A SEARCH FOR THE PRESENCE OF C_{60} AS AN INTERSTELLAR GRAIN IN METEORITES. I. Gilmour, S.S. Russell, J. Newton and C.T. Pillinger, Planetary Sciences Unit, Department of Earth Sciences, Open University. J.W. Arden, Department of Earth Sciences, University of Oxford. T.J. Dennis, J. P. Hare, H.W. Kroto, R. Taylor, and D.R.M. Walton, Department of Chemistry, University of Sussex.

Two allotropic forms of carbon, (diamond and graphite) and silicon carbide which are proposed to have condensed from late type stars to become interstellar grains, have been discovered in primitive chondrites as a consequence of tracing isotopic anomalies first recognised in the bulk meteorites. A new form of elemental carbon has recently been recognised in laser desorption experiments (1). Its proposed structure, as the icosahedron C_{60}, was confirmed (2) once it was realised that it could be produced in abundance by graphite vaporisation and purified chromatographically (2,3). The anticipated stability, the circumstances of its synthesis and certain peaks in its infra red absorption spectrum make C_{60} a perfect candidate for interstellar grains(4). In a reversal of the conventional approach to interstellar grain studies involving meteorites, we have made a conscious decision to search for C_{60} in carbonaceous and other chondrites. If the appropriate molecule can be found it hopefully will carry an isotopic anomaly to confirm its presolar origin. Prerequisite to the investigation is a knowledge of how C_{60} behaves during the various analytical procedures normally used in isolating and analysing carbonaceous components from meteorites. To test C_{60}'s response to these, authentic samples of the material have been employed.

The most robust forms of interstellar carbon, diamond and silicon carbide are concentrated in meteorite residues by oxidative decomposition of large quantities of isotopically normal organic and amorphous carbon using chromic and perchloric acids respectively. Since C_{60} has some affinities to soot species, it is appropriate to establish whether it can be decomposed by either of these reagents. An exploratory experiment with a small sample revealed C_{60} could be partially oxidised with $Cr_2O_7^{2-}$ in 2N H_2SO_4. However the residue of this experiment was not attacked by further treatment in $HClO_4$. Since this result is clearly unanticipated it is being checked with a larger specimen of guaranteed purity to confirm that inadvertent contamination is not involved.

Since a standard method of screening meteorites for the presence of interstellar grains is stepped combustion, an effort has been made to establish the characteristics of C_{60} during such a procedure. Two samples have been investigated: one on a system used only for carbon and a second in the dual carbon/nitrogen facility reported by Russell *et al* (5). The latter experiment had the ancillary purpose of checking whether C_{60} (which is manufactured under relatively poor vacuum conditions) contained any trapped N within either its structure or the cage. The carbon

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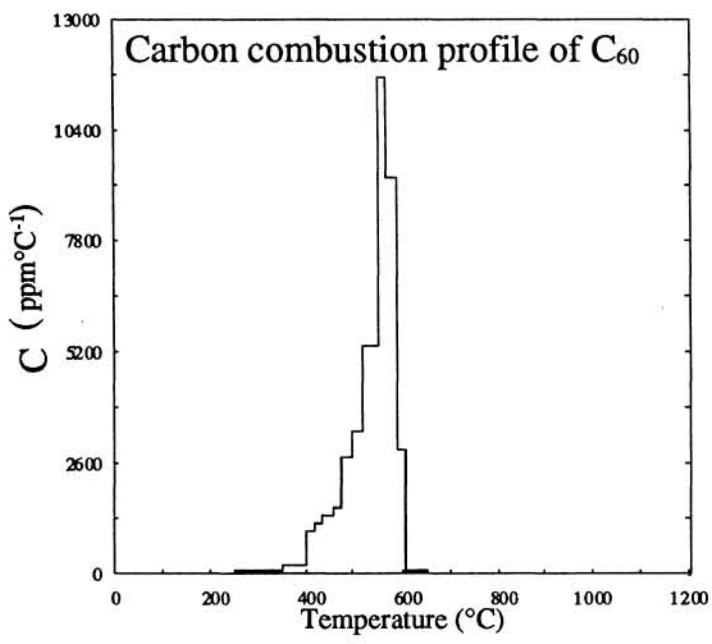
release profiles during stepped combustion, both reached a maximum at 570° - 575°C, an example is shown in the fig.

A simple comment which can be made is that despite its smaller grain size (7Å *vs* 25Å) C_{60} is more stable than interstellar diamond Cδ which can be completely combusted by *ca* 500°C. Additionally C_{60} exhibits a much longer combustion tail than the diamond which shows a sharp cut-off temperature. Rather surprisingly neither of the two samples analysed gave a yield in excess of 88 wt% carbon; a bulk specimen combusted overnight at 1000°C similarly afforded only a 91 wt % carbon yield. The discrepancy is not due to nitrogen incorporated into the sample because stepped combustion revealed no more than 280 ppm N the majority of which may be attributed to contamination.

The solubility of C_{60} in several organic solvents makes it suitable for study using high performance liquid chromatography (HPLC). Different concentration solutions of C_{60} in toluene were examined by normal phase HPLC using UV-VIS detection. The detection wavelength was 330 nm, an absorption displayed by C_{60} but not C_{70} and well removed from any mobile phase interference. Interestingly C_{60} displays very little retention eluting ahead of hydrogen containing polyaromatic molecules, confirming its non-polar nature and apparent chemical inertness. Accordingly solvent extracts of the Murchison meteorite are being investigated.



References
1. H.W. Kroto, J. Heath, S.C. O'Brien, R.F. Curl and R.E. Smalley, Nature **318**, 162-163 (1985). **2**. R. Taylor, J.P.Haxe, A.K. Abdul-Sada and H.W. Kroto, J. Chem. Soc, Chem. Commun. **20**, 1423-1425 (1990). **3**. W. Kraetschmer, L.D. Lamb, K. Fostiropoulos and D.R. Huffman, Nature **347**, 354-358 (1990). **4**. W. Kraetschmer, K. Fostiropoulos and D.R. Huffman, in Dusty Objects in the Universe, eds. Bussoletti and Vittone, Kluwer, Dordect, 1990 in press. **5**. Russell *et al* L.P.S.C. **XXI**, 1051 - 1052 (1989).