Stable isotope geochemistry of strontium in a typical karst forest ecosystem

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The $^{88}Sr/^{86}Sr$ ratio has traditionally been considered to be a constant value in order to correct instrumental mass fractionation during measurement of the radiogenic strontium isotope ratio ($^{87}Sr/^{86}Sr$). However, recent study showed that the $\delta^{88/86}Sr$ ratios of a variety of geological samples is not zero rather vary to a large extent [1]. By double-spiking samples with a $^{84}Sr/^{87}Sr$-spike of known composition [2], it is possible to measure the $\delta^{88/86}Sr$ ratios even more precisely. Here the $^{87}Sr/^{86}Sr$ and $\delta^{88/86}Sr$ ratios of rock, soil, vegetation, groundwater samples were measured to gain insight into biogeochemical processes in a typical karst virgin forest in Guizhou province, Southwest China.

The $^{87}Sr/^{86}Sr$ ratio of carbonate is about 0.708 and the $\delta^{88/86}Sr$ ratio is about 0.40‰. The $^{87}Sr/^{86}Sr$ ratios of groundwater are also 0.708, but the $\delta^{88/86}Sr$ ratios vary from 0.11 - 0.27 ‰, which is distinctly different from the bedrock. This may indicate that secondary sedimentary processes induce significant Sr fractionation. Thus, $\delta^{88}Sr/^{86}Sr$ can be developed as a new geochemical tracer to secondary sedimentary processes in the terrestrial environment.

The $^{87}Sr/^{86}Sr$ ratio of soil is about 0.713 and the $\delta^{88}Sr/^{86}Sr$ ratio is about 0.02 ‰. The $^{87}Sr/^{86}Sr$ ratio of vegetation is about 0.709 and the $\delta^{88}Sr/^{86}Sr$ ratio is about 0.14 ‰. Simple kinetic isotopic fractionation theory cannot explain the Sr isotopic composition of soil and vegetation. Source identification of the vegetation base on paired $^{87}Sr/^{86}Sr$-$\delta^{88/86}Sr$ values suggest predominance of binary end-members, that is soil and groundwater. This shows that the stable Sr isotopic compostions can trace the biogeochemical process in the forest ecosystem.

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Modeling of two-phase flow at the East Pacific Rise 9°50′N

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We present 2-D numerical simulations of two-phase seafloor hydrothermal systems at East Pacific Rise 9°50´ N. These simulations use the finite control volume numerical scheme FISHES [1] for fluid flow, heat and salt transport in a NaCl-H_2O system in a 1.5 km deep and 3 km wide homogeneous box geometry with a surface pressure of 25MPa. We explore the effects of bottom temperature and permeability on the evolution of vent temperature, heat output and salinity.

Fluids from both Bio9 and P vent at EPR 9°50´ N have chloride concentrations that are different from sea water, indicating that phase separation has occurred. Repeated sampling of the vent fluids between 1991 and 2002 shows that the chlorinity of Bio 9 and P vents evolves differently with time. P vent reaches a chlorinity greater than seawater, while Bio 9 vent remained less than seawater suggesting different source regions for the two vents despite their close proximity (~60m) on the sea floor [2]. Our simulations show that with a homogenous permeability of 10^{-13} m^2 and a maximum bottom temperature of 440°C, the hydrothermal plume splits into several vents at seafloor over a distance of a few hundred meters. Fluids from different vents have significantly different salinities, with one of them is around 3.2wt% and the other one ranges from 2.8wt% to 3.9wt%. The different salinities evolve with time, and fluids with salinities above and below seawater can vent simultaneously from different vents, which is in good agreement with the observation at Bio9 and P vent at EPR 9°50´ N. These results suggest that vent salinity and its evolution with time may simply reflect the complexity of phase separation dynamics and does not necessarily directly reflect depth of the hydrothermal cell or the PT conditions at which phase separation occurs.

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