Chemistry

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Characterization of carbonaceous matter in several coals and carbonaceous chondrites from the viewpoint of thiophenic absorption of sulfur *K*-edge NEXAFS spectra

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Introduction

Various techniques have been applied to the characterization of carbonaceous matter in carbonaceous chondrites. The major fraction of this matter is solvent insoluble macromolecular matter. Some researchers have begun to use X-ray absorption fine structure (XAFS) spectroscopy for the characterization of some extraterrestrial carbonaceous materials, and aromatic structure was indicated [1, 2, 3]. In this investigation, we observed, however, sulfur, not carbon, *K*-shell excitation XAFS spectra. The carbonaceous matter contains sulfur heterocycles [4], and we intended to evaluate the thermal history of meteorites in their parent bodies from the viewpoint of thiophenic absorption.

Experimental

11 CM chondrites (various degrees of aqueous alteration and thermal metamorphism) and Allende (CV) were studied. 10 CMs and Allende have also been studied by pyrolysis-GC [5]. Four terrestrial coals were also analyzed. The samples were powdered and pressed onto stainless plates (10mm×10mm×1mm). The plates were set in the sample chamber at BL-11B, and sulfur *K*-edge NEXAFS spectra were observed.

Results and Discussion

Fig. 1 shows the sulfur *K*-edge NEXAFS spectra of a coal (Mae Moh), and the Murchison (CM) and Allende (CV) carbonaceous chondrites. The spectra of CM chondrites showed thiophenic absorptions with various intensities in common with coal samples. Sulfidic and sulfate absorptions were also observed. Allende showed sulfidic absorption, however, thiophenic and sulfate absorptions were not observed, suggesting little organic sulfur in this chondrite. Based on the intensity of thiophenic absorption, the chondritic samples can be classified into the following four groups; I. Weak absorption: Yamato (Y)-82054, Y-86789, Y-86695, Belgica (B)-7904, and Y-793321. II. Comparable to the sulfidic absorption: Y-791198, Murray, Cold Bokkeveld, and Murchison. III. Depleted in sulfur: Asuka (A)-881458 and A-881334. IV. Allende. Although the group III does not correspond to the degree of aqueous alteration or thermal metamorphism, the group I corresponds to strongly heated chondrites in their parent bodies [5]. The group II corresponds to unheated chondrites [5], suggesting that the thiophenic structure of the carbonaceous matter in CM chondrites has been gradually lost during thermal metamorphism. Cold Bokkeveld, which suffered strong aqueous alteration, showed the strongest thiophenic absorption.

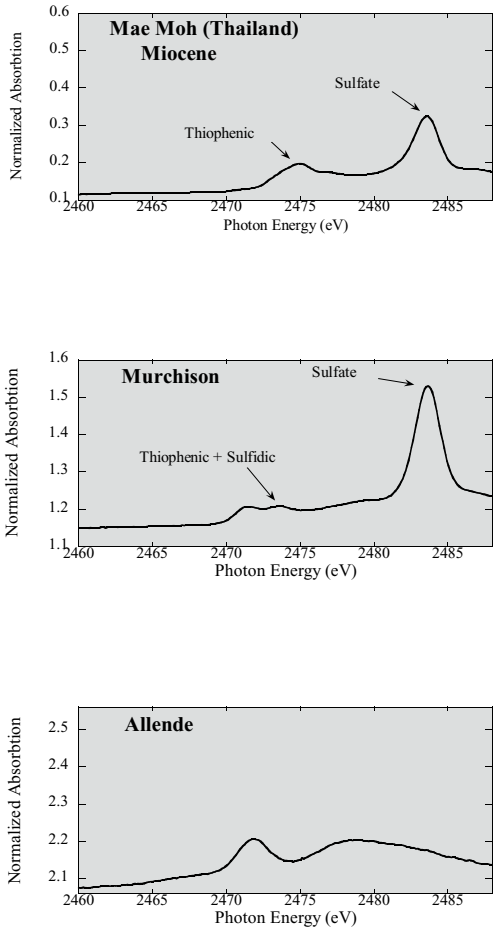

Fig 1. Sulfur *K*-edge NEXAFS spectra of a coal, the Murchison (CM) and Allende (CV) carbonaceous chondrites

References

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