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Inferring surface sediment provenance and transport on the Scotian Shelf (Eastern Canada) from grain-size, mineralogical and geochemical signatures.

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The Scotian Shelf is a 700 km-long by 200-km wide, platform with deep troughs and shallow banks (e.g., Emerald Basin, Sable Island and Middle banks) shaped by Quaternary glaciations.

Understanding its inherited morphology and modern hydrodynamics has become increasingly relevant to Canada's energy transition because of Nova Scotia's plan to license 5 GW of offshore wind energy by 2030. Improved constraints on surficial geology and sediment remobilization are therefore essentials for informed regional decision-making.

In this study, we integrate mineralogical, geochemical and grain-size properties to better constraint surficial sediment composition on the Scotian Shelf, with the goals of distinguishing sediment provinces, identifying potential sediment sources and evaluating the spatial extent of sediment reworking across the shelf.

For these, we compiled more than 450 surficial sediment samples collected by the Geological Survey of Canada between 1965 and 2025. Mineralogic composition was quantified using X-ray diffraction (qXRD), bulk geochemical composition by energy dispersive X-ray fluorescence (ED-XRF), and grain size distributions by laser diffraction and optical particle counting. Multivariate statistical analyses (PCA and clustering) combined with geospatial mapping were used to define sediment groups and relate their distribution to bathymetry and regional spatial positioning, including their occurrence on shallow banks versus deeper basins.

Preliminary analyses reveal a strong bathymetric control on the mineralogical composition across the study area. Shallow-banks sediments are dominated by quartz (~85-95%), and exhibit notable enrichment in K-feldspars (~8-15%).

Middle Bank, a prospective site for offshore wind infrastructure contains only trace amounts of surficial glauconite (~1% when present).

Geochemical classifications using the Herron diagram reveal pronounced compositional heterogeneity across the shelf, consistent with mixing of glacially derived relict materials.

These results indicate a modern sediment budget largely sustained by reworking of inherited surficial sediments, modulated by depth and likely amplified during storm-wave events.

Future work should expand sampling on the western outer shelf to test this approach under tide-influenced conditions. It should also ink sediment properties (e.g., median grain size) with hydrodynamic predictors to quantify sediment transport pathways over multi-year timescales.