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Geochronology and Isotope Geochemistry of Lower Crustal Melts from the Pan-African Damara Belt

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The Pan-African granite-migmatite terrane of the Khan area (Central Damara Orogen, Namibia) consists of basement gneisses, upper amphibolite to lower granulite facies metasedimentary rocks, migmatites and crust-derived granites. The migmatites are formed at 680-710ºC/4-5 kbar during the peak of regional metamorphism which occurred between 523±4 and 509±3 Ma based on Sm-Nd gnt-whole rock ages obtained on migmatites and metasedimentary rocks. U-Pb monazite ages range from 531±1 Ma to 508±1 Ma and are thus similar to the Sm-Nd gnt-whole rock ages. The Sm-Nd gnt-whole rock ages for felsic intrusive bodies indicate emplacement of these melts at 509±5 Ma close to the main peak of metamorphism but also at 469±3 Ma. These intrusions are confined to the post-collisional phase of the orogeny probably related to the rapid exhumation of the belt. Gnt-bearing xenoliths from these melts give higher P/T estimates of 760ºC/7.5 kbar and a Sm-Nd gnt-whole rock age of 921±3 Ma which indicate an early high grade metamorphism in the source. Additional evidence for this event is recorded in U-Pb zircon ages of ca.1000-1100 Ma from the basement gneisses from this area. Metasedimentary rocks and migmatites have isotopic compositions (init. $^{87}Sr/^{86}Sr$: 0.720-0.730; init. ε_{Nd}: -5.4 to -10.6; Depleted mantle Nd model ages (T_{DM}): 1.7-1.9 Ga, $\delta^{18}O$: 11.6-13.0%o) similar to previous published values for Al-rich metasedimentary rocks throughout the belt. Crust-derived granites that crop out in the Khan area fall into two groups: one has more evolved isotopic compositions (init. $^{87}Sr/^{86}Sr$: 0.725-0.732; init. ε_{Nd}: -14.6 to -18.6, T_{DM}: 2.2-2.5 Ga; $\delta^{18}O$: 10.3-13.9%o; higher $^{208}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ ratios at a given $^{206}Pb/^{204}Pb$ ratio) whereas the other group has less evolved isotopic compositions (init. $^{87}Sr/^{86}Sr$: 0.722-0.724; init. ε_{Nd}: -6.5 to -13.6, T_{DM}: 1.6-2.1 Ga; $\delta^{18}O$: 12.7-15.2%o; lower $^{208}Pb/^{204}Pb$ and $^{207}Pb/^{204}Pb$ ratios at a given $^{206}Pb/^{204}Pb$ ratio). These isotopic features indicate derivation of the granites from chemically and isotopically different sources. One source is probably located within old (Archaean?) basement lithologies whereas the other source is represented by slightly younger (Proterozoic?) basement rocks. Even in complex terranes granites can preserve a record of their sources and can be used to place limits on possible compositions of the unexposed sources of the granites and thus on the nature of the terranes through which the melts ascended.