

Episodic Volcanic Iron Inputs and Their Impact on Coastal Marine Biogeochemistry: Insights from the 2021 Tajogaite Eruption

PROF. J. MAGDALENA SANTANA-CASIANO¹, **DAVID GONZÁLEZ-SANTANA**², ARIDANE G. GONZÁLEZ³ AND MELCHOR GONZÁLEZ-DÁVILA¹

¹Universidad de Las Palmas de Gran Canaria (ULPGC). Instituto de Oceanografía y Cambio Global (IOCAG)

²Universidad de Las Palmas de Gran Canaria (ULPGC)

³Universidad de Las Palmas de Gran Canaria

The 2021 Tajogaite volcanic eruption on La Palma, Canary Islands, provided a unique opportunity to study the impact of volcanic activity on coastal iron (Fe) dynamics and marine biogeochemistry. Over 85 days, the eruption released significant amounts of volcanic ash and lava into the ocean, altering local Fe concentrations and speciation. Measurements showed that seawater Fe concentrations exceeded 1900 nmol L^{-1} , with 99% of the Fe in particulate form. Soluble Fe concentrations were about ten times higher than typical values in the open Atlantic, highlighting the role of the eruption in enhancing bioavailable Fe.

Our study tracked the evolution of Fe size fractionation and observed a transition from large particulate dominance to increased colloidal and soluble Fe over time. Lava-seawater interactions generated surface plumes characterised by elevated temperatures, low pH and high turbidity, significantly altering the local marine environment. Spatial and temporal variability in Fe concentrations highlighted the dynamic nature of these coastal systems during volcanic events.

The results demonstrate that volcanic eruptions can act as an important natural Fe fertilisation mechanism, particularly in iron-limited regions. The episodic nature of these interactions requires refined models to incorporate volcanic contributions to ocean biogeochemistry. The study also highlights the importance of considering both ash deposition and lava-sea interactions in understanding Fe inputs to coastal waters.

These findings have implications for primary productivity and carbon cycling in marine ecosystems and stress the need for further research into the biogeochemical impacts of volcanic activity. The study considers the complex interplay between geological processes and marine biogeochemistry, providing valuable insights into the role of volcanoes in global nutrient cycles.