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Oxygen minimum zone dynamics and anammox in the Gulf of Alaska (IODP Site U1419)

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In the modern northeast Pacific Ocean, an oxygen minimum zone (OMZ) occurs in depths of 700 to 1300 metres. Under current climatic conditions, this OMZ extends northwards into the Gulf of Alaska and is most pronounced during spring and autumn and disappears during winter. While its modern behaviour is well constrained, the extent of this OMZ in the past, especially in the Gulf of Alaska, is not well understood.

Anaerobic ammonium oxidation (anammox) only takes place under suboxic to anoxic conditions. With the BHT-isomer (bacteriohopanetetrol-stereoisomer) the involved microorganisms leave a distinct biomarker trace in sedimentary organic matter. This biomarker is well preserved compared to other anammox biomarkers (e.g., ladderanes) and while BHT is produced by a broad range of microbes, the BHT-isomer is only produced by anammox bacteria. The ratio between BHT and BHT-isomer can, therefore, be used as a reliable proxy for suboxic-anoxic conditions in the overlying water column at the time of deposition.

We present the application of this BHT-isomer at a new high-resolution record at the continental shelf off Alaska (IODP Expedition 341 Site U1419) that provides a 60 ka record of paleo-environmental conditions. The BHT-isomer displays significant variability and partly very high concentrations, indicating periods of sub- or anoxic conditions in the overlying water column. Elemental ratios such as Cu/Al, Mo/Al, S/Al and U/Al, which are commonly used as inorganic proxies for water column oxygenation do not show the same pattern in the respective intervals. However, these proxies can be affected by authigenic mineral formation in the course of early diagenesis, redistributing elements in the sediment column which impact their usefulness as paleo-redox-proxies. In contrast, the BHT-isomer ratio appears to be a robust proxy for water column oxygenation and not sensitive to early diagenesis.