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Chemical Techniques for the Isolation of Elemental Carbon from Sediments

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Oral Presentation 3.4

CHEMICAL TECHNIQUES FOR THE ISOLATION OF ELEMENTAL CARBON FROM SEDIMENTS

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Sedimentary rock samples have been analyzed for the presence of elemental carbon in the form of soot from three geologic events associated with meteorite impacts: the Cretaceous-Tertiary (KT) boundary (65 Ma old), the Sudbury Impact Structure, Canada (1800 Ma old), and the Gardnos Impact Structure, Norway (400 ñ 900 Ma old). Sudbury and Gardnos samples were similar in bulk composition (carbonates, silicates) to those from the KT boundary. Therefore, it was assumed that traditional KT boundary chemical techniques for the isolation of carbon from sedimentary rocks would be effective. These techniques include acid dissolution of carbonates with HCl followed by treatment with HF/HCl to remove silicates. Elemental carbon is then separated from kerogen (resistant organic material) using acidic dichromate oxidation under controlled temperature conditions and duration. Soot is recognized and quantified by particle size analysis using a scanning electron microscope (SEM).

Though effective on the Sudbury samples, it was discovered that these chemical methods were less effective on the Gardnos samples. Significant quantities of fine-grained acid-resistant minerals remained in the Gardnos samples after extensive demineralization. Likewise, large amounts of kerogen remained after oxidation. The presence of these components led to difficulties in SEM analysis and identification of possible soot in these samples. While the problems with Gardnos samples were ultimately rectified, they have brought into question the general applicability of the chemical techniques used to isolate and identify elemental carbon in sedimentary rocks. Ongoing studies are being conducted to develop and broaden such techniques so as to be useful for samples of varying ages and compositions. To begin this task, twenty-four carbonaceous shale samples were obtained from The Field Museum of Natural History in Chicago. These shales range from Pre-Cambrian to Carboniferous in age and come from a variety of locations in North America. The carbon composition of these samples ranges from 0.0008 percent to 75.385 percent by mass. A systematic analysis of traditional KT boundary demineralization and oxidation techniques is being performed on each sample to determine the applicability of reactants and conditions for elemental carbon isolation. These results will be correlated with sample and kerogen type. Once this has been established, the results should be generally applicable to any carbon-containing sedimentary rock in which organic geochemists wish to separate land-derived elemental carbon from organic carbon of marine provenance.