Distribution of Cesium sorption on micas and application on nuclear waste disposal

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Introduction Cs is an important radionuclide in nuclear waste. It not only ^{135}Cs is extremely long-lived ($t_{1/2}$=2.0×10^6) and ^{137}Cs is a major radioactive contaminant in high-level nuclear waste (HLW), but also exhibits almost unlimited solubility, so it is very necessary to find highly insoluble phases able to fix radionuclide Cs and to have a long-term stability in geological repositories.

Natural micas are important constituents of geological formations and they also contain elevated contents of Cs, therefore we tried to make cesium sorption experiments on micas and to evaluate the ability of micas to incorporate and retard radionuclide cesium.

Experiments Four different micas, such as muscovite, lepidolite, biotite and phlogopite were hand-picked from the pegmatite and granite samples. Micas that had not been exposed to CsCl solution were analyzed by EMPA, average Cs content of muscovite and lepidolite are very lower and respectively are 0.02wt% and 0.09wt%, Cs content of biotite and phlogopite all below detectable limit.

All minerals were processed by ultrasonically washing in deionized water before absorption experiments. Cesium-absorption experiments were performed by 0.1g samples of the reaction vessels with 20ml 0.1M CsCl solution for 7 days, 14day and 21days. No additional buffer was used. Treated slab samples was simply removed from the reaction vessels, then ultrasonically washing in deionized water and allow to air dry. Treated slabs were observed and analyzed by the EMPA method.

Conclusions 1) Cs content of all treated micas became higher than untreated samples, even in the treated biotite for 21days, Cs content up to 2.05wt%. These show that the four micas are able to fix radionuclide Cs in their interlayer structure and may be the possible stable waste disposal phases in the near field of geological barrier; 2) The distribution of Cs in micas was variable, Cs was preferentially sorbed where individual sheet boundaries were crude steps and abundant on these areas; 3) The ability of bonding of cesium is different. Ferriferous micas, such as biotite and phlogopite, are likely to be higher than muscovite and lepidolite. It indicates that biotite and phlogopite are good candidates for the storage of Cs.

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Biogeochemical investigations of the Zunyi sedimentary Ni-Mo-PGE ores in the Lower Cambrian black shale formation, South China

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The metalliferous black shales and their Ni-Mo-PGE ores can be traced across a broad region of South China, mainly south of the Yangtze River, extending a 1600 km belt of main provinces. The Lower Cambrian black shales that host the ores are approximately 60 to 150 m thick and include the Niutitang Formation of Guizhou and Hunan and stratigraphic equivalents elsewhere. The Ni-Mo ore bed itself varies in thickness from a featheredge to ~30 cm and consists largely of pyrite, apatite, vaesite, gersdorffite (NiAsS), and an amorphous Mo-S-C mixed-layer phase. Lots of organic matter, including algae and bacteria are abundant and constitute up to 10% of the ores, which may have played an important role in their formation.

Combined organic petrography, elemental and stable isotope (S) analyses of samples from the Lower Cambrian shale Ni-Mo-PGE ores of Zunyi provide insight into the relationship of organic matter-ores, biogeochemical alteration of hydrocarbons, microbial sulfate reduction, and mineral deposition. In the absence of vitrinite, relative thermal maturity were determined from the reflectance of bitumen, and marine kerogen like algal remains, Ro basically in range from 2.0 to 4.1%. Elemental analyses suggest that organic matter has been oxidized throughout the study area. The sulfur isotopic composition of the metal sulfides correlates with the degree of biodegradation of hydrocarbons, with the base-metal content and with the proportion of aromatics in the organic extracts. Sulfur isotopes study shows that micro-organism took active part in the re-enriching processes of metal sulfide, barite and witherite during digenesis. Variation of conventionally determined δ^{34}S values are great, ranging from +25‰ to -12‰ for samples from the study area in Zunyi. Individual nodules also show large variations in the drilled sulfide data of up to 15.7‰ between rims and cores of sulfide ore nodules. The high variation in isotopic fractionation of the ores may reflect the varying proportions of different sulfide minerals. On the other hand, Extreme variation of δ^{34}S values during the formation of the Ni-Mo sulfide ores could have been caused by the effects of both biogeochemical and hydrothermal activity during the formation of these unusual ores.

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