THE GEOCHEMISTRY OF BUCKMINSTERFULLERENE (C_{60}) I: SOLID SOLUTIONS WITH SULFUR AND OXIDATION WITH PERCHLORIC ACID. D. Heymann, Department of Geology and Geophysics, Rice University, Houston, Texas 77251. (713) 527-4890.

Buckminsterfullerene (C_{60}) was discovered in 1985 (1). It is a form of elemental carbon which crystallizes as molecular crystals in which the basic unit is C_{60}, a truncated icosahedron in which the carbon atoms occupy the (shared) corners of 12 pentagons and 20 hexagons. Today, gram-quantities of C_{60} with 10 to 20 weight % C_{70} can be quite easily synthesized (2).

It has been suggested that fullerenes (all molecules analogous to C_{60}, but with fewer or more C-atoms; always even numbers) form whenever elemental carbon condenses, as it might in the atmospheres of carbon-rich red giant stars. It has been suggested that one or several fullerenes may be responsible for the diffuse interstellar lines, hence that such molecules exist in various interstellar media. I have suggested that fullerenes and their associated soots might be carriers of isotopically strange inert gases (3). Whereas it is true that diamond and SiC have meanwhile been identified as carriers (4), it is also true that soot in alpha carbon is the carrier of Ne-E(L) (5). Thus, whether fullerenes occur in chondritic meteorites is an unsettled issue which has hardly been addressed.

I report here on some "geochemical" aspects of the chemical properties of C_{60}. The term "geochemical" is used in a very broad context. It includes not only the behavior of C_{60} in nature, but also it's chemical properties in the context of laboratory-based studies of meteorites.

It is now known that the fullerenes are the most volatile modifications of elemental carbon. At this writing, the vapor pressure of C_{60} is not yet known accurately. However, it is quite obvious that C_{60} is geochemically about as "volatile" as elemental sulfur (6), which occurs in the C1 carbonaceous chondrites. Hence it is not certain that C_{60} is too volatile to be found in the most primitive meteorites.

C_{60} survives quantitatively treatment with HF-HCl at room temperature for one week and at 100 ^{o}C for 48 hours. The customary treatment of chondrites with these acids for the production of acid-resistant residues does not seem to destroy fullerenes. However, both elemental sulfur and C_{60} dissolve well in CS_2 from which they crystallize upon evaporation of the solvent as solid solutions with up to about 1 mole % C_{60} (7). The customary digestion of residues with CS_2 will therefore place any free fullerene into solid solutions with sulfur, from which they must be recovered.

During the course of my study of the resistance of C_{60} to oxidation by hot perchloric acid, I found one possible method for separating S and C_{60}. At 120 ^{o}C and 130 ^{o}C, milligram quantities of sulfur (up to 40 mg) are destroyed within 10 to 15 minutes. Larger quantities may take longer as the molten sulfur floats on the acid, thus presenting only the underside of the droplet for contact with the acid. C_{60}, however, when treated with this acid at these temperatures loses at most 10 % by weight after exposure of one hour. The oxydation at 130 ^{o}C of solid solutions containing more than 1 (weight)% fullerene, however, remains incomplete even after one hour, presumably because the fullerene forms a protective crust around the sulfur.

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