COMBINED MONAZITE AND GARNET AGES AND GARNET TRACE ELEMENT COMPOSITIONS FROM GRANULITE-FACIES MIGMATITES AND GRANITES - IMPLICATIONS FOR ELEMENT REDISTRIBUTION DURING HIGH-GRADE METAMORPHISM AND MELTING

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Migmatitic and metapelitic garnet from the granulite-facies (5-6 kbar/750°C) part of the Damara orogen (Namibia) has been used to date high-grade regional metamorphism and yielded high-precision Sm-Nd grt-whole rock ages that range from 523±4 to 509±3 Ma, similar to the U-Pb monazite ages (531±2-517±2 Ma) from the same rock. Pb-Pb garnet ages are also similar but have significantly larger errors due to very low 206Pb/204Pb ratios of the garnets. For restitic garnets Sm-Nd and Pb-Pb ages are younger (Sm-Nd: 493±7 Ma; Pb-Pb: 500±5 Ma) than U-Pb monazite ages (515±2 Ma) implying that monazite is restitic whereas the growth of garnet dates the time of melt extraction. Igneous garnets have similar Sm-Nd and Pb-Pb garnet ages (Sm-Nd: 488±8; Pb-Pb:481±10 Ma) implying rapid melt extraction rates from lower crustal source regions. Despite the low 206Pb/204Pb ratios (< 100), all garnet species show significant variation in 208Pb/204Pb-206Pb/204Pb, Nd/U-Th/U and U/Nd-Sm/Nd space suggesting a significant contribution of minute accessory phases.

HREE concentrations in migmatite garnets decrease from core to rim, as well as the magnitude of a pronounced negative Eu anomaly (Eu/Eu* (core): 0.010, Eu/Eu* (rim): 0.023). These garnets are enriched in Ti, Zr, V and Cr in which the positive Zr-Y variation suggest variable contribution of zircon, monazite and ilmenite during garnet growth. Low Sr concentrations suggest equilibration with plagioclase during melt-
ing. Garnets from metapelites are not zoned and have a less pronounced negative Eu anomaly (Eu/Eu*: 0.04). Restitic garnets show generally higher Sr and Y concentrations, a core-rim HREE(Y) enrichment and a strong negative Eu anomaly (Eu/Eu*: 0.002). Igneous garnet is one order of magnitude less enriched in HREE than the other garnet species but shows also a depletion in HREE in the core relative to the rim, similar to the restitic garnet. However, this igneous garnet is depleted in Y, Sr, Ti, Zr and Cr compatible with the trace element-depleted nature of the host leucogranite. All garnet species show distinct (Sm/Gd)N and Eu/Eu* covariations which are evaluated together with previously published trace element systematics of amphibolite-facies, granulite-facies and igneous garnets.