Trace element partitioning in the granulite facies

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Granulites from Central Finland experienced pT-conditions of 800-950°C at 9-11 kbar during a major collisional event in the late Archean. Anatexis was induced by dehydration melting of amphibole leading to the formation of cpx, opx, garnet and tonalitic melts. We constrained granulite facies trace element distribution by *in situ* LA-ICP-MS studies of the principal mineral phases. Our analyses indicate that equilibrium was attained between most phases. Garnets grew in microdomains and only equilibrated with their immediate surrounding. Hence, garnet exerts limited control on the bulk partition coefficient. Accessory phases are important hosts of REE (apatite), HFSE (ilmenite) and transition elements (ilmenite, magnetite).

Using predictive models, comparisons with published data and relationships between minerals and observed melt compositions, we formulate $D^{mineral/melt}$ values that are applicable for trace element modelling under lower crustal conditions; these are broadly similar to magmatic values for intermediate melt compositions. Uniform $D^{amph/cpx}$ for the REE were integrated into the set of D-values so that

$$D^{mineral/melt} = 3 \times D^{amph/cpx}$$

We provide the first self-consistent set of D-values for Sc, V, Cr and Ni between cpx, amph, grt, opx, bt and ilm:

	D (mineral / cpx)				D (mineral / melt)			
	Sc	V	Cr	Ni	Sc	V	Cr	Ni
cpx	1	1	1	1	11	7.3	2.5	1.7
grt	0.8-1.2	0.4-0.6	1-2	0.04	14.5	2.6	2.5	0.06
amph	0.8-1.2	1.6-2.5	1-3	1.6-2.5	11	12	6	3.2
opx	0.15-0.25	0.2-0.5	0.2-0.5	1	2.7	2	1	1.7
bt	0.15	2.2	2.5	3.6	1.6	13	6.3	6.1
il	0.15-0.3	1	1-1.7	0.2-0.3	4	12	3	0.5

Ilmenite was found to strongly influence the distribution of Nb and Ta and has partition coefficients an order of magnitude higher than amphibole. Thus, ilmenite has to be considered in future discussions about the role of melting of amphibole-bearing source rocks as the driving mechanism for Archean crust generation.

Geochemistry of I-type granodiorite and tin-bearing S-type granites from Gouveia area, central Portugal

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The Gouveia area is located in the Iberian Massif, which is a large segment of the European Variscan Belt. Granitic rocks intruded a Cambrian schist-metagraywacke complex and predominate in the area. SHRIMP U-Pb zircon age for a peraluminous biotite I-type granodiorite is 481.8±5.9 Ma. So, it was emplaced during the Early Ordovician. The granodiorite has $(^{87}Sr/^{86}Sr)_{482}$=0.7036, εNd_{482}=2.5 and $\delta^{18}O$=8.84‰, which indicate that it contains a mantle component.

Seven peraluminous two-mica S-type granites are Variscan, as SHRIMP U-Th-Pb monazite ages range from 288 to 304 Ma and record granite emplacement. They have average Sn contents of 16-40 ppm. Most granites define individual fractionation trends, have REE patterns that intersect each other and distinct initial $^{87}Sr/^{86}Sr$ ratios ranging from 0.7086 to 0.7129 and $\delta^{18}O$ values of 10.34–13.34 ‰ and represent different pulses of granite magma. Their zircon core ages range from ~300 to 2100 Ma suggesting that these granites were derived by partial melting of sediments having a range of sources. Granites contain zircon cores similar in age to the granite.

One of these granites and another granite define a sequence shown by fractionation trends for major and trace elements of granites and their micas, subparallel REE patterns of granites and a common whole-rock Rb-Sr isochron. Least square analysis of major elements and modelling of trace elements indicate that the younger granite is derived from the older granite by fractional crystallization of quartz, plagioclase, biotite and ilmenite. Initial $^{87}Sr/^{86}Sr$ ratio and $\delta^{18}O$ values increase from the older to the younger granite suggesting that fractionational crystallization was accompanied by assimilation of metasedimentary materials. Fractional crystallization was the mechanism responsible for the increase in Sn content in individual granites, sequence and their micas, but it is crucial that the granite melt contains at least 8 ppm Sn. Muscovite retains a higher granite tin content than biotite does.

Cooling ^{39}Ar-^{40}Ar plateau ages of micas through the Ar closure temperature range from 285 to 293 Ma. There is no significant difference between these ages if errors are taken into account. When the four youngest S-type granites were emplaced at 288-290 Ma, I-type granodiorite emplaced at 482 Ma and the three oldest S-type granites emplaced at 301-304 Ma were affected by the Saalian Variscan movements and their mica ^{39}Ar-^{40}Ar ages record recrystallization or Ar loss. Trace elements of biotite from the I-type granodiorite were affected, while trace elements of micas from the three oldest S-type granites define individual fractionation trends.