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Supracrustal origin of plagiogranite from the Gallieni Fracture Zone, Southwest Indian Ridge

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Abstract: Small amounts of felsic rocks such as tonalite, trondjhemite and diorite often called oceanic plagiogranites were found at all structure levels of the oceanic crust. They can be formed either by partial melting of hydrated gabbros and/or sheeted dikes, or by late-stage differentiation of parental mid-ocean ridge basalt melts. Here we report a granodiorite sampled in the Gallieni Fracture Zone, Southwest Indian Ridge, shows no ocean crust affinity but the nature of the continental crust. The granodiorite is extremely enriched in K2O (3.72%) and its rare-earth-element distribution pattern is incomparable to any type of oceanic plagiogranites from mid-ocean ridge and ophiolites, but similar to the Upper Continental Crust. Moreover, the in-situ zircon O isotopes (δ18O=5.9-7.5‰ are much higher than the plagiogranites from all the tectonic settings relevant to ocean crust generation, while Hf isotope compositions (εHf(0) =-4.0 to -7.9) are much lower than global oceanic basalts. In addition, the granodiorite suffered low-grade metamorphism as reflected by the penetration of late-stage felsic veins and the occurrence of metamorphic minerals such as epidote and chlorite. Secondary vein quartz has negative δ18O values as low as -3.9‰ suggesting the involvement of meteoric water. Zircon U-Pb age (183.7$\pm$1.2Ma) shows that the granodiorite was formed contemporarily with Karoo volcanism associating with the breakup of Gondwanaland. We suggest that it may be formed by the anataxis of continental crustal materials by underplated Karoo basaltic magma. Combining our unreported high-grade quartzite with zircon U-Pb ages of more than 500Ma and a Jurassic quartz diorite reported earlier which all sampled in or near the Gallieni Fracture Zone, we propose that a continental block probably from the South Madagascar was split during continental breakup but retained near the ridge segment as a result of repeated ridge jumping and transform migration.
Keywords: zircon Hf-O isotopes, U-Pb age, plagiogranites, Gondwanaland, continental block, Southwest Indian Ridge