Using Elemental Concentrations as Stratigraphic Markers in the Hudson River

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Society has contributed to and been affected by air pollution for centuries and many communities across the globe have been impacted. Measuring elemental concentrations and comparing the results to historical records can determine the origin of pollutants. To do this we must first study the stratigraphy of core samples in locations where good historical records have been kept; an excellent example of this has been witnessed in the Hudson River core LWB01-08 taken in 2003 near Yonkers, New York downstream from the transit path of the Peekskill meteorite. The elemental concentrations measured in this Hudson River core are the focus of our research. The base of modern Pb deposition (1880 A.D.) has been determined from previous work on Central Park Lake. By using ^{137}Cs dating and Pb concentrations (from XRF) we were able to confirm a modern annual sedimentation rate of ~1 cm/year and develop an age model for LWB01-08. We measured magnetic susceptibility and quantified elemental concentrations using X-Ray Fluorescence spectroscopy (XRF) at 1 cm intervals from 0-178 cm depth. We determined that layers with high Ni/Cr and Ni/Fe ratios likely bear cosmic spherules. Four layers with the highest Ni/Fe ratios were picked using light microscopes and contain cosmic spherules, verified using a scanning electron microscope (SEM). The model ages of some layers containing cosmic spherules coincide with times in the 19th century when intense historical meteor showers were recorded. Because cosmic spherules are rare in Hudson River sediments they can potentially serve as useful regional stratigraphic markers. This is important because there were previously no known methods to identify potential spherule bearing layers within Hudson River sediments. We also found ~10 pelagic foraminifera per 5 gram sample in two layers with high Sr/Ti ratios. Benthic foraminifera, gastropods and bivalve shell fragments are also present within these layers. Finally, abrupt peaks in Sr in the modern (post 1880) part of the sequence show complementary abrupt Pb peaks. As New York Harbor and the Hudson near Manhattan contain sediments with higher average Pb contents than those near Yonkers, the complementary Pb peaks suggest a downriver provenance for the sediments consistent with the occurrence of pelagic foraminifera. The events are likely brief.