Polycyclic aromatic hydrocarbons and aliphatic hydrocarbons in Jbilet Winselwan carbonaceous chondrite : Attempt to evaluate the thermal metamorphism degree on the parent body

Hiroki Kato[1], *Hikaru Yabuta[1]

1. Hiroshima University, Department of Earth and Planetary Systems Science

Introduction: On June 27, 2018, Hayabusa2 spacecraft arrived at the C-type asteroid Ryugu. The surface of Ryugu has been thought to have experienced dehydration at least partially, according to the grand-based observation (Vilas et al. 2008; Hiroi et al. 1993). Therefore, it is important to investigate the chemical compositions of dehydrated carbonaceous CM chondrites for understanding the surface process of asteroid Ryugu. Although the extents of thermal metamorphism of CM chondrites have been evaluated by mineralogical compositions (e.g., Nakamura et al. 2006) and elemental and molecular compositions of insoluble organic matter (IOM) (e.g., Naraoka et al. 2004; Yabuta et al. 2005), the estimated temperature varies widely. On the other hand, soluble organic molecules from the dehydrated CM chondrites have not been quantified or below detection (e.g. Shimoyama et al. 1989), and there has been no study which evaluated thermal metamorphism based on the compositions of soluble organic molecules. Therefore, in this study, we analyzed aliphatic hydrocarbons and polycyclic aromatic hydrocarbons (PAHs) in Jbilet Winselwan CM chondrite, which is a dehydrated CM chondrite (Zolensky et al 2016) and show similar reflectance spectrum to that of asteroid Ryugu (Kameda et al. 2015), for precise evaluation of parent body thermal metamorphism. The relative abundances of the hydrocarbons were compared with those of Murray meteorite, which is a primitive CM chondrite.

Samples and Methods: Powdered samples of Jbilet Winselwan meteorite and Murray meteorite (0.2 - 0.4g) were extracted with dichloromethane/methanol (9:1) by sonication. The extracts were applied to a silica gel column. From the column, aliphatic hydrocarbons were eluted with hexane and then PAHs were eluted with dichloromethane. The hexane and dichloromethane eluates were concentrated to 100 μl individually under a nitrogen flow for analysis by a gas chromatography coupled with mass spectrometry (GC-MS). Identification and quantification of compounds were made by comparison of peak retention times on mass chromatograms and mass spectra, and peak areas, respectively, with those of standard compounds. For compounds without standard compounds, identification was made by comparison of mass spectra with library data.

Results and discussion: Total concentration of *n*-alkanes from Jbilet Winselwan meteorite (1.85 μg/g meteorite) was 40 times lower than those from Murray meteorite (80.7 μg/g meteorite). Relative abundances of short-chain *n*-alkanes (C_{15}-C_{16}) were dominant in Jbilet Winselwan meteorite, while those of long-chain *n*-alkanes (C_{17}-C_{21}) were dominant in Murray meteorite. This difference implies that short-chain *n*-alkanes were resulted from cracking of long-chain *n*-alkanes and/or IOM during thermal metamorphism of the parent body of Jbilet Winselwan meteorite. Total concentration of PAHs from Jbilet Winselwan meteorite (0.05 μg/ meteorite) was 1000 times lower than those from Murray meteorite (62.0 μg/g meteorite). Dimethylnaphthalene, fluorine, phenanthrene, pyrene, fluoranthene, methylbiphenyl (0.003-0.039 μg/g meteorite) were identified, while low molecular weight PAHs, such as naphthalene, methylnaphthalene, and acenaphthene, were not detected. The results suggest that PAHs with high volatility in Jbilet Winselwan meteorite were lost or involved in further aromatization during thermal metamorphism. Distributions of dimethylnaphthalene and methylbiphenyl isomers in Jbilet Winselwan

and Murray meteorites were similar, respectively, which indicates that the parent body of Jbilet Winselwan meteorite experienced relatively mild thermal metamorphism.

Keywords: Jbilet Winselwan meteorite, Soluble organic molecules, Dehydration

