Earth-Science Reviews 107 (2011) 375–397

Contents lists available at ScienceDirect

Earth-Science Reviews

journal homepage: www.elsevier.com/locate/earscirev

Sveconorwegian massif-type anorthosites and related granitoids result from post-collisional melting of a continental arc root

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ARTICLE INFO

Article history:
Received 3 November 2009
Received in revised form 28 October 2010
Accepted 15 April 2011
Available online 21 April 2011

Keywords:
Proterozoic massif-type anorthosites
Jotunites
Ferroan granites
Post-collisional magmatism
Sveconorwegian orogen
Lower continental crust

ABSTRACT

Two magmatic suites were emplaced during the post-collisional evolution of the Sveconorwegian orogeny: an Anorthosite–Mangerite–Charnockite suite (AMC suite), and an hornblende- and biotite-bearing granitoids suite (HBG suite). The AMC suite is exclusively located in the westernmost and warmest part of the orogen, in granulite facies gneisses, whereas the HBG suite intruded in the rest of the orogen, but not in the granulite domain. New U–Pb zircon geochronological data confirm previous age determinations: 970–932 Ma (HBG suite) and 933–916 Ma (AMC suite).

The mafic facies of the two post-collisional magmatic suites have similar geochemical compositions but the HBG differentiation trend displays higher CaO, Sr, U and Th as well as lower K_2O and FeO_t/MgO than the AMC differentiation trend. The HBG suite is hydrous and has a broadly higher fO_2 whereas the AMC suite is anhydrous.

The inferred parent magmas of both suites have overlapping initial Sr, Nd and Pb isotopic compositions. With increasing differentiation, the two trends point towards two different crustal contaminants. Together with the recent recognition of a major crustal shear zone located just east of the AMC suite, this difference suggests that the suites were emplaced in two different lithotectonic units.

Using published experimental constraints and geochemical modeling, we suggest that the mafic facies of both suites were produced by partial melting of lower crustal sources which were previously underplated, probably during the evolution of a long-lasting convergent margin. Later, these lower crustal sources were modified by the regional granulite facies metamorphism (1.035 to 0.97 Ga) prevailing in the westernmost part of the orogen, thus producing an anhydrous lower crustal source for the AMC suite.

Accordingly, we conclude that the Sveconorwegian massif-type anorthosites result from partial melting of the continental arc root. This process, if accepted for other AMCG (Anorthosite–Mangerite–Charnockite–Granite) complexes, was possible in the Proterozoic because of a sufficiently high temperature, but not in the Archean because in subduction zones the main transfer to the crust was then felsic (tonalites, granodiorites) and not basaltic. We thus further suggest that the onset of massif-type anorthosites at the beginning of the Proterozoic may mark the time when plate tectonics began to operate in a similar way as today.

Contents

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0012-8252/$ – see front matter
doi:10.1016/j.earscirev.2011.04.005