Isotopic compositions of sulphur and nitrogen in rains of Guiyang, China

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Introduction

Variations of isotopic composition of sulphur and nitrogen in rains of Guiyang, a rainy city, have been studied to discriminate between different sources of atmospheric nitrogen and sulphur, since sources of nitrogen and sulphur in precipitation are most important for the understanding of atmospheric acidity because sulphur and nitrogen are major components of acidity and their concentrations are increasing rapidly in the atmosphere due to anthropogenic activities such as the burning of coal and petroleum products.

Results and Discussion

A significant difference in mean sulphur isotopic composition was found between samples collected from flurries (-4.90±2.76‰) and storms (+4.58±5.02‰), indicating that sulphur in the two types of rains is of different sources. Since no obvious air masses came from other areas, sulfate in the flurries was only controlled by atmosphere over Guiyang city. Negative $\delta^{34}S$ values of sulfate in flurries are attributed to mixing of local sulfur sources (particulate sulphur, -2.32‰; SO_2, -15.06‰; biogenic sulphur, -10.02‰). During the storm periods, however, there were larger air masses transported from Pacific Ocean. The average of $\delta^{34}S$ values in storms is close to that of sea spray sources (+20‰, Pichlmayer et al., 1998), indicating they are of maritime origin.

Nitrogen isotopic composition of ammonium changes in different rain events. $\delta^{15}N$ values of ammonium in flurries vary with change of ammonium concentrations. The lower values in the range of $\delta^{15}NH_4^+$ (-1.7‰ ~ -22.0‰) are due to the less incorporation of ^{15}N by cloud water, which probably has a $\delta^{15}N$ value of about –28.6‰. According to the relationship between $\delta^{15}N$ value and ammonium concentration, we can estimate high $\delta^{15}N$ values for ammonium in flurries if concentrations increase. The high concentrations (averaged 1.25 mg l^{-1}) and the low$\delta^{15}N$ values (averaged -12.2±6.7‰) indicate that sources of ammonium are widespread agricultural use of excretory wastes and the release of NH_3 from soils.

Reference

Pichlmayer, F., Schoner, W., Seibert,, et al. (1998). Atmos. Environ. **32**, 4075-4085.

Fluid/rock interactions in UHP metamorphic rocks from drill holes in Donghai, Sulu, China: Preliminary results

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The Chinese Continental Scientific Drilling Program (CCSD) is carried out at Donghai in the Sulu ultrahigh-pressure (UHP) terrain. Using a combined study of fluid inclusions and oxygen isotopes on UHP metamorphic rocks from pre-pilot holes of the CCSD, we aim to determine the nature and extent of fluid/rock interactions during metamorphic evolution of these rocks, and to provide information about possible changes of fluid compositions with depths.

The investigated samples were collected from the pre-pilot holes PP2 and ZK703. ZK703 penetrated 558 m and consists mainly of eclogites, whereas PP2 penetrated to depths of 1000m with only minor eclogite. Our investigations focus on eclogites.

Different types of fluid inclusions were identified and were related to various metamorphic stages: Ca-rich brines in kyanite and omphacite probably contain relic metamorphic fluids during peak metamorphism; primary Na^+-bearing low-salinity inclusions in quartz from eclogite, and primary K^+-bearing low salinity inclusions in quartz from gneiss appear to be trapped during the retrograde symplectite-forming stage; the latest generation of fluid inclusions is represented by secondary pure water inclusions in quartz. These features are comparable with the UHP metamorphic rocks in the Dabie Shan aera, (Xiao et al., 2000, 2001, 2002). Final melting temperatures of primary inclusions from various depths are slightly different, but secondary fluid inclusions in quartzes have more or less the same final melting temperatures. This indicates that the fluid phase during early retrograde metamorphism was controlled by the host rock, whereas the rocks interacted with another fluid at a later retrograde metamorphic stage.

Three important observations can be drawn from the oxygen isotope data: i) All the investigated samples have $\delta^{18}O$ values lower than normal metamorphic rocks, indicating meteoric water/rock interactions and provide support for structural coherence of the geothermal system throughout subduction and exhumation (Rumble & Yui, 1998). ii) Eclogite and gneiss in sharp contact have more or less the same $\delta^{18}O$ values, suggesting that the rocks have already obtained the depleted isotope values before subduction. iii) UHP eclogites from different depths in ZK703 have similar whole-rock $\delta^{18}O$ values between 2 and 3‰, implying that the meteoric water/rock interactions were homogeneous on a kilometer-scale in a vertical-sequence.