Age and source of bioturbated late Pleistocene muds on the continental slope: the use of portable X-ray fluorescence logging

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Much of the continental slope off eastern Canada comprises bioturbated muds with a stratigraphic record of sediment supply from ice streams crossing the shelf and variations in oceanic currents. Outstanding questions include: (a) Were times of rapid ice stream retreat and maximum sediment supply synchronous between different ice outlets? (b) What was the relative importance of freshwater plume and contour current transport of sediment? (c) Were there major shifts in the location of oceanic currents over the last glacial cycle? Rapid down-core logging of selected elements at a 1 cm resolution using a track-mount X-ray fluorescence device (pXRF) has revolutionized our ability to address these questions. This is despite the fact that pXRF does not detect light elements, is strongly influenced by matrix effects including water content and core irregularities, and provides at best semi-quantitative data. Down-core variations in Ca/Ti ratio reveal detrital carbonate intervals derived from Lancaster Sound and Hudson Strait, the latter corresponding to Heinrich events. A core on the SE Baffin Slope has a full record of Hudson Strait supply but pXRF also shows a cryptic Baffin Bay detrital carbonate record, invisible to the naked eye, that is diachronous with respect to Heinrich events. The Heinrich detrital carbonate layers around Flemish Cap provide reliable stratigraphic markers that allow down-slope and lateral variations in the thickness of stratigraphic units to be interpreted. They suggest that carbonate deposition during Heinrich events was from a surface plume, but that interbedded red muds were transported by contour currents. In later Heinrich events, a "log jam" of tabular icebergs grounding on Sackville Spur may have reduced Labrador Current flow through Flemish Pass. The changing provenance of sediment in cores can be characterized by scatter plots of two dissimilar elements, including Ti, K, Zr, Ca, and Sr. Generally, K is higher in muds and Zr in silts and sands, so these elements can be used to monitor chemical variations due to changes in grain size. Such techniques demonstrate changes in sediment supply through time from Hudson Strait, Notre Dame Channel, and Halibut Channel, and also show that late Holocene carbonate in the Labrador Current in Flemish Pass is derived from Baffin Bay and not from slope erosion off Hudson Strait. This rapid, low-cost, non-destructive technique can guide subsequent sampling for more precise and expensive quantitative X-ray diffraction or bulk geochemistry.

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