SUGARS AND OTHER POSSIBLE FORMALDEHYDE PRODUCTS IN THE MURCHISON METEORITE.

G. W. Cooper, P.O. Box 204, Moffett Field CA 94035, USA.

Introduction: The Murchison meteorite contains numerous compounds of interest in the study of the origin of life and early solar system organic chemistry. These include: amino acids, sulfonic acids, phosphonic acids, purines and pyrimidines [1]. Absent among the biologically important compounds reported in Murchison are sugars, polyhydroxy aldehydes or ketones (polyols). Ribose and deoxyribose, five carbon sugars, are central to the role of contemporary nucleic acids, DNA and RNA. If polyhydroxylated compounds are indigenous to meteorites, then, because of the delivery of meteoritic and cometary material to the Earth and other planets, this would demonstrate that such compounds could have been part of the initial mixture of prebiotic and biologically important compounds on the early Earth.

If polyols, or any series of organic compounds, are true products of abiotic chemistry, it seems likely that such synthesis would begin with smaller members of the series and gradually build to more complex members. This is the case with all homologous series of indigenous organic compounds seen in the Murchison meteorite, i.e., amino acids, carboxylic acids, amides, etc. [1,2]. In the case of sugars and closely related compounds, referred to as polyols or polydroxylated compounds, one of the most generally agreed upon scenarios for natural abiotic synthesis is the "Formose" reaction [3]. In this reaction formaldehyde (CH_2O), in slightly basic aqueous solution, reacts with itself to gradually build a variety of hydroxylated compounds and sugars of increasing carbon number. Among the products seen are glycoaldehyde, ethylene glycol, glyceraldehyde, dihydroxyacetone, glycerol, erythrose, ribose, six-carbon sugars, etc. [4]. Because there was aqueous alteration on the Murchison parent body and formaldehyde is a ubiquitous interstellar compound, the Formose reaction would have been possible in Murchison. Our objective is to determine the nature and abundance of polyols in Murchison.

Methods and Results: The method used for the initial, bulk, separations of standards and Murchison compounds into fractions containing compounds of various acidities is that described in [2]. The fractions containing only neutral or weakly acidic compounds were dried, derivatized, and injected into a gas chromatograph-mass spectrometer for the identification of as many individual compounds as possible. A portion of these fractions were also analyzed by HPLC and ion chromatography. Isotopic analysis, carbon and hydrogen, were performed as in [5].

Our analysis of Murchison extracts suggests at least a partial product distribution of the type mentioned above, i.e., a series of polyols of increasing carbon number indicating abiotic synthesis. Some of the identified compounds are ethylene glycol, glycerol, dihydroxyacetone (a sugar), and glyceric acid. There is also evidence of higher polyols. Bulk carbon ($^{13}C/^{12}C$) and hydrogen (D/H) isotopic measurements indicate that the majority of these compounds are indigenous to the meteorite. Determination of the isotopic composition (D/H, $^{13}C/^{12}C$, and $^{16}O/^{17}O/^{18}O$) of individual compounds as well as further bulk measurements will help to determine their origins as well as verify that they are indigenous to Murchison.

References: [1] Cronin, J. R. and Chang, S. (1993) In "The Chemistry of Life's Origin", p. 209-258, Eds. J. M. Greenberg et al., Kluwer Academic Publishers, The Netherlands. [2] Cooper, G. W. and Cronin, J. R. (1995) Geochim. et Cosmochim. Acta 59, 1003. [3] Langenbeck W. (1956) *J. Prakt. Chem.* (4) 3, 196-210. [4] Walker J. F. (1964) Formaldehyde. Reinhold Publishing Corp. [5] Cooper, G.W., Thiemens, M.H., Jackson, T.L., Chang, S. (1997) Science 277, 1072-1074.