be connected with the main Mesozoic stage of the evolution of the Lambert and Amery glaciers riftogenic structure [Kurinin et al., 1980, 1988]. The alkaline-ultrabasic dikes and sills within Jetty oasis cut the rocks of the Beaver complex, Permo-Triassic terrigeneous successions of the Amery complex, and late Paleozoic low-alkaline basic dikes as well. Dashed chain of 6 stock bodies spread out on 15 km along the eastern shore of the Beaver Lake, marked their allocation with submeridianal zone of the deep cracks, boarded of the eastern side of the Beaver Lake trough. At the same time, new data upon Quaternary magmatism of the mountain Gaussberg has confirmed the unique features of ultra-potassium alkaline magmatism (up to 14-17% K2O) formed under exclusively continental conditions [Murphy et al., 2002]. Volcanic cone is located at the continuation of Gaussberg rift zone which is possibly a part of Lambert fracture zone. Its formation is connected with the early stages of Gondwana development, perhaps, reactivated in different Precambrian events and according to numerous data is a single rift zone which is traced Indian inland (Indrani graben, [Golynsky, 2011]). The time of lamproitic magmas eruption is estimated at 56000±5000 yeas ago [Tingey et al., 1983].

Earlier it had been shown the Mesozoic (about 170 Ma) basaltic dykes of the Schirmacher Oasis and basalts and dolerites of the Queen Maud Land (180 Ma) are identical in petrology and geochemistry terms and supposedly could be interpreted as the manifestation of the Karoo–Maud plume activity in Antarctica [Sushchevskaya et al., 2012]. The spatial distribution of the dikes indicates the eastward spreading of the plume material from DML to the Schirmacher Oasis within at least 10 Ma (up to ∼35 Ma, taking into account the uncertainty of age determination). On the other hand, the considerable duration and multistage character of plume magmatism related to the activity of the Karoo–Maud plume in Antarctica and Africa [Leat et al., 2007; Luttinen et al., 2002] may indicate that the Mesozoic dikes of the oasis correspond to a single stage of plume magmatism.

On the basis of obtained isotopic data it has been determined two magmatic melt evolution trends for basalts from: Queen Maud Land – Kerguelen Archipelago – Afanasy Nikitin Rise (Indian Ocean) and Jetty – Schirmacher oasises which mantle sources are quite different. Thus the Jetty – Schirmacher oasises magmatic melt sources are characterized by prevalence of the matter of moderately enriched or primitive chondritic mantle source and lithospheric mantle of Proterozoic ages but the substances of depleted mantle source similar to MORB-type and ancient mantle are absent.

New data obtained on Nd, Sr, Pb isotopic and lithophile elements compositions of the alkaline-ultrabasic rocks from the Jetty oasis and Gaussberg volcano completed imagine of the Kerguelen-plume evolution. It has been confirmed unique character of the alkaline lamproiites of the Gaussberg volcano enrichments. Highly radiogenic Sr and Pb isotope ratios of these lamproiites reflect melting of the ancient sublithospheric depleted mantle which was stored from the Archean till nowadays unaffected by metasomatic-enrichment processes. During modern melting of this mantle part there is input of additional substances (crustal fluid of sediment origins, subducted sediments etc.) with high Rb/Sr ratio.