Soluble high molecular alkylated N-heterocycles in the CM and CR chondrites

HIROHI NARAOKA[1,2*] AND MINAKO HASHIGUCHI[2]

[1]Department of Earth and Planetary Sciences and [2]Research Center for Planetary Trace Organic Compounds, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka, 819-0395 Japan; *naraoka@geo.kyushu-u.ac.jp.

Introduction: The methanol extract of the Murchison meteorite (CM2) is enriched in ^{15}N and D, and contains significant variety of organic compounds consisting of CHO, CHN, CHNO, CHOS and CHNOS in elemental compositions [1, 2]. In particular, the positive CHN ions are predominant as extensively alkylated N-containing cyclic compounds such as alkylpyridines and alkylimidazoles. These compounds could be produced from aldehydes and ammonia through formose reaction and imine formation [2]. In this study, we further examind the occurrence of N-heterocyclic compounds to compare between CM and CR chondrites.

Materials and Methods: The powdered samples of the Murray meteorite (CM2) and Y002540 (CR) were extracted with hexane followed by methanol. The methanol extract was analyzed by high-resolution mass spectrometry ($m/\Delta m$ ~ 140,000 at m/z 200) using electrospray ionizaton coupled with nano liquid chromatography (C18 and amide columns using 0.1% HCOOH acetonitrile/water as eluents).

Results and Discussion: Alkylated CHN and CHN_2 homologues were observed from Murray and Y002540 in the range between m/z 140 and 300 with the maxima of m/z ~240 and ~180, respectively, as seen in the methanol extarct of the Murchison meteorite [2], The distribution of N-containing compounds is very similar between Murray and Murchison, in which the alkylated pyridines ($C_nH_{2n-5}N$) were the most abundant. In contrast, the distribution of the alkylated N-heterocycles in the CR chondrite was very different from that of the CM2 chondrites. The aliphatic (i.e. hydroganated) cyclic homologues (e.g. $C_nH_{2n+1}N$) were more predominant in Y002540. The similar chemical feature was observed in the CHN_2 compounds. Therefore, the N-heterocycles of the CR chondrite were likely formed under more reducing conditions, which is consistent with the common occurrence of reduced metal in CR chondrites. The results of this study indicate that the redox conditions of the meteorite parent bodies could control reaction pathways of extraterrestrial organic compounds.

References: [1]Schmitt-Kopplin et al. (2010) *PNAS* **107**, 2763. [2]Yamashita & Naraoka (2014) *Geochem. J.* **48**, 519.