

Mantle-like magnesium isotopic composition of orogenic eclogites from the Dabie-Sulu UHPM belt, China

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To date, little is known about the behaviour of Mg isotopes during metamorphic dehydration. Orogenic eclogites are eclogite-facies metamorphosed subducted oceanic crust or mafic continental materials. Studies of orogenic eclogites can therefore help to constrain Mg isotope geochemistry during high-grade metamorphism and understand subduction processes. Here, we reported high-precision Mg isotopic data for a suite of orogenic eclogites from Bixiling in the Dabie-Sulu ultrahigh-pressure metamorphic (UHPM) belt, China.

The Dabie-Sulu UHPM belt of east-central China was formed by deep subduction of continental crust. The Bixiling eclogitic body is one of the well-studied eclogitic bodies in the Dabie area. The protolith of the Bixiling eclogite has been suggested to be gabbro cumulates derived from fractionation of basaltic magma at the deep crust, which subsequently experienced continental crust subduction, metamorphism and fast exhumation [1, 2]. Fresh eclogite samples were collected along a road section across the Bixiling eclogitic body. Samples are characterized by low SiO₂ content (44.4 to 53.0%), variable MgO content (5.1 to 10.5%), and positive Eu anomalies (δEu of 1.1 to 1.4).

Regardless of the variable MgO contents and different degrees of olivine crystallization, Mg isotopic compositions of the Bixiling eclogites are relatively homogeneous, with $\delta^{26}\text{Mg}$ ranging from -0.44 to -0.26, and fall within the range of terrestrial basalts and mantle peridotites. The mantle-like Mg isotopic signature of the Bixiling eclogites seems to record that of their protoliths, i.e. mantle-derived gabbro cumulates. This observation agrees with the absence of Mg isotope fractionation during basalt differentiation [4] and suggests limited Mg isotope fractionation during metamorphism, up to eclogite-facies, for mafic rocks. Consequently, Mg isotopes could be potentially used as tracers of source materials of metamorphic rocks.

[1] Zhang *et al.* (1995) *J. Petrol.* **36**, 1011–1037.

[2] Chavagnac & Jahn (1996) *Chem. Geol.* **133**, 29–51.

[3] Xiao *et al.* (2000) *Contrib. Mineral. Petrol.* **139**, 1–16.

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Mg isotope exchange rate and fractionation factor between epsomite and aqueous solution constrained by three isotope method

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Sulfates are considered as one of the major reservoirs for water on the Martian surface [1] and Mg-sulfate is the most abundant Martian sulfate [2]. Mg-sulfates are also common minerals in the Phanerozoic evaporites on Earth. Use of the Mg isotope composition of Mg-sulfates as a recorder of the hydrological histories of Mars and Earth requires well constrained Mg isotope fractionation factors between the Mg-bearing solid and aqueous phases.

Re-crystallization experiments of two batches of fine epsomite grains (average size: 5 μm vs. 15 μm) in saturated MgSO₄ solution were carried out at 7°C and 20°C. The three isotope method was applied to monitor the degree of isotope exchange between the solid and aqueous phases using a ²⁵Mg spike and to determine the equilibrium isotope fractionation factor between epsomite and aqueous Mg. Each experiment was duplicated and XRD analyses confirmed that all the mineral reactants and products were epsomite.

The isotope exchange rate is faster at 20°C than 7°C but all experiments show near complete isotope exchange (Figure 1). Additionally, at a given temperature, isotope exchange is more rapid in the finer grained epsomite (Figure 1). The Mg isotope fractionation factors between epsomite and aqueous Mg at 7°C and 20°C are indistinguishable. At 20°C, $\Delta^{26/24}\text{Mg}_{\text{eps-sol}} = 0.53 \pm 0.22\text{‰}$, while at 7°C, $\Delta^{26/24}\text{Mg}_{\text{eps-sol}} = 0.53 \pm 0.12\text{‰}$.

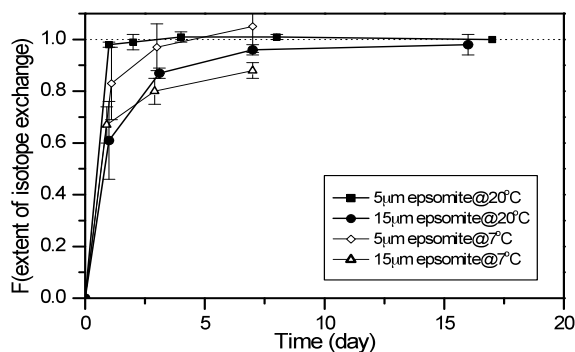


Figure 1: Rate of Mg isotope exchange in epsomite recrystallization experiments (error bars show the 2sigma variation from duplicate experiments).

[1] Wang *et al.* (2008) *JGR* **113**, 1–35. [2] Clark *et al.* (2005) *EPSL* **240**, 73–94.