

Molecular and isotopic distributions of PAHs from three Antarctic carbonaceous chondrites (CM2)

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Polyaromatic hydrocarbons (PAHs) have been reported from carbonaceous chondrites (Pering and Ponnampertuma, 1971; Naraoka *et al.*, 1988), a martian meteorite (McKay *et al.*, 1996), and

interstellar environment (Allamandola *et al.*, 1987). PAHs should be important compounds to study organic cosmochemistry and origins of life in the universe. Although extraterrestrial organic matters

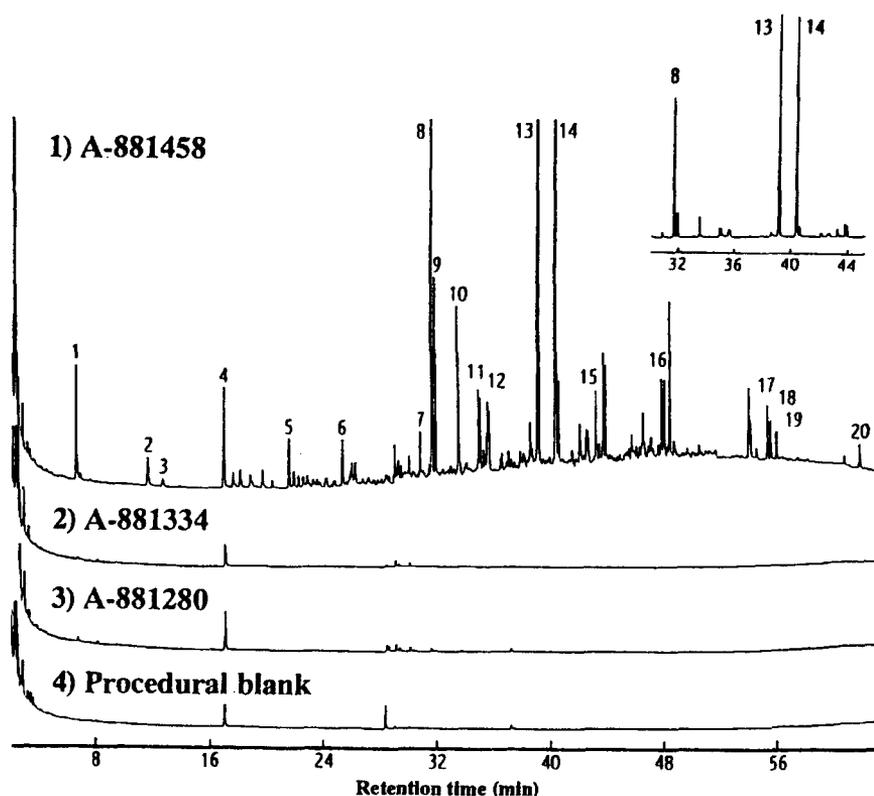


Fig. 1. Gaschromatograms of PAHs from Antarctic carbonaceous chondrites. 1) A-881458, 2) A-881334, 3) A-881280 and 4) procedural blank. Peak numbers denote: 1, naphthalene; 2, 2-methylnaphthalene; 3, 1-methylnaphthalene; 4, diphenyl; 5, acenaphthene; 6, fluorene; 7, dibenzothiophene; 8, phenanthrene; 9, anthracene; 10, carbazole; 11, 2-methylphenanthrene; 12, 1-methylphenanthrene; 13, fluoranthene; 14, pyrene; 15, 2,3-benzofluorene; 16, crysene and/or triphenylene; 17, benzo[e]pyrene; 18, benzo[a]pyrene; 19, perylene; 20, benzo[ghi]perylene.

have been extensively studied on the Murchison (CM2), Antarctic meteorites give us new opportunities to examine the occurrence of organic compounds. In this study, PAHs were examined in three Asuka carbonaceous chondrites collected from Antarctica in 1989, including carbon isotopic compositions of individual PAHs.

Samples and experimental

Three Asuka (A-) CM2 chondrites, A-881280, A-881334 and A-881458, were recovered from Nansen Plateau (~73°S; ~24°E), Queen Maud Land, Antarctica. Bulk carbon concentrations were determined using a CHN analyser (A-881280, 2.46%; A-881334, 1.49%; A-881458, 1.77%). Powdered samples of the interior parts of chondrites (~0.5 g) were extracted with benzene/CH₃OH and subjected to silica gel column chromatography to obtain a PAH fraction. Molecular identification was carried out using gas chromatography/mass spectrometry. Carbon isotopic compositions of individual PAHs were determined using gas chromatography/combustion/mass spectrometry by coinjecting n-alkanes as isotopic internal standards.

Results and discussion

In Fig. 1 more than 20 PAHs were identified in the extract of A-881458 from naphthalene to benzo[ghi]perylene, being fluoranthene and pyrene abundant (~3.5 µg/g). Such a molecular abundance is similar to PAHs in Murchison (Pering and Ponnampuruma, 1971) and Y-791198 (Naraoka *et*

al., 1988). Carbon isotopic compositions of naphthalene, biphenyl and acenaphthene (~ -26‰, relative to PDB) are similar to those of terrestrial PAHs, but different from phenanthrene (-14.0‰), fluoranthene (-8.3‰) and pyrene (-15.8‰) which are more enriched in ¹³C. In particular, fluoranthene and pyrene have the same chemical formula (C₁₆H₁₀) and may have the same thermodynamic characteristics. The isotopic difference is attributable to a kinetically-controlled formation mechanism for the PAHs as suggested by Gilmour and Pillinger (1992). On the other hand, A-881280 and A-881334 are depleted in PAHs in spite of a comparable carbon content to A-881458. The molecular distribution of PAHs is consistent with that of monocarboxylic acids (Naraoka *et al.*, 1998). The depletion is not due to weathering on ice, because the degrees of weathering are small and similar among the three chondrites. Probably the latter two chondrites may have been subjected to aqueous alteration or metamorphism on their meteorite parent bodies.

References

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