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Late Variscan postcollisional extensional events in the Danubian domain (Romania): the Motru Dyke System

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An extensive system of dykes, known as the Motru Dyke Swarm (MDS), penetrates through the whole Danubian basement (Neoproterozoic high-grade metamorphic rocks, granitoid plutons of the same age in addition to a range of post-collisional Variscan granitoid plutons) in a presumed pre-Ordovician thermo-tectonic event [1]. Previously considered as illustrative for a sub-volcanic event occured in the early Palaeozoic (Cambrian – Ordovician), in a oceanic arc setting, based on the crosscutting field relationships with the Variscan post-collisional granitoid plutons combined with new geochemical and isotopic data, a new tectonic setting of emplacement is inferred. Even if the new zircon U/Pb ages on some components of MDS together with already published data reported by [2] does not confirm any Variscan or Late Variscan age, based on the same field relationships an upper Carboniferous age is supposed.

The MDS belongs to a major complex of calc-alkaline dykes of Pan-African origin. The entire system penetrates most of the Lainici-Paius terrane components, at a relatively high crustal level, although it penetrate also Drăgşan terrane components in some places. Its components consist of medium- to high-K sub-volcanic suites, composed of numerous sub-volcanic components of basic to felsic composition. These components compile a complete medium-K calc-alkaline to shshonitic differentiation series, ranging from basaltic andesites to rhyolites (46.59-68.79 wt% SiO_2).

Even if the trace elements trends share some similarities to those previously reported (e.g. [2]) generally they point to source heterogeneity. Some samples reveal low abundances in Nb, P and Ti, while others show relative enrichments in these elements in addition as well as in Th, Pb, Zr and Y, pointing to already enriched sources in these incompatible elements. The trace elements concentrations proportionally decrease with the increase of the SiO_2 compositions. The mafic and intermediate rocks show enrichment in trace elements concentrations as compared to the felsic ones, even though their trends are similar. The high values of Al concentrations (exceeding 14%) correlated to the Na concentrations and the absence of Eu anomalies in the REE distributions, exclude the plagioclase fractionation in the bulk generation of these melts.

Sr and Nd isotopic data from several components of the MDS, do not comply with the previous assumptions regarding source, yet indicates a heterogeneous source of mixed mantle and dominant crustal origin. The negative values of initial Nd (assuming an age of 300 Ma), for 12 out of 13 collected samples ranging from – 13.0 to + 5.7 (with clustering between -6 and 0) and the relatively high 87Sr/86Sr initial ratios (0.70745-0.73746) point clearly to a mixing of sub-crustal and crustal derived melts.

Trace elements concentrations along with the radiogenic isotope data support the assumption of an enriched mixed mantle source with crustal components that is also sustained by the presence of inherited zircon grains in MDS.

Therefore we can constrain the emplacement age of MDS to Late Paleozoic (i.e. Carboniferous). It is very likely that they might have been generated during the post-collisional late Variscan extensional event, in a very likely relation to lower crustal delamination that might have triggered the partial melting of the uppermost mantle, which could have induced the partial melting of crustal components.

[1] Balintoni, I., Balica, C., 2012. Avalonian, Ganderian and East Cadomian terranes in South Carpathians, Romania, and Pan-African events recorded in their basement. Mineralogy and Petrology - DOI: 10.1007/s00710-012-0206-x

[2] Berza, T., Seghedi, A., 1975. The pre-Silurian filonian complex from Motru Basin (in Romanian) Dări de Seamă ale Institutului de Geologie şi Geofizică, LXI/1, 131-149.

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