Chlorine-rich fluid in granulite facies continental collision zone

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In the granulite facies rocks, CO_2-rich fluid has been considered important and studies on Cl-rich fluid are not sufficiently available, because Cl-rich fluid inclusions are less observed than CO_2-rich ones. However, Cl-bearing brines are increasingly recognized as playing an important role in high-*T* metamorphic rocks [1]. Using Cl concentration of minerals, it is possible to decipher the Cl-rich fluid activity and its role during metamorphism.

We have investigated the field distribution of Cl-rich Bt in the pelitic gneisses of the Sør Rondane Mountains, East Antarctica where Late Proterozoic to Cambrian granulites are widely exposed [2]. Among more than 20 samples studied, a Grt-Bt-Sil gneiss from Balchenfjella was selected as best suited sample to constrain the *P-T-t* condition of Cl-rich fluid activity. This gneiss contains Grt porphyroblasts (5-10 mm) that have P-rich core with oscillatory zoning in P. The Grt core includes Cl-poor Bt and Ap. This core is once resorbed and discontinuously overgrown by the P-poor rim, in which Cl-rich Bt and Ap are included. Coarse-grained (ca. 100 μm), round Zrn grains are exclusively included in the rim of the Grt porphyroblast and present in the matrix. This mode of occurrence suggests that Cl-rich Bt and Ap, and coarse Zrn were formed almost simultaneously. The *P-T* conditions of the Cl-rich Bt entrapment in the Grt rim were estimated to be ca. 800 °C and 8 kbar, and those of the peak metamorphic condition were ca. 850 °C and 11 kbar, using Grt-Bt geothermometer and GASP geobarometer [3]. The f_{HCl}/f_{H2O} ratio of the fluid in equilibrium with Cl-rich Bt [4] and Ap [5] in the Grt rim are ten times larger than that in equilibrium with Cl-poor Bt and Ap in the matrix and the Grt core. The LA-ICPMS U-Pb dating of the coarse Zrn gave $^{206}Pb/^{238}U$ age of ca. 600 Ma. Therefore, the Cl-rich fluid infiltration took place at near metamorphic peak condition of ca. 800 °C and 8 kbar at ca. 600 Ma.

The field distribution of Cl-rich fluid activity is somewhat linear. Some of them are located near the ductile shear zones [6], and suggesting its relation to high-strain zones [e.g. 7]. Regional distribution of near-peak metamorphic Cl-rich fluid activity in the Sør Rondane Mountains implies that it is one of the major phenomenon in the continental collision processes.

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Cenozoic seawater chemistry – insights from Mg isotopes in pelagic carbonate sediments and pore-fluids

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10b. Seawater chemistry changes through time

Large changes in seawater chemistry accompanied a decline in atmospheric CO_2 and cooling of Earth's climate over the Cenozoic. Sources and sinks of magnesium in seawater have distinct isotopic compositions, making the magnesium isotopic composition of seawater a tracer of the processes that control seawater chemistry [1]. Here we present Mg isotope data from both pore-fluids and pelagic carbonate sediments from ODP sites 1265 and 807A in the Atlantic and Pacific ocean basins, resepecitvely. Pore-fluid profiles of Mg and Ca in deep-sea carbonate sediments can be explained to first order by the recrystallization of biogenic carbonate and changes in Cenozoic seawater Mg and Ca. Our results are consistent with a substantial (>10 mmol) increase in seawater Mg over the Neogene, approximately balanced by a similar decline in seawater Ca. Magnesium isotope ratios measured in pelagic carbonates and corrected for re-crystallization vary systematically: peaking in the Paleogene, declining by ~0.4‰ to the Oligocene-Miocene boundary and remaining approximately constant from the Miocene to the present. Using a numerical model of global geochemical cycles (C, Mg, Ca, alkalinity), we explore mechanisms for changing seawater Mg and Ca and discuss implications for carbon cycling during the Neogene.

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[1] Higgins (2010) *Geochimica et Cosmochimica Acta* **74**, 5039-5053.