Geochronology and geochemistry of Xingdi No. 1 intrusion in Kuluketage, NW China: Tectonic implication for Xingdi mafic-ultramafic rock belt

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The Xingdi No. 1 mafic-ultramfic intrusion is the largest in the Xingdi mafic-ultramafic belt with an exposed area of ca. 20 km^2 and intruded into the Paleoproterozoic basement. Gabbro is the major rock type and there is minor olivine pyroxenite. Sm-Nd geochronometry of the gabbro gives an isochron age of 761.2±31.2 Ma. It is the same with the intrusion age of Xingdi No. 2 pluton (760±6 Ma). The gabbro is systematically enriched in large ion lithosphere elements (LILE), light rare earth elements (LREE) and depleted in high field strength elements (HFSE) and heavy rare earth elements (HREE). The studied rocks are characterized by low whole-rock and mineral $\varepsilon Nd_{(t)}$ values (–7.8 to –7.1) and elevated $(^{87}Sr/^{86}Sr)_i$ values (0.7066–0.7073). These geochemical characteristics, together with the presence of the abundant hornblende, biotite, bladed biotite enclosed in amphibole, and crescent-shaped Paleoproterozoic wall-rock enclosed within the intrusion are key features of magma mixing in the source or assimilation during its emplacement. The rocks have Zr/Y ratio of 3.81–13, which fall in the area of within-plate basalt area. As the Xingdi No. 1 and No. 2 plutons formed at the same period and display similar geochemical characteristics, we propose that they formed within the same tectonic setting and derived from the same origin, but No.1 experienced higher extent of evolution and contamination. On the basis of previous studies, the Neoproterozoic tectonic and magmatic events in Kuluketage comprise syn-collisional granite around TC (ca. 1.0–0.9 Ga), post-collisional K-rich granite and alkaline mafic-ultramafic intrusions (ca. 830–800 Ma) and rifting-related mafic-ultramafic plutons, dykes and bimodal volcanic rocks (ca. 774–744 Ma).

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CO_2 sequestration in deep aquifers: Insights into future hazards from a natural analog (Campi Flegrei, Italy)

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Among the major challenges facing the world today are climate changes and the alteration of Earth's surface geochemistry that are occurring as the result of release of anthropogenic CO_2 into the environment. Geologic sequestration of CO_2 in deep aquifers is an approach to reducing CO_2 emissions to the atmosphere that has recieved much attention recently [1]. The largest of the sequestration projects currently underway, the In Salah Project (Algeria) injects approximately 1 Mt of CO_2 per year [2]. A large coal-fired powerplant emits over an order of magnitude more CO_2 than this; for example, the Scherer plant (GA, US) emitted about 25 Mt in 2010 [3].

Campi Flegrei is a natural analog for large-scale CO_2 sequestration in confined saline aquifers. At Campi Flegrei active magmatism at depth is releasing large amounts of CO_2 that migrate upward into a confined saline aquifer at depths of about 2-3 km. Campi Flegrei is estimated to have injected 63 Mt of H_2O and CO_2 during the crisis of 1982-1984, corresponding to a total volume increase of $5.7*10^7$ m^3 or $2.85*10^7$ m^3/y [4]. This is similar to the volume ($2.4*10^7$ m^3) that would be occupied by the annual CO_2 emissions from the Scherer plant at the T&P conditions of interest in a geologic sequestration scenario. We predict that large-scale sequestration of CO_2 as a supercitical phase will have consequences similar to those observed at Campi Flegrei – seismic activity, bradyseism, and release of CO_2 rich fluids from the aquifer to the surface. These effects may be mitigated to some extent through careful management of the reservoir during and following injection.

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