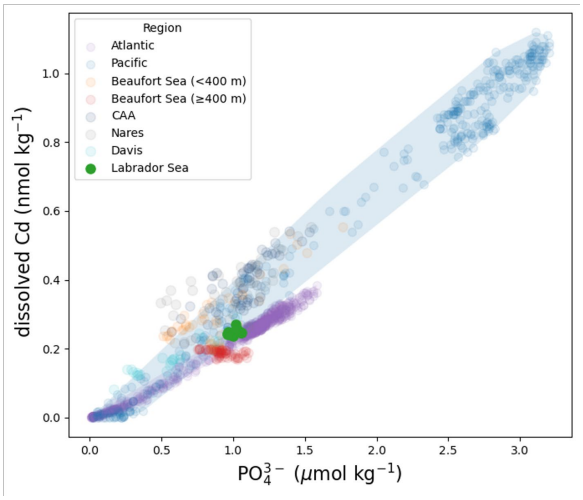
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Tracing cadmium distribution and transport pathways across the Arctic Ocean

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Cadmium (Cd), a nutrient-type trace metal strongly correlated with phosphate (PO_4) , serves as an effective tracer of water mass circulation in the Arctic Ocean. This basin receives inputs from both Pacific and Atlantic sources, with Pacific waters typically exhibiting higher dissolved Cd concentrations than Atlantic waters. Pacific-derived Upper Halocline Layer (UHL) waters enter through the Bering Strait and transit the Chukchi Shelf, where sedimentary inputs further elevate Cd concentrations. These waters preserve a characteristic Cd/PO_4 ratio of approximately 0.37, enabling their tracking across the Canadian Arctic.

A distinct subsurface Cd maximum linked to these modified Pacific waters is observed in the Canada Basin and continues through the Canadian Arctic Archipelago into Baffin Bay and Davis Strait. While dissolved Cd concentrations decrease from ~740 pM in the Canada Basin to ~320 pM in Baffin Bay, the Cd/PO_4 ratio remains relatively constant, indicating strong internal biogeochemical regulation. Surface waters show reduced Cd concentrations due to biological uptake and dilution from sea-ice melt, whereas deeper layers influenced by Atlantic inflows are characterized by comparatively low Cd concentrations and Cd/PO_4 ratios.

By the time Pacific-origin waters reach the Labrador Sea, their elevated Cd signature is substantially attenuated, with maximum observed Cd/PO_4 ratios of only 0.28. Overall, these findings demonstrate that Cd distributions effectively trace Pacific water transport across the Arctic, while also reflecting modification through shelf interactions and regional biogeochemical processes.