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Deciphering circulation patterns, timescales and mixing in the Arctic and North Atlantic Oceans: insights from radionuclide transient tracers –the TITANICA project

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The ERC-funded project entitled TITANICA (A New Era of Transient Tracers in the Arctic and Atlantic Ocean) embarked on its official journey in July 2021, with the aim to decipher circulation patterns, transport timescales and mixing in the Arctic and subpolar North Atlantic oceans. The novelty of TITANICA is the use of a new set of transient radionuclide tracers (^{129}I , ^{236}U , ^{39}Ar and ^{14}C), a quartet that allows studying and constraining oceanographic processes on timescales of years to millennia. In particular, releases of ^{129}I and ^{236}U from European Nuclear Reprocessing Plants (NRPs) are used as powerful tracers of Atlantic waters circulation on their journey through the Arctic Ocean and subsequent entrainment into the overflow waters in the Nordic Seas and Labrador Sea (Wefing et al., 2021; Casacuberta&Smith). In addition, the cosmogenic radionuclides ^{14}C and ^{39}Ar are reemerging today as a powerful dual tracer to reassess the long ventilation timescales of the deep and bottom waters in the Arctic Ocean. In this talk, we will present a compilation of results from 15 oceanic expeditions covering the Arctic Ocean basins, the subpolar North Atlantic (mostly Labrador Sea, Irminger Sea and seas around Iceland) and the main gates connecting both oceans (i.e. Fram Strait, Davis Strait and Sta. Anna Trough). In the Arctic Ocean and Fram Strait, we have reevaluated transit time distributions of Atlantic waters in years 2020/2021 (Payne et al., submitted) and used these tracers to estimate storage of anthropogenic carbon (Raimondi et al., 2024). Latest results of cosmogenic tracers ^{14}C and ^{39}Ar in the deep Arctic Basins provide with new estimates of ventilation timescales, reassuring the isolation of these waters from any anthropogenic imprint. In the subpolar North Atlantic, the combination of ^{129}I and ^{236}U proved to be an additional tool to constrain water mass mixing and origin of overflow waters, a signal that can be chased down to Bermuda. TITANICA has sailed half of its journey, so this story is far from over...

Student Submission

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