Species-specific diatom silicon isotopes from the Benguela Upwelling System over the Late Quaternary

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Eastern Boundary Upwelling Ecosystems (EBUEs) are some of the key loci of biogenic silica (opal) burial in the modern ocean, representing important productive ecosystems that contribute significantly to marine organic carbon fixation. The Benguela Upwelling System (BUS) is one of the major EBUEs, and is under the direct influence of Southern Ocean waters. Quantification of past changes in opal productivity through time, in response to climatic change, feeds into our understanding of the sensitivity of these systems to future perturbations. Existing sediment archives of marine silica cycling include opal burial fluxes, diatom assemblages and opaline silicon isotopic variations (denoted by δ^{30}Si). Burial fluxes and assemblages are limited to recording the remains reaching the sediment (i.e. export), and Si isotope variations are complicated by species-specific influences and seasonality. Here, we present the first species-specific diatom δ^{30}Si record from the BUS, encompassing full glacial conditions Marine Isotope Stages (MIS) 4 through the late MIS 1. We only analyse large diatoms with well-constrained ecologies, *Actinocyclus curvatulus* and *Coscinodiscus radiatus*. In addition to export, our new data allows us to reconstruct utilisation of dissolved Si in surface waters. During MIS3/4, diatom Si utilisation and productivity was high, coincident with a greater input of Si-rich Southern Ocean water and strong upwelling. From late MIS3 into MIS2, both diatom Si utilisation and productivity crash, as silica leakage and upwelling decline. In MIS1, whilst production is low, the large pelagic diatoms dominate the assemblage and Si utilisation is relatively high. We combine our findings with mass balance model experiments to show that changes in surface silica cycling through time are a function of upwelling intensity and utilisation changes, illustrating the sensitivity of EBUEs to glacial-interglacial climatic change. This method represents a promising new approach to understanding the different components of the Si cycle, and the impacts of Si leakage from the Southern Ocean into the Atlantic.