

of flask, inoculation fungus after autoclave (setting sterile control) for studying direct weathering process; putting dialysis bag with apatite powder (200 mesh) in liquid culture medium of flask, inoculation fungus after autoclave (setting sterile control) for studying indirect weathering process. The supernatant collected at different incubation periods was determined for concentrations of Ca^{2+} , Mg^{2+} , Al^{3+} , Fe^{3+} , K^+ , Mn^{2+} and Na^+ by ICP-OES, concentration of H_2PO_4^- , SO_4^{2-} , Cl^- and F^- by Dionex ICS-90. The micromorphology of remainder mineral was analyzed by electron probe and the composition of minerals was determined by XRD. The results showed that the direct weathering process was stronger than indirect process and that change of ion concentrations was almost consistent with growth of fungus, namely, it was a steady increase firstly, then came to a smooth state, finally fell. Kaolinite was weathered firstly, followed by apatite, illite and montmorillonite with increasing time. During weathering of the minerals, a second-mineral calcium oxalate was produced. This study confirmed organic acid chelation during microorganisms weathering process. Based on our experimental results, it is concluded that mechanical breakage of mycelium growth, bio-degradation of extracellular macromolecule, and cooperation of many factors were the reasons of mineral bio weathering. Phosphorite rock is the most important mineral resource on the earth. Research on weathering of phosphorite rock by microorganisms is of important significance in the aspect of phosphorus biogeochemical cycle, soil science and plant nutrition.

Key words phosphorite rock; *Aspergillus niger*; weathering

Boron isotopic geochemistry of karst groundwater in Guiyang City, China

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Boron has two stable isotopes (^{10}B and ^{11}B) with relative abundances of about 20% and 80%, respectively. Boron isotopic ratios in natural materials show a huge range of variations, from -70‰ to +60‰, when expressed with the classical $\delta^{11}\text{B}$ notation. Most of these isotopic variations occur at the surface of the Earth. Hence, boron isotopic composition can be used as a sensitive tracer in geochemical study, for instance, to identify the different sources of contamination and factors controlling the salinity of groundwater. During the last decade, boron isotopes have been used to discriminate between the influences of seawater intrusion and anthropogenic discharge. But few of those researches can precisely identify the different sources of contamination. We measured the boron concentrations and boron isotopic ratios of groundwater samples collected in Guiyang City, as well as the major ions. The results indicate that the major ion composition of the groundwater in the investigated area is mainly controlled by the interactions between water and the dominant rock i.e. carbonates. All the water compositions are characterized by high concentrations of Ca^{2+} , Mg^{2+} , HCO_3^- , SO_4^{2-} , and NO_3^- , which are the dominant contaminants. Both dissolved boron concentrations and isotopic ratios show large variations among the ground waters, from 2 $\mu\text{g/L}$ to 90 $\mu\text{g/L}$ and from -6‰ to +26‰, respectively. The boron concentrations and isotopic ratios indicate that the river across the studied city has been seriously contaminated by urban discharge. Boron concentrations of river water samples varied from 20 $\mu\text{g/L}$ to 140 $\mu\text{g/L}$, with an average $\delta^{11}\text{B}$ value of +2.0‰. Using boron isotopic compositions and different geochemical indices allowed us to clearly identify and distinguish the two major sources of contamination, agricultural activity and urban wastewater. Both of the two sources are characterized by high boron concentrations but their boron isotopic compositions significantly differ. The $\delta^{11}\text{B}$ values of urban effluents range from -6.0‰ to +5.0‰, clearly lower than the mean $\delta^{11}\text{B}$ values of a typical fertilizer, about +15‰. For the studied city, some groundwater sites of the suburban area were contaminated by agricultural activities and most sites of the urban area were contaminated by sewerage waters. The two types of contamination present distinct evolution during a hydrologic cycle.

Key words boron isotope; ground water; pollution; Guiyang City; China

Relationship between heavy metals and clay mineralogy of the modern sediment of salt marsh at the east coast of Wadden Sea, Denmark

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Salt marshes play a significant roll in the marine and coast ecological systems. They can function as a sink for pollutants that would