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Sedimentological, physical and magnetic properties of surface sediments from the Canadian Arctic

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Fifty box cores distributed over a large area covering the Makenzie Shelf/Slope, the Amundsen Gulf, the M'Clure Strait, the Banks Island Shelf, the Queen Maud Gulf and the Barrow and Victoria Straits were recovered in 2016 and 2017 on board of the GCCS Amundsen as part of the ArcticNet program in order to compare the sedimentological, magnetic, geochemical and physical properties of sediments during the Little Ice Age (∼1550 et 1850 AD), the Medieval Warm period (∼900 et 1300 AD) and the recent period. This will allow the reconstruction and comparison of sediment dynamics during these climatic periods. Here, we will focus on the surface sediment samples.

Preliminary results of the geochemical (XRF core scanning), magnetic (volumetric and frequency dependent magnetic susceptibility, hysteresis measurements, natural, anhysteretic and isothermal remanent magnetizations), physical (Multi Sensor Core Logger) and sedimentological (grain-size) properties of the surface sediment samples reveal a West-East trend described by all of the parameters. Principal component and clustering analysis of log-ratio transformed XRF data have allowed us to divide the study area in three provinces with distinct sedimentary compositions: (1) the West (Mackenzie Shelf/Slope, West of Banks Island, Amundsen Gulf) is characterized by a high input of detrital (Al-K-Ti-Rb-Y) and Fe oxides materials near to the mouth of Mackenzie River, and detrital carbonates in the West of Banks Island; (2) the intermediate zone (central Amundsen, Coronation and the Queen Maud Gulfs) with a predominance of reddish sediments (a*>6) and redox sensitive elements predominance (Mn-Fe-Zn); (3) the East (Victoria Strait and Barrow/Lancaster Sounds), described by a predominance of detrital elements (Ti-Fe-Si-Al-Zr-Sr-K) and carbonates gradually diminishing in proportion toward the Barrow Strait.

The shape of hysteresis loops, the pseudo S-ratio (>0.94) and the median destructive field suggest an assemblage dominated by pseudo-single domain low coercivity minerals such as magnetite. Magnetic susceptibility increases from 10 in the West to 20 in the intermediate zone, decreases to 10 in the Victoria Strait, to finally increase again up to 50 (x 10-5 SI) east of Barrow Strait and seems to be correlated with the magnetic grain size. Indeed, the Mrs/Ms and Hcr/Hc ratios and detrital grain size show a similar West-East trend with finer unsorted grains in the West and coarser poorly sorted grains in the East. Combined with XRF data, these results suggest that the West province is dominated by detrital sediment supply from by numerous rivers inputs (e.g., Mackenzie plume, Coppermine, Ellice rivers) and by coastal erosion of dolomite cliffs and glacial tills cropping out in the Banks Island Shelf. On the other hand, the East province seems influenced by sediment-laden sea ice and icebergs with important carbonate inputs likely originating from the coastal erosion of Ordovician- Silurian carbonate-bearing rocks cropping out in the Victoria and the Prince of Wales Islands. Finally, the magnetic and physical properties of selected box cores from a West-East transect indicate that the cores may be correlated. These correlations, in addition to ongoing 210Pb measurements will be used to establish the chronology of key cores.