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Distributions and Inventories of Pb-210 and Cs-137 in Sediments along the North American Arctic Margin

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Processes occurring actively along the margins, including scavenging, deposition and burial of materials in sediments, are important in the biogeochemical cycling of many elements in the Arctic Ocean. However, with wide variation in environmental conditions along Arctic margins and a scarcity of sediment core data for many regions, our understanding of how these processes operate on a large scale and estimates of fluxes and inventories for budgets remain highly in doubt. Here, we report new Pb-210 and Cs-137 data for 25 sediment cores collected in 2007-2008 along the shelf and upper slope in various regions of the North American Arctic margin, including the North Bering-Chukchi and Beaufort Seas, the Canadian Arctic Archipelago (CAA) and Baffin Bay/Davis Strait. Sediment inventories of excess Pb-210 vary more than 10-fold (8-114 dpm/cm2), reflecting both regional and local differences in the supply of particles and particle-reactive elements. The inventories are generally much greater (on average six-fold) than the 'expected' supply of Pb-210 from in situ production by Ra-226 in the overlying water and atmospheric deposition. The implication is that lateral inputs of Pb-210 dominate the Pb-210 supply to sediments not only in high productivity areas (e.g., Chukchi shelf), where we expect strong particle scavenging, but also in regions with deep water exchange and continued supply of unscavenged dissolved 210Pb. Sediment Pb-210 inventories are low in the interior CAA probably as a result of dissolved Pb-210 having been effectively scavenged from Pacific-origin waters upstream on the Chukchi and Beaufort shelves and slopes and low vertical particle supply, where production is severely limited by permanent sea ice cover. Large lateral Pb-210 inputs to sediments in Davis Strait/Baffin Bay imply supply of Pb-210 from the North Atlantic. Cs-137 inventories in the sediment cores also generally exceed those expected from global fallout. Furthermore, profiles of Cs-137 in the sediment cores indicate relatively recent (1980s-90s) inputs, which cannot be explained by global fallout inputs alone. Contrasts in sediment inventories of Cs-137 and Pb-210 are interpreted as reflecting differences in the major transport pathways for the two radioisotopes (e.g., oceanic transport, sea ice rafting) and provide insight into how these pathways vary regionally. Sedimentation and mixing rates were also derived from the Pb-210 data and verified using the Cs-137 profiles and provide, for the first time, a foundation for regional elemental budgets. Finally, the dataset represents a critical baseline for evaluating changes in deposition and burial along the North American Arctic margin under altered climate scenarios.