Analysis of organic compounds in coal macerals by laser micropyrolysis

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Introduction

Organic matter in sedimentary rocks is microscopically heterogeneous. Its chemical composition is related to biological activity, sedimentation, and diagenetic processes. Most methods used for the study of organic matter in rock are associated with bulk sample analyses, which provide only averaged information. They sometimes completely miss microscopically tiny points that may contain geochemically important information.

In this study, laser micropyrolysis combined with gas chromatograph-mass spectrometry was developed for analyzing organic compounds in coal macerals. By containing thermal effect surrounding the irradiated area, we established a method to more precise analysis of organic matter at micron scale by the laser micropyrolysis technique.

Method and samples

Our laser micropyrolysis system consisted of laser optics, a sample chamber, a gas trap/transfer line, and GC-MS system. A model 48-2W CO_2 laser (Synrad Inc.) was tuned to radiate a pulsed (5 kHz, 50% duty) infrared beam. Focusing the beam through ZnSe lens formed an image of about 160 μm in diameter on the sample surface.

We used Tertiary coal samples from three regions in Japan: the Sarufutu region, Ikeshima region, and Yubari region. These coals comprised mainly vitrinite and degradinite with lesser amounts of suberinite, cutinite, etc.

Results and Discussion

Analyses of the organic compounds generated by irradiation of the macerals showed that each maceral generated different organic compounds. Aromatic hydrocarbons such as phenol, cresol, and methylguaiacol were the main compounds detected from vitrinite. While no n-alkanes/alkenes were detected from vitrinite of the Sarufutu coal, a series of *n*-alkane/alkene were detected from vitrinite of the Ikeshima and Yubari coals. The difference may be due to difference of thermal maturity or difference of species of original higher plant. Degradinite from the three coals commonly generated the series of *n*-alkanes/alkenes. It is important information for origin of degradinite, because microscopic observation provided no clue to its origin due to the fragmented particles.

References

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The major ultrahigh-pressure metamorphic rock types in the main hole of Chinese Continental Scientific Drilling

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There are 4 major lithologic units in the main hole core drilled at the depth between 100-2000m. (1) Rutile phengite eclogite intercalated with eclogitic gneiss, occasionally amphibolite (100.00-607.00m); (2) Titanoclinohumitebearing garnet peridotite with eclogites(607.00-682.80m); (3) Epidote amphibole biotite gneiss intercalated with kyanite eclogite, phengite eclogite and occasional garnet peridotite bed (682.80-1130.00m); (4) Garnet-bearing biotite quartz-feldspathic gneiss, shear zones, kyanite eclogite and uralitized garnet pyroxenites(1130-2000m).

Eclogites, eclogitic gneiss, amphibolites, garnet peridotites and quartz-feldspathic gneiss are the major rock types occurred in the main hole. These are closely related with ultrahigh pressure metamorphism and are retrograded in various degree..Eclogites are of two types, the one is crustal prograde metamorphic eclogite and the other is mantle derived eclogites. They are different in mineralogy and geochemistry.

The diversity of UHPM rock types occurred in the main hole illustrates:

(1) There must be a voluminous crustal material that have been involved in the deep subduction process of the Yangtze plate as evidenced by the findings of coesite micro-inclusions in zircons from these rocks.;

(2) Garnet peridotites are mantle wedge materials tectonically incorporated into the subducted slab and had undergone UHP metamorphism;

(3) The garnet bearing quartz felspathic gneisses are resulted from the partial melting of the crustal rock ,including the eclogitic gneiss during their uplift from the deep mantle into the mid-lower crust. .Shear zones, water fluid incorporation are the major conditions facilitating the melting process.

(4) The eclogites in the main hole are rich in rutile. In some of the productive layers the rutile content reaches 10-15%, suggesting that the Donghai rutile deposit is prospective of economic interest.