Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4705

Late-orogenic juvenile magmatism of the Mesoproterozoic Namaqualand Province (South Africa) and its relation to REE-Th monazite-iron oxide mineralization

CHRISTOPHE BALLOUARD[1], MARLINA A. ELBURG[2], DANIEL E. HARLOV[3], SEBASTIAN TAPPE[2], MICHAEL W. KNOPER[2], AURÉLIEN EGLINGER[4] AND MARCO A.G. ANDREOLI[5]

[1]Université de Lorraine-GeoRessources
[2]University of Johannesburg
[3]Deutsches GeoForschungsZentrum GFZ
[4]Université de Lorraine
[5]University of the Witwatersrand

Presenting Author: christophe.ballouard@univ-lorraine.fr

The Bushmanland Subprovince of the Mesoproterozoic Namaqua-Natal orogenic belt in southern Africa hosts numerous occurrences of monazite-magnetite-(biotite-apatite-sulfide)-bearing veins and granitoid dykes, including the Steenkampskraal dyke and vein system, which is one of the highest-grade REE-Th ore deposits in the world. Here, we provide whole-rock geochemical data along with zircon and monazite U-Pb dates and monazite Sm-Nd isotope analyses of these REE-Th-rich veins and granitoid dykes. U-Pb geochronology indicates that the monazite-rich veins and granitoid dykes formed between 1050 and 1020 Ma, contemporaneously with Late-Namaqua granulite-facies metamorphism and mafic magmatism of the Koperberg Suite. Similar to the Koperberg Suite intrusive rocks, monazite-rich veins and granitoid dykes located in the southern part of the Bushmanland Subprovince have more radiogenic Nd isotopic compositions ($\varepsilon Nd(t) \sim -1$ to zero) than equivalent dykes and veins to the north ($\varepsilon Nd(t) \sim -12$ to -6). Mafic rocks of the Koperberg Suite are strongly enriched in lithophile elements and share geochemical similarities with other late-orogenic mafic igneous rock suites worldwide. More specifically, the Koperberg Suite mafic igneous rocks reach Th and REE concentrations > 300 ppm that largely exceed that of other rock types from the Bushmanland Subprovince, except for the monazite-rich veins and granitoid dykes, suggesting a genetic relationship between these rock units/types. Within LREE-Th-rich veins and granitoid dykes, monazite, biotite and magnetite are commonly anhedral and occur interstitially between the felsic mineral constituents; they are, thus, late crystallizing phases. Moreover, the whole-rock REE-Th concentrations of granitoid dykes increase with Fe-Mg contents. Therefore, their incompatible element enrichment is not linked to assimilation-fractional crystallization processes. The Nd isotope signature as well as Fe-Mg and REE-Th-rich character of the Koperberg Suite and monazite-rich granitoid dykes might reflect partial melting of lithospheric mantle domains, metasomatized during previous Namaqua subduction events, and the mixing of mantle-derived melts with REE-Th-rich metamorphic fluids during their ascent in the crust. We propose that the monazite-magnetite vein mineralization represents Fe-P-rich immiscible liquids exsolved from mantle-derived magmas with a composition similar to those of the most mafic granitoid dykes.