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Variscan adakites in Brittany, France – potential sources and geodynamic implications

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The first Variscan adakites were identified in association with the Early Carboniferous St-Jean-du-Doigt (SJDD) pluton, a bimodal layered intrusion of dominantly gabbroic composition (200 km^2) located in the Precambrian crust of the Armorican massif, northern Brittany, France (Barboni et al., this meeting). Mafic rocks have chemical characteristics intermediate between the tholeiitic and calc-alkaline trends. The associated felsic rocks display trace-element features suggesting derivation from several sources, including direct lineage from the mafic magma (sodic granite) and partial melting of lower crustal levels induced by underplating of mantle-derived magmas (A-type granite).

The adakite-type rocks, previously described as ultra-differentiated (SiO_2 $>$ 73 wt%) microtrondhjemites and albitites, emplaced as small bodies (2-3 km^2) or dykes close to the western border of the SJDD main intrusion. Trondhjemites consist of quartz, oligoclase and minor biotite (1 to 3 mm grain size), while albitites are characterized by 5-7 mm tabular albite and quartz crystals. Preliminary U/Pb dating by LA-ICP-MS on zircons from an albitite sample yielded an age of 347 +/- 4 Ma, similar to that of the SJDD main intrusion (Barboni et al., this meeting). Both rock-types exhibit typical adakitic chemical features, like low Y (3.2-5.1 ppm), low Yb (0.2-0.5 ppm), high Na_2O ($Na_2O>>K_2O$) and high Sr/Y (63-167). They can be classified as high silica adakites (HSA. Martin and Moyen, 2003) with similar Na_2O, K_2O, Nb, Sr, Zr, REE contents and Na_2O/K_2O, Sr/Y, Zr/Sm, Nb/La ratios (e.g. Martin et al., 2005). Rare earth element patterns are strongly fractionated ($(La/Yb)_n$= 16) without Eu anomaly. HFSE are also strongly depleted with Nb and Ti negative anomalies.

Adakites may form in different ways, although it is commonly thought that they must be directly or indirectly related to subduction-zone systems. Alternative petrogenetic models to slab melting include melting of underplated basalts located at the mantle-crust boundary, melting of delaminated garnet-bearing lower continental crust, as well as derivation from high-pressure crystallization of hydrous mafic melts in the presence of garnet and outside the stability field of plagioclase.

It has been suggested that the SJDD pluton intruded in a back-arc extensional environment linked to the southward subduction of the Rheic (Faure et al., 1997) or more probably the Rheno-Hercynian ocean underneath Gondwana. But considering the highly bimodal nature of the SJDD intrusion (highly differentiated character of the adakites and other felsic rocks) and the dominantly tholeiitic affinity of the mafic rocks, it is unlikely that the described adakites derive directly from subduction-related processes like slab-melting. We rather favour remelting of garnet-bearing hydrated basalts underplated under a thickened continental crust or, possibly, derivation through high-pressure crystallisation in the garnet stability field. Sr-Nd-Pb isotopic data (work in progress) should provide additional constraints to the petrogenesis of these highly unusual rocks in the Variscan orogeny.

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