Tight coupling between Si and Fe biogeochemical cycles in the ocean: Evidences from diatom-bound proxies

L.E. PICHEVIN[1], R.S. GANESHRAM[1], W. GEIBERT[1], R.THUNELL[2] AND R. HINTON[1]

[1]School of Geosciences, Grant Institute, University of Edinburgh, West Main Road, EH9 3JW, Edinburgh, UK, laetitia.pichevin@ed.ac.uk, Tel +44 131 650 8547, Fax +44 131 668 3184

[2]Dept. of Earth and Ocean Sciences, University of South Carolina, Columbia, SC 29208, USA

Large swathes of the ocean are Si-limited and this imposes a cap on siliceous vs. calcareous primary production, the export of organic and inorganic carbon (C rain-rate ratio) and the sequestration of CO_2 in the ocean. Sedimentary burial of biogenic silica is the main oceanic Si sink and is distributed equally between open ocean, iron-limited provinces and upwelling margins. However, the margin Si sink is mainly localised in the eastern Pacific while contributions from other upwelling systems are comparatively small. Such large inter-margin differences remain unexplained. Here we investigate this difference using biogenic fluxes and diatom-bound proxies in sedimentary material from the Gulf of California, an archetypal Si sink. We suggest that transient Fe limitation during intense upwelling periods results in dramatic increases in Si:Corg export ratios and induces elevated Si burial -a view also supported by long sedimentary records from the same basin. An global compilation shows that hotspots of Si burial are characterised by high Si:Corg export ratios which are diagnostic of Fe limitation during diatom growth. Therefore, we propose that prevailing conditions of widespread Si limitation in the ocean is largely caused by Fe deficiency imposing an indirect constraint on oceanic C sequestration.