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Construction and differentiation of the ferroan (A-type) Sveconorwegian (=Grenvillian) Kleivan intrusion

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It was recognized that two important boundaries, the Farsund-RAP shear zone and the Sveconorwegian (=Grenvillian) opx-in isograd, controlled the composition of the post-collisional magmatism of southern Norway (0.97 to 0.92 Ga) (Vander Auwera et al., 2011). The Farsund-RAP shear zone (Bolle et al., 2010), a boundary between two contrasted lithothectonic units, separates magmatic bodies with different isotopic compositions mainly due to different contaminants. During the regional metamorphism (1.035 to 0.97 Ga: i.e. Bingen et al., 2005), southern Norway lower crustal segments were variably modified, with granulite facies conditions prevailing in the westernmost part of the orogen and producing dehydrated lower crustal sources west of the opx-in isograd, and more hydrated sources east of this isograd. The small Kleivan intrusion ($\approx$ 20 km^2, 930 $\pm$ 7 Ma, Rb-Sr; Pedersen & Falkum, 1975), located in the eastern hydrated part of the orogen, confirms these interpretations. This pluton contains two different trends. The *main trend* displays, from North to South and with increasing SiO_2, a gradual variation from opx-bearing charnockites to amphibole-bearing and finally biotite-bearing granites (Petersen, 1980), in which titanite is absent. In the subsidiary *Hbl+Tit trend*, titanite is present, opx is absent and amphibole is the dominant ferromagnesian. The *main trend* has a significantly higher Fe# than the *Hbl+Tit trend,* echoed by higher Fe# in amphiboles and accompanied by a larger range in SiO_2 (63.9 to 77% in the *main trend*; 63.5 to 68.9% in the *Hbl+Tit trend*). Both trends are ferroan and have overlapping compositions for trace and other major elements. The bulk magnetic susceptibility (K_m) is higher in the *Hbl+Tit trend,* reflecting its higher magnetite/ilmenite ratio. The two trends have similar initial Sr, Nd and Pb isotopic compositions indicating contamination by the eastern crustal contaminant only, in agreement with the emplacement of the Kleivan intrusion east of the Farsund-RAP shear zone. Experimental data (Bogaerts et al., 2006) indicate a lower H_2O content ($<$4.5 wt%) in the parent magma of the *main trend* than in that of the *Hbl +Tit* trend ($>$5.5 wt% H_2O). In addition, higher magnetite/ilmenite ratio and titanite occurrence within the *Hbl+Tit trend* agree with a higher fO_2. The presence of two trends differing by their H_2O content and fO_2 is here related to straddling of the opx-in isograd (Sveconorwegian metamorphism) by the Kleivan intrusion (Vander Auwera et al., 2011).

It is also worth noting that, despite similar rheologies (similar major elements composition and temperature), the two trends did not mix, preserving their characteristics towards their level of emplacement (3.5 to 5 kbar) through differentiation and upward migration from the lower crust.