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Hydropyrolysis of the organic macromolecular material in the Murchison meteorite

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Carbonaceous chondrites are the most primitive chondrites having escaped much of the geological recycling endured by other solar system bodies and contain several percent indigenous carbon, the majority of which is organic in nature. Less than 25% of this organic component is attributed to the presence of free, readily solvent extractable species. The remainder is present as a predominantly aromatic macromolecular network, this fraction has been relatively poorly characterised. From past studies it is evident that there is a significant interstellar component.

Hydropyrolysis refers to pyrolysis assisted by continuous flow high pressure hydrogen in the presence of a catalyst. This technique has been successfully used in the past to liberate high yields of GC amenable hydrocarbons from a variety of organic macromolecules, while retaining their structures and stereochemistries. This study is the first time this hydropyrolysis method has been applied to extraterrestrial material.

Relatively high molecular weight polycyclic aromatic moieties (characterised by GC-MS) were released from the macromolecule. These included phenanthrene, carbazole, flouranthrene, pyrene, chrysene, perylene, benzoperylene and coronene with varying amounts of alkylation. Aromatic isomers are dominated by the most stable configuration. Comparison with hydrous pyrolysis indicated that hydropyrolysis is more efficient at releasing fragments from the condensed organic macromolecule.

Figure 1: Partially reconstructed mass chromatogram displaying hydropyrolysis products from Murchison macromolecule.

