Geochemistry and mechanic emplacement of Late proterozoic dyke swarms, Eastern Desert, Egypt

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Geologic and geochemical data of intraplate Late Pan-African (493±7Ma) dykes assemblage in the Eastern Desert of Egypt are presented. The dyke swarms consist of a bimodal mafic-felsic suite of transitional alkaline to subalkaline chemistry and exhibit a broad compostional range. Geochemical studies show that they can be subdivided into three distinct chemical groups with two distinct compositional gaps and correlate fairly well with other occurrences of late Pan –African dykes in Egypt. This bimodal suite bears a genetic relation to corresponding rock types in the study area.

These dykes trend predominantly in NW and NNW directions and less frequently in NW and N orientations; parallel to the major fracture pattern and lineament trends. Despite of the small geographic area and limited time interval in which the dykes were extruded, their complex geochemistry requires multiple sources together with varying amounts of open system fractionation assimilation. It is believed that the crystallization of the studied dykes follow the one-step emplacement either in open or closed system under both brittle and ductile crustal conditions. The time (ts) required to solidify these types of dykes is generally longer in the acidic than the basic variety.

Nb-depleted calc-alkaline dacites from Iceland: Implications for Archean crust formation

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Samples from the dacitic Kroksfjordur volcanic center, NW Iceland, have calc-alkaline compositions contrasting the alkaline to tholeiitic composition commonly observed for felsic rocks from ocean islands or plateaus (JÓNASSON, 2006). New major, trace element, and isotope data show that these samples display a distinct depletion of Nb (La/Nb_{PM} = 2.7 ± 0.4; 1σ) and enrichment of Pb (Ce/Pb_{PM} = 0.7 ± 0.1) in primitive mantle normalized trace element plots, and high Na/K ratios (3.6 ± 0.3).

The Sr-Nd-Hf-Pb isotopic compositions preclude the involvement of old continental lithosphere in the petrogenesis of the dacitic melts. The limited variation in major element data and the small though systematic variation of La/Nb and Ce/Pb ratios with TiO_2 and Ce concentrations, respectively, suggest that the dacites were derived by partial melting of a mafic protolith comprising plagioclase + clinopyroxene + amphibole + Fe-Ti oxides. Inverse modelling shows that the calculated trace element composition of the source is similar to that of mafic crustal xenoliths hosted by one of the dacitic bodies. This observation suggests that partial melting of Icelandic mafic lower crust, most likely during magmatic underplating, has produced the calc-alkaline dacites at Kroksfjordur.

The major and trace element composition of the dacites closely resembles that of Archean tonalite - trondjemite - granodiorite (TTG) associations. Depletion of Nb and enrichment of Pb in TTG associations have hitherto been interpreted as evidence for their exclusive formation in Archean subduction zones (e.g. DRUMMOND and DEFANT, 1990; MARTIN, 1999). The new findings from the Kroksfjordur volcano demonstrate that partial melting of mafic protoliths in an oceanic intra-plate setting can also lead to chemical signatures similar to that of magmatic rocks generated in subduction zone environments. This provides evidence that the Archean continental crust could have been formed in a variety of geodynamic settings including intra-plate as well as plate margin settings.

References

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