Chemical imaging of organic compounds in the Murchison meteorite by desorption electrospray ionization coupled with Orbitrap MS.

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Carbonaceous chondrites contain variety of organic materials, including CHO, CHN, CHNO, and CHNOS compounds [1, 2]. Spatial distribution of the organic compounds and its relationship with minerals in the host matrix are critical important to understand evolution history of the extraterrestrial organic materials [e.g. 3]. Recently, in-situ chemical imaging of CH or CHS species was carried out on Bells (CM2) meteorite using two-step laser mass spectrometry (MS) [4]. In contrast to the laser ionization, electrospray–based ionization technique is powerful tool to analyze polar organic compounds [e.g. 2]. In this study, we applied the high-resolution chemical imaging using desorption electrospray ionization (DESI) [5, 6] coupled with orbitrap MS on Murchison (CM2) meteorite to reveal spatial distribution of polar organic species in the meteorite.

Fragments of the Murchison (~ a few mm) with flat surface was embedded in Indium or alloy with low melting point. The DESI-MS analysis was performed using spraysolvent of MeOH 100% solution with 1 μl/min flow rate.

Among numerous ion peaks ranging from m/z 70-500 detected from sample surface, homologues of alkylimidazole ($C_nH_{2n-1}N_2^+$), alkylpyridine ($C_nH_{2n-4}N^+$), alkylpiperidine ($C_nH_{2n+2}N^+$), alkylhydroxyimidazole ($C_nH_{2n-1}N_2O^+$), and alkyl-hydroxypyridine ($C_nH_{2n-4}NO^+$) were observed from the surface of Murchison. DESI-MS spectral images showed different spatial distribution between alkylpyridine and alkylimidazole. Furthermore, the observed CHN or CHNO compounds showed different distribution depending on the C number even among the same homologues. These results might be attributed to chromatographic effect during aqueous alteration in the early solar system.

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