INTRODUCTION

Sediment particles deposited on the seafloor carry a record of the environment from which they were derived and in which they were deposited. As particles settle to the seafloor, particularly those rich in organic matter, they scavenge contaminants such as polycyclic aromatic hydrocarbons (PAHs) from the water column [1]. Thus, well-dated sediment cores may contain a record of past contaminant sources and depositional processes. This information is valuable, particularly in the Arctic, where baseline data are often not available.

In recent years, industrial shipping traffic through Chesterfield Inlet, NU has increased due to mining activities inland. Community members have expressed concerns about the potential for oil spills to impact food security and fisheries (e.g., Arctic Char and Scallops) near town. Wager Bay, UKuskusikal National Park (UNP) has not experienced industrial shipping traffic. However, mining activities outside the Park could lead to shipping through Wager Bay (UNP) waters at some point in the future. To prepare for this potential future shipping in Wager Bay (UNP) and address concerns about shipping through Chesterfield Inlet, Parks Canada Agency and the Government of Nunavut Fisheries and Sealing Division supported collection of sediment core and baseline PAH measurements in these two coastal environments.

Here we present PAH profiles in four dated sediment cores collected across Chesterfield Inlet and Wager Bay (UNP). We examine PAH composition to assess the importance of pyrogenic sources (combustion of wood or fossil fuels) vs. petrogenic sources (releases of petroleum hydrocarbons) [2]. We also describe geochemical properties of the sediments that inform us about depositional and post-depositional processes that affect PAH fluxes and profiles in sediments.

**Objectives**
- Determine composition and concentrations of the suite of PAH compounds in dated sediment cores
- Identify the predominant sources of PAHs within the study area
- Characterise the diagenetic conditions within the sediment cores using profiles of organic carbon and redox elements
- Interpret vertical profiles of PAHs in the cores in the context of sources and geochemical controls

SAMPLE COLLECTION AND ANALYSES

**PAH Analyses:** PAHs were extracted from selected samples from four (4) stations according to methods outlined in US EPA 3546 (D). The extracts was fractionated using silica gel chromatography via a modified version of the US EPA method 3630C (E).

The solution was then analysed to identify the individual compounds and concentrations using a LECO Pegasus GC/IRF equipped with a high resolution time of flight mass spectrometer operated in Full Scan mode (300-305 amu) at the CEOS PETRL Lab, University of Manitoba (F).

**TOC Analyses:** Total Carbon (TC) and Total Inorganic Carbon contents were analysed at the Stable Isotope Lab at the University of Manitoba using an Eltra Helios Elemental Analyser. TOC was calculated with the formula TOC=TC-TCIC

**Redox Elements Analyses:** Dried and ground samples were submitted to ACME Labs (Bureau Veritas, Vancouver BC) for analyses. A total of 47 samples were analyzed following Aqua regia digestion.

**RESULTS AND DISCUSSION**

**PAH Sources - Diagnostic Ratios**

- A total of 20 PAH compounds including several alkylated PAHs and some members of the 16 “priority” PAHs were detected at low concentrations in the samples. Total PAH concentrations (sum of detected compounds) ranged from 222.9 ng/g dw to 90.6 ng/g dw. These concentrations reflect typical background levels (uncontaminated Arctic sediments).
- PAH sources assessed using diagnostic ratios and principal components analyses imply dominance of pyrogenic sources (combustion) [2].

**PAH Sources - Principal Component Analysis (PCA)**

PCA was conducted on log transformed PAH data. Pyrogenic components were found to have the greatest influence on the data. For examplle, the (40%) compared to petrogenic compounds (17%) on PC2 (G). There is some separation between Wager Bay and Chesterfield Inlet samples on PC2, which implies some subtle regional differences (H).

**Geochanical Controls**

Profiles of Total Organic Carbon (TOC) and redox-sensitive elements were examined in the cores to elucidate depositional and post-depositional conditions, which may affect profiles of PAHs.

**TOC Composition and Profiles**

TOC content is similar in cores NU-WAB-10 and PLK-NU-15 (averages of 1.68% and 1.59%, respectively), slightly higher in core NU-WAB-08 (1.95%) and very low at CI-08 (0.75%). Decrease in TOC with depth in the sediment implies TOC oxidation [4].

**Redox Elements Composition and Profiles**

Profiles of concentrations of redox sensitive elements (Mn, S and Fe) adjusted for variations in the lithologic component provide information about the strength of reducing conditions in the cores, which reflect the intensity of TOC oxidation [5].

Mn concentrations (and Mn/Al ratios) are high in the top 8cm of NU-WAB-08 and 3cm of CI-08, which implies oxide conditions in the surface sediment layers. (J) The low concentrations of Mn in deeper sediment sections imply reducing conditions. The Mn concentration remains unchanged throughout PLK-NU-15 and NU-WAB-10, signifying that no oxide is present and the sediments are reducing throughout. The differences in Mn profiles in the cores suggest differences in labile carbon flux, with lower fluxes at NU-WAB-08 and CI-08. These two cores came from the deepest and most shallow sites, respectively, and the sediment had the highest and lowest TOC contents, respectively.

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