Elemental, isotopic, and structural analyses of insoluble organic matter from in Jbilet Winselwan carbonaceous chondrite

*Kanami Kamide[1], Hikaru Yabuta[1], Minoru Ikehara[2]

1. Hiroshima University, 2. Kochi University

Introduction: Complex organic macromolecules in meteorites were resulted from the chemical evolution of organic molecules from interstellar clouds to protoplanetary disks and planetesimals in the early Solar System (Ehrenfreund and Charnley‚ 2000). Insoluble organic macromolecule (IOM) accounts for a major portion of organic carbon in carbonaceous chondritic meteorites (Glavin et al. 2018). It has been known that IOM sensitively records chemical history of meteorite parent body processes (Alexander et al. 2007). To date‚ graphitization degrees of IOM have been often used to evaluate long duration heating events of petrologic type 3 chondrite parent bodies (e.g.‚ Busemann et al. 2007; Cody et al. 2008). However‚ relationship between chemical variations of IOM and short duration heating events of types 1 and 2 carbonaceous chondrites have not been systematically understood. Therefore‚ we investigated the elemental and isotopic compositions‚ and chemical structures of IOM from thermal metamorphosed CM chondrite‚ Jbilet Winselwan meteorite (King et al 2019). The chemical compositions of this meteorite were compared with those from primitive CM2 chondrites and thermal metamorphosed CV3 chondrite.

Samples and methods: Four kinds of carbonaceous chondrites‚ Jbilet Winselwan (CM2)‚ Murray (CM2)‚ Murchison (CM2)‚ Allende (CV3) meteorites‚ were used in this study. IOM were purified from each meteorite powder by HCl⁄HF and⁄or CsF⁄HF treatment. The IOM samples were analyzed by a Flash elemental analyzer (EA) 1112 (Thermo Fisher Scientific‚ The Center for Advance Marine Core Research)‚ a FlashEA 1112 linked to a Delta Plus Advantage mass spectrometer (Thermo Fisher Scientific‚ The Center for Advance Marine Core Research)‚ and a micro-Raman spectroscopy (T64000‚ Horiba-JY‚ Hiroshima University).

Results and discussion: Elemental and isotopic analyses of IOM from Jbilet Winselwan meteorite estimated H⁄C atomic ratio of 0.405±0.039‚ N⁄C atomic ratio of 0.0368±0.0018‚ and δ^{13}C of -10.408±0.486‰. Comparing with the data by Alexander et al (2007)‚ Jbilet Winselwan meteorite showed clearly different compositions from those of primitive CM chondrites and thermally metamorphosed CV chondrites. On the other hand‚ the values were plotted in a similar range of those from some of the thermal metamorphosed CM chondrites (Yamato 793321‚PCA91008‚WIS91600) and ungrouped C2 Tagish Lake chondrite. In particular‚ the compositions of Jbilet Winselwan were comparable with those of WIS 91600 meteorite. Thus‚ it is likely that the two meteorite parent bodies experienced a similar thermal history. It has been discussed that WIS 91600 meteorite experienced a moderate heating at 400 - 500 ℃ after an episode of aqueous alteration under conditions that were similar to those experienced by Tagish Lake meteorite (Yabuta et al. 2010). Despite different H⁄C ratios‚ Raman spectra of IOM from the Jbilet Winselwan were similar to those from Murchison‚ and Murray meteorites but Allende meteorite‚ indicating that IOM of Jbilet Winselwan meteorite is as disordered as those of primitive chondrites. However‚ the values of Raman D- and G-band widths for Jbilet Winselwan IOM were deviated from a linear relationship of these parameters between Murchison and Murray IOMs and Allende IOM‚ which is reflected by graphitization of IOM during long duration heating (Busemann et al.

2007). Thus‚ aromatic condensation of IOM does not efficiently during the short duration heating.

Keywords: Carbonaceous chondrite, Insoluble organic matter