
Buckminsterfullerene, and the search for
fullerenes in carbonaceous substances associated
with the Oklo natural nuclear fission reactors

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Buckminsterfullerene (C_{60}), a soccer ball-shaped molecule of 60 carbon atoms, is a new form of carbon first synthesized in 1985. Fullerenes, including C_{60} , have potentially important industrial applications including manufacture of molecule-size electronic devices. C_{60} remains difficult to purify once synthesized and consequently commands a high price. Nowhere in nature has it

been found to be concentrated. The first report of a natural occurrence was in 1992 from shungite, found as inclusions in diabase, in the Lake Onega region of Karelian, Russia. Shungite is a highly carbonaceous metasedimentary rock similar in appearance to meta-anthracite and to solid bitumen. C₆₀ has since been reported in meteorites, in soot at the K/T boundary, in carbonaceous tuff from Sudbury's Onaping Formation impact breccia, in fulgurites, and in sediments at the Permian/Triassic boundary. Our search for fullerenes at Oklo, Republic of Gabon, was prompted by the presence of "onion skin-like" structures in a sample of Oklo carbonaceous substances, as revealed by transmission electron microscopy. Initially our focus was the carbonaceous substances associated with the 2 Ga-old natural nuclear fission reactors of Oklo. Analytical techniques employed include infra-red spectroscopy, laser desorption, laser desorption post ionization (TOF), and high resolution electron impact mass spectroscopy. Without exception, the results of this work have proven negative. We find no indications of the presence of fullerenes in Oklo carbonaceous substances. If, as initially hypothesized, C₆₀ was produced during the sustained nuclear fission at Oklo, then it either is present below the detection limit (ca. 1 ppm) or it has been destabilized, possibly due to the high hydrogen fluence that prevailed during criticality. Assessment of this possibility is difficult because the stability of C₆₀ is not well understood. Among our intended natural fullerene-bearing standards we confirm the presence of C₆₀ in the "Black Tuff" from Sudbury's Onaping Formation, and the presence of C₆₀ in one sample of Karelian shungite. We view as highly unlikely reports that C₆₀ formed in the carbonaceous sediments of Karelia as a result of regional metamorphism; more likely the fullerenes are a consequence of the intrusion of basalt into sedimentary rocks highly enriched in reduced carbon.