

## **Gulf Stream eddies rival atmospheric supply of iron to the North Atlantic subtropical gyre**

GREGORY F. DE SOUZA<sup>1</sup>, TIM M. CONWAY<sup>1,2</sup> AND JAIME B. PALTER<sup>3</sup>

<sup>1</sup>ETH Zurich, Institute of Geochemistry and Petrology, Zurich, Switzerland

<sup>2</sup>College of Marine Science & School of Geosciences, University of South Florida, St. Petersburg FL, USA

<sup>3</sup>School of Oceanography, University of Rhode Island, RI, USA

The oligotrophic subtropical North Atlantic Ocean is an important region for the fixation of atmospheric nitrogen by diazotrophic cyanobacteria. The high iron (Fe) requirements of these organisms necessitates a large external input of Fe to the subtropical gyre, typically assumed to be satisfied by atmospheric deposition of Saharan dust. However, dust supply is episodic, varying strongly with season and storm activity, resulting in a highly-variable Fe concentration in surface waters. Furthermore, the subsurface is strongly depleted in Fe due to the presence of nutrient-depleted Subtropical Mode Water throughout the gyre.

We present the observation of a Gulf Stream cold-core ring transporting Fe-rich Slope Water into the Fe-depleted subtropical gyre, serendipitously sampled during the 2011 US GEOTRACES GA03 section cruise in the North Atlantic. Iron concentrations within the ring were 2× higher than those in subtropical waters of the same density, and Fe was present nearer the surface due to the upward doming of isopycnals within the ring.

By combining these oceanographic observations with a recent satellite-based dataset of mesoscale eddy activity, we estimate that such cold-core rings produce a flux of  $4.0 \pm 2.0 \times 10^7$  mol Fe/yr into the subtropical gyre. This estimate is comparable in order of magnitude to a range of observationally- and model-based estimates of soluble Fe supply by atmospheric deposition, which range from  $4.2 \times 10^7$  to  $8.6 \times 10^8$  mol Fe/yr.

We thus contend that ring-mediated transport constitutes an important and overlooked supply mechanism for Fe to the subtropical gyre, especially to the region to the immediate south-west of the Gulf Stream, where it possibly rivals atmospheric Fe supply. This cross-Gulf-Stream flux of Fe may be especially important for diazotrophs, since transport of Fe is accompanied by the transport of phosphorus compounds that are required by nitrogen-fixing organisms.