Geochemistry, U-Pb and Sr-Nd-Hf Isotopes of the Baijuhuajian A-type granites in Zhejiang Province: evidence for a continuous extensional regime in the mid and late Mesozoic

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The Baijuhuajian granite in western Zhejiang Province, SE China, is an A-type granitoid with an U-Pb zircon age of 125.6±3 Ma. The granite, emplaced along the Jiangshan-Shaoxing fault zone, shows a porphyritic texture and is composed of K-feldspar phenocrysts and a groundmass of K-feldspar, quartz, plagioclase, and biotite. It is peraluminous (A/CNK > 1.0), showing typical A-type granite signatures, and possesses high total REE (227 – 649 ppm), high HFSE content and high FeO_t/MgO ratios (11 – 33). Compared with the I- and S-type granites its total alkalis ($Na_2O + K_2O = 4.8$ to 8.5 wt.%) are relatively high, whereas the compositions of CaO (0.51 – 1.01 wt.%), TiO_2 (0.06 – 0.14 wt.%), P_2O_5 (< 0.001 wt.%) and Sr (7.0 to 9.5 ppm, 39 and 65 ppm) are relatively low. Fine-grained groundmass with perthite indicates a shallow-depth emplacement. Various discrimination diagrams consistently classify the Baijuhuajian granite as within-plate type. The Baijuhuajian granite has a slightly negative whole rock $\varepsilon Nd(T)$ (-2.46) and negative to positive zircon $\varepsilon Hf(T)$ (-0.53 to +4.24) values, indicating mixing between a mantle component (reworks of juvenile mafic crust extracted during the Neoproterozoic) and a crustal component. To date, Mesozoic A-type granites within the magmatic belt of South China have been identified at 180–160 Ma and 100 Ma. Existing tectonic models for South China have involved this ca. 60 My “quiescence” of A-type granite emplacement in terms of a transition period from collision to extension. The recognition of the 125.6 Ma Baijuhuajian granite in this study requires a need for reconsidering the existing tectonic models for South China. It appears that regional extension is more continuous than previously thought and may have taken place episodically throughout the Mesozoic times.

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Sr, Sm and Nd isotope geochemistry and U-Th-Pb geochronology of the Naantali Carbonatite, SW Finland

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The Naantali Carbonatite is a small swarm of calciocarbonatite dykes in southwest Finland. In addition to calcite, the dykes contain 5-10% modal fluorapatite with minor allanite and titanite [1]. For this study, we have investigated the Sr, Sm and Nd isotope geochemistry as well as monazite U-Th-Pb geochronology.

Sr, Sm and Nd isotope measurements were performed by ID-TIMS at the Geological Survey of Finland. Initial $^{87}Sr/^{86}Sr$ ratios cluster tightly between 0.7030-0.7031, while $\varepsilon_{Nd}(1800)$ values range from -0.8 to 1.5. These data indicate a mantle source region enriched via subduction of juvenile crustal material, in agreement with the tectonic model for the Svecofennian domain (e.g. Nironen 1997 [2]).

The fluorapatite grains show complex zoning in BSE images and contain abundant, small (ca. 10μm) inclusions of monazite, quartz, bastnäsite and magnetite. The textures indicate that primary homogeneous Th-Si-LREE-rich fluorapatite macrocrysts underwent dissolution-reprecipitation during magma emplacement via autometasomatic reaction with the magmatic fluid.

A total U-Th-Pb date of 1776 ± 18 Ma for the monazite inclusions, and therefore the magma emplacement, was obtained using the SX-100 Ultrachron electron microprobe at the University of Massachusetts, Amherst, USA. To validate the chemical age, further monazite inclusions were analysed at the NORDSIMS facility in Stockholm, Sweden, although the minimum spot size achieved was roughly equivalent to that of the monazite inclusions. Despite the low signal intensity from the reduced spot size and the risk of contamination from the host apatite or secondary bastnäsite, our U-Th-Pb concordia date of 1746 ± 22 Ma is only slightly younger. The electron microprobe provided higher spatial resolution, ensuring that only pristine monazite domains were analysed. Therefore, we regard the slightly older chemical age as the more accurate of the two.

[1] Woodard & Hölttä (2005) *GSF Special Paper* **39**, 5-11.
[2] Nironen (1997) *Precam. Res.* **86**, 21-44.