Understanding diagenetic processes and overprint in Quaternary Arctic Ocean sediments

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Over the past years, significant progress has been made in our understanding of early diagenetic processes in Arctic Ocean sediments. This has been instrumental in understanding certain paleo-environmental proxy records that are frequently used in the Arctic to correlate glacial and interglacial deposits across the Arctic Ocean, namely brown Mn-rich layers that are typically considered to document warmer interglacial/interstadial conditions. The combination of sediment and pore water geochemical analyses in particular has unequivocally shown that Mn is being re-distributed in Arctic marine sediments, with the potential to overprint primary climate-related signals.

Here we present geochemical data of pore waters and sediments from various parts of the Arctic Ocean that highlight the following concepts: A) Mn diagenesis occurs in most Arctic Ocean margin sediments, but its intensity and impact on the sedimentary Mn record is variable and likely depends on the amount of reactive organic matter buried in the sediments and sedimentation rates. B) Pore water data allow us to recognize depositional settings where Mn diagenesis is currently taking place, and shows that authigenic Mn (oxyhydr)oxide re-precipitation is likely coupled to nitrate reduction. C) There is a systematic relationship between the degree of diagenetic overprint experienced by individual Mn layers and their trace metal contents (layers gaining Mn by diagenesis have high Mo/Co ratios, while layers losing Mn by diagenesis have low Mo/Co ratios) that can be recognised without pore water data and is consistent with bioturbation studies. D)

As a future perspective, an in-depth understanding of the complete formation history of individual Mn layers in the context of Arctic environmental conditions will only be possible by combining paleo-environmental information, sediment and pore water geochemistry, and reaction-transport modeling.