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Iron and mesoscale eddy dynamics in the south-west Indian Ocean - RESILIENCE cruise

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Mesoscale eddies can influence marine ecosystem functioning through the lateral and vertical exchange of heat, carbon and nutrients. In particular, the south-west Indian Ocean (SWIO) is one of the most intense regions of mesoscale activity in the global ocean. Here we present a preliminary assessment of iron (Fe) dynamics from high resolution surface (~20 km's; ~5 m depth) data from two contrasting eddy systems: an oligotrophic cyclone-ring dipole in the Mozambique channel (MCD) and a coastal cyclonic Durban eddy (DE), which were sampled during the RESILIENCE cruise (April-May 2022, R/V Marion Dufresne). Measurements included soluble Fe (sFe; 0.02 µm filtered seawater) and dissolved Fe (dFe; 0.2 µm filtered seawater) concentrations from which colloidal Fe (cFe = dFe-sFe) concentrations were calculated.

Iron concentrations from open ocean samples (dFe = 0.26±0.07 nmol/kg; n=12) were lower than concentrations in MCD and DE suggesting eddy-associated Fe enrichment. Additionally, significant in-eddy Fe variations were observed. For example, the northern limb of the MCD had lower dFe (0.59±0.19 nmol/kg; n=13) compared to the southern limb (1.08±0.29 nmol/kg; n=11) while there was little variation in chlorophyll a related- fluorescence within the MCD. Interestingly, sFe concentrations were comparable between northern (0.34±0.17 nmol/kg; n=10) and southern (0.47±0.25 nmol/kg; n=9) limbs while cFe in the northern limb (0.28±0.18 nmol/kg; n=10) was ~3-fold lower than the southern limb (0.75±0.17 nmol/kg; n=9) indicating the importance of eddy source water composition. The DE had higher dFe concentrations on the coastal western limb (1.81±0.41 nmol/kg; n=10) compared to the eastern limb (0.66±0.18 nmol/kg; n=9). This was driven by an increase in cFe (1.05±0.12 nmol/kg; n=10) relative to sFe (0.76±0.12 nmol/kg; n=10) in the western limb whereas sFe (0.33±0.07 nmol/kg; n=8) and cFe (0.35±0.17 nmol/kg; n=8) in the eastern limb were comparable. The elevated Fe (and major nutrient) availability near the coast promoted phytoplankton growth, as inferred from chlorophyll a related-fluorescence concentrations which were ~2-fold higher compared to offshore concentrations. Iron cycling within eddies of the SWIO therefore appears to be driven by the composition of the eddy source waters, physical eddy circulation and proximity of the eddy to shelf/continental sources.