Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.17142

The shelf-to-basin transport of iron from the Northern U.S West Coast to the Pacific Ocean

ANH LE-DUY PHAM[1], PIERRE DAMIEN[2], DANIEL MCCOY[2], FAYÇAL KESSOURI[3], JAMES MCWILLIAMS[2], JAMES MOFFETT[4], DANIELE BIANCHI[2] AND MATTHEW MAR[2]

[1]University of California, Los Angeles
[2]University of California Los Angeles
[3]Southern California Coastal Water Research Project
[4]University of Southern California

Presenting Author: anhlpham78@ucla.edu

Release of iron (Fe) along continental shelves is a major source of this limiting nutrient for phytoplankton in the open ocean, including in highly productive Eastern Boundary Upwelling Systems. However, the mechanisms governing the transport and fate of Fe along continental margins remain poorly understood, reflecting a complex interaction of physical and biogeochemical processes that are crudely represented by global ocean biogeochemical models. Here, we use a submesoscale-permitting regional physical-biogeochemical model to investigate the processes governing the delivery of shelf-derived Fe to the open ocean along the northern U.S. West Coast continental margin. We find that about one-fifth of the Fe released by the sediment on the shelf is transported offshore, where it supports phytoplankton growth in open waters, fertilizing the broader Northeast Pacific Ocean. This shelf-to-basin transport of Fe is governed by two main pathways that reflect interaction between the wind-driven circulation and release by low oxygen sediment: the first in the surface boundary layer, driven by summer upwelling, and the second in the bottom boundary layer, associated with the friction of the poleward California Undercurrent with the seafloor. In the water column interior, this offshore transport is strengthened by transient and standing eddies that oppose the mean upwelling circulation. Along the coast, several hot-spots of intense Fe delivery to the open ocean are maintained by standing meanders in the mean current and episodic swirls and transient eddies. Our results highlight the importance of fine-scale dynamics for the delivery of Fe and other shelf-derived elements from continental margins to the open ocean, and the need to improve representation of these processes in biogeochemical models used for climate change studies.