The post-collisional magmatism of southern Norway: the role of partial melting of the lower crust in the evolution of the Proterozic continental crust

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In southern Norway, the post-collisional magmatism is represented by two suites: 1) theanorthosite-mangerite-charnockite (AMC) suite (930 Ma) emplaced in the Rogaland Province and 2) the hornblende-, biotite-bearing granitoid (HBG) suite intruded in the Vest-Agder Province (980 to 890 Ma). Petrographical, geochemical and isotopic data indicate that these two suites represent two distinct liquid lines of descent whose least differentiated samples, supposed to be their respective parent magmas, have an intermediate composition (SiO_2 = 50-52 %). The AMC suite is alkali-calcic ferri-potassic,whereas the granitoid suite is high-K calc-alkaline. The AMC suite has higher K_2O, FeOt and lower CaO, and Th contents than the HBG suite.

The two suites overlap in Sr isotopic initial ratios (AMC: 0.7029 - 0.7085; granitoids : 0.7027 - 0.7569 at 930Ma) but epsilon Nd is characteristically higher in AMC (0 to +5.7) than in HBG (+1.9 to -4.90) (Demaiffe et al, 1986; Demaiffe et al., 1990; Menuge, 1988). These isotopic data suggest that, despite their penecontemporaneity, the parent magmas of the two suites probably result from the partial melting of two different sources: a LILE–depleted source (either the upper mantle or a mafic rock derived from it) for AMCG and an undepleted or slightly enriched source for the HBG.

Phase equilibrium data bring additional constraints and show that the parent magma of the AMC suite results from the partial melting of a lower crustal anhydrous gabbronoritic source (Longhi et al., 1999). Several geochemical arguments converge to suggest that the parent magma of the HBG suite derives from partial melting of a garnet absent amphibolite. Experimental liquids obtained at 8 kb on the dehydration melting of a low-K amphibolite (0.21 wt % K_2O) by Rapp and Watson (1995) are close to the parent magma of the HBG suite for CaO, MgO, FeOt, TiO_2 and the Peacock index, but much higher in Na_2O and much lower in K_20. A high-K amphibolite source would thus better account for the HBG suite.

These two contrasting sources, granulitic versus amphibolitic, are corroborated by the Th depletion and generally positive epsilon Nd of the AMC suite compared to the Th undepletion and slightly positive or negative epsilon Nd of the HBG suite. Penecontemporaneous partial melting of two distinct sources could reflect stratification of the continental crust (Rudnick and Fountain, 1995) or may indicate that the two suites belong to two distinct crustal segments as formerly proposed by Duchesne et al (1999).