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Efficacy of authigenic uranium as a proxy for reconstructing North Pacific deglacial oxygen concentrations

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Reconstructed ocean dissolved oxygen concentrations (DO) in deep waters were lower at the Last Glacial Maximum (LGM, ~20 ka) than present, both on a global scale [1] and specifically in the Pacific [2,3]. This finding has largely been based on high glacial authigenic uranium (aU) content in abyssal sediments, with the assumption that aU behaves as thermodynamically predicted to DO. However, aU can also be influenced by sedimentary processes like variable sedimentation rates, porewater respiration, and diagenetic remobilization, and disentangling these three mechanisms can be challenging.

Here, we present a new, high-resolution record from Northeast Pacific core W8709A-8TC/PC (3111 m, 42.17°N, 127.58'W), which has a highly constrained age model based on planktonic radiocarbon (total n=16, new = 10) and benthic stable isotopes (total n=146, new = 86). With high sedimentation rates (~5-18 cm/kyr), we were able to generate a sub-millennial scale aU mass accumulation rate (MAR) record for the past 25 ka that is relatively insensitive to diagenetic remobilization. When the aU MAR was compared with ^{230}Th-normalized fluxes of Ba_{xs}, opal, and C_{org} as proxies for export productivity, we found that the contribution of porewater respiration to aU accumulation varies substantially over time. During the LGM, low export productivity and high sedimentation rates resulted in high aU inferred to reflect low DO. In contrast, during the Holocene, high aU was likely driven by high export productivity and sedimentary respiration rather than low DO. The deglaciation reveals a mixed signal, with enrichments not as clearly controlled by either export productivity or DO. The sedimentary record from core W8709A-8TC/PC reveals that interpretation of the sedimentary aU proxy and accompanying reconstructions of DO may not be as simple as previously assumed.

[1]Global oceanic oxygenation controlled by the Southern Ocean through the last deglaciation, Wang, Y. et al. (2024), *Sci. Adv.* **10.**

[2]Deep Pacific storage of respired carbon during the last ice age: Perspectives from bottom water oxygen reconstructions, Jacobel, A.W. et al. (2020), *Quat. Sci. Rev.* **230.**

[3]Direct ventilation of the North Pacific did not reach the deep ocean during the last deglaciation, Jaccard, S.L. and Galbraith, E.D. (2013), *Geophys. Res. Lett.* **40.**