ORIGIN OF CARBONACEOUS MATTER IN ROCKS FROM THE WHITEWATER GROUP OF THE SUDBURY STRUCTURE. D. Heymann[1] and B. O. Dressler[2], [1]Department of Geology and Geophysics, Rice University, Houston TX 77251-1892, USA, [2]Lunar and Planetary Institute, Houston TX 77058, USA.

It has long been known that heterolithic breccias of the Black Member of the Onaping Formation and mudstones of the Onwatin Formation, both formations belonging to the Whitewater Group, contain on the order of 1% carbonaceous matter. Crucial observations are that this large carbon content is wholly contained within the Sudbury basin and that the carbon content of the Gray Member of the Onaping, which, like the Black Member, is supposed to be a fallback breccia from the impact, is an order of magnitude smaller. The anthraxolite veins in the Onwatin are thought to consist of the same carbon which was mobilized. Among the hypotheses forwarded for the origin of the carbon are: (1) reduction of gases during fumarolic activity [1], (2) carbon from the impactor [2], (3) transformation of CO to CO_2 + C in the cooling atmospheric impact plume [3], and (4) a biogenetic origin [4]. Each of these hypotheses has its own problems.

Biogenetic processes do not form carbonaceous matter such as present in the Whitewater Group rocks, but organic matter with O, N, S, and H still bonded to it. It is generally thought that a metamorphic heating event is required to strip off O, N, S, and H from the organic remains to form carbonaceous matter, and it is known that metamorphic conditions can be deduced from the Raman spectra of the carbon formed [5]. The Raman spectrum of single crystal graphite has one first-order line at 1580 cm^{-1} (G-line). A forbidden line at 1360 cm^{-1} (D-line) appears in the spectra of disordered graphite. The intensity ratio D/G is a rough indicator of grain size or degree of disorder. Carbonaceous matter formed from organic remains during greenschist facies metamorphism has roughly equally intense G- and D-lines [5].

We have obtained Raman spectra for 9 samples of the Black Onaping (BO) and 1 Onwatin sample, and for anthraxolite from near the Errington 1 mine. The BO rocks came from High Falls, Chelmsford, Capreol, Nickel Offset Road, and Nelson Lake collection sites. All spectra had nearly equally intense G- and D-lines. When these results are combined with C isotopic data ($\delta^{13}C$ of –31.06‰, –30.10‰, and –30.24‰ respectively) for two BO and one Onwatin rock [4], for an anthraxolite ($\delta^{13}C$ of –31.5‰) from Lot 10, Concession 1, Balfour Township [6], and the presence of algal relics in an Onwatin rock [4], then the biogenetic hypothesis for the origin of the carbonaceous matter in the Onaping and Onwatin formations becomes the leading contender. Its major problem has been one of timing. The Black Member is thought to have sedimented rapidly and soon after the deposition of the Gray Member. How rapidly and how soon cannot, however, be deduced with any great precision, and algal blooms, given the conditions extant, (warm waters, ample nutrients, CO_2-rich atmosphere) could have been super-fast, with the appearance of fresh crops at the surface keeping pace with the burial of older crops beneath the growing thickness of the Onwatin package. The in situ biogenetic hypothesis has the additional forte that it demands that the formation of the carbonaceous matter took place entirely within the Sudbury basin.

The impactor- and CO-based hypotheses cannot be totally dismissed, however. Raman spectra of carbon in the Allende meteorite are very similar to those obtained for the Onaping and Onwatin rocks and so is the Raman spectrum of a heavily shocked graphite, both obtained in the present study.

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