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A new perspective on Arctic Ocean stratigraphy

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Our understanding of past climate conditions in the Arctic Ocean has been hampered by poor age control, low sedimentation rates (< 1cm/kyr), hiatuses during glacial intervals as well as the scarcity and poor preservation of calcareous nanno- and microfossils in the sediments. Although recent advances using variations in single element (e.g. Mn) content or physical sediment properties (e.g. bulk density) of the recovered sediments have aided intra-Arctic core-to-core correlations, they remain prone to strong individual uncertainties.
To tackle this issue, we have developed an algorithm that combines clustering and multivariate ordination to test the interrelation of multiple input parameters (e.g. an array of individual XRF elemental contents), and subsequently identifies statistically significant stratigraphic units. Our preliminary results show that a distinct sedimentological pattern characterizes cores in the region of the Morris Jesup Rise and the Greenland side of the Lomonosov Ridge during the past 45,000 years. The obtained stratigraphic unit sequence contrasts their individual lithology and Mn profiles but is mimicked by grain-size variability. The comparison of this stratigraphic pattern to cores on the Siberian Side of the Lomonosov Ridge yields distinct differences, allowing for novel insights into sedimentary processes shaping the different regions within the Arctic Ocean. We also argue that our statistical approach can compensate for some of the weakness of single element or proxy applications, and hence aid the construction of a robust stratigraphic framework for a wide geographical range of Arctic Ocean sediments.