Beyond authigenic apatite: New (and old) insights into the marine phosphorus cycle

C. MÄRZ[1], H.-J. BRUMSACK[2], S. KASTEN[3], S.W. POULTON[4], N. RIEDINGER[5], B. SCHNETGER[2] AND T. WAGNER[1]

[1]School of Civil Engineering & Geosciences, Newcastle University, UK (christian.maerz@ncl.ac.uk)
[2]ICBM, Oldenburg University, Oldenburg, Germany
[3]Alfred Wegener Institute Bremerhaven, Germany
[4]School of Earth & Environment, University of Leeds, UK
[5]School of Geology, Oklahoma State University, USA

Robert Berner has contributed significantly to our understanding of global P cycling, including its adsorption to Fe oxides [1], its riverine input to the sea [2], its involvement in diagenetic processes [3], and its coupling to the carbon cycle [4]. One of the most significant findings was the widespread formation of carbonate fluorapatite in continental margin sediments [5], constituting the largest sink in the global biogeochemical P cycle. In this presentation, I will highlight some recent (in fact, partly long-standing but neglected) insights into the marine P cycle that may significantly impact current views on this bioessential nutrient's environmental behaviour.

On the one hand, these insights are based on Pleistocene-Pliocene Bering Sea sediments (IODP Expedition 323), where opal-bound P appears to be an important reactive P sink, while carbonate fluorapatite seems to be mainly detrital and not part of the reactive P pool [6]. If these relationships are more widespread, they might require a revision of the average residence time of reactive P in the ocean.

On the other hand, analyses of deep-sea fan sediments off major African and South American rivers reveal that below sulphate-methane transition zones, geochemical conditions are conducive for the precipitation not of authigenic apatite, but of Fe(II) phosphate minerals like vivianite [7]. Iron(II) phosphates have now been suggested to precipitate in a range of other marine sedimentary environments as well. They might therefore represent an important component of marine Fe-P coupling and reactive P burial.

[1] Berner RA (1973) *EPSL* **18**, 77-83; [2] Berner RA, Rao J-L (1994), *GCA* **58**, 2333-2339; [3] Krom MD, Berner RA (1981) *GCA* **47**, 207-216; [4] Berner RA (2013) *Aquat. Geochem.* **19**, 565-568; [5] Ruttenberg KC, Berner RA (1993) *GCA* **57**, 991-1007; [6] März C et al. (2014) *Chem. Geol.* **363**, 270-282; [7] März C et al. (2008) *Mar. Geol.* **255**, 118-130.