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The silica cycle in the modern and past ocean : updated views

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Diatoms play a leading role in the control of the export production of carbon towards the ocean interior, and the availability of silicic acid in the surface waters might play a key role in the control of the atmospheric pCO_2. Thus, if we are to correctly describe and model the cycle of carbon in the world ocean, to better understand that of silicon is of major interest. This invited talk will address 3 questions: (1) what are the processes that control the recycling of silica in the world ocean? (2) is the Si cycle at steady state in the modern ocean? (3) which proxies to use to describe better the export production in the past ocean ?

In spite of decades of efforts our knowledge of the silica cycle in the world ocean still remains preliminary. Recent process studies on the silicic acid pump in different oceanic and coastal environments give new lights on the mechanisms that control the dissolution of biosilica in the photic and mesopelagic zones, and on the role of biota (microbial loop, metazoan) on the dissolution/preservation of biosilica. Thus, the recycling of Si is not a function of temperature alone and biogeochemical models must be improved. At global scale, our best estimates for the inputs of silicic acid in the ocean and for the outputs of biosilica in sediments are far from being balanced, and the steady state hypothesis for the silica cycle in the modern ocean is challenged.

The isotopic fractionation of Si that occurs during the uptake of silicic acid by diatoms was quantified by De La Rocha et al. (1997). Since that, δ^{30}Si signals have been used as a proxy of the consumption of silicic acid in the surface layer, and variations in silicon-isotope composition of diatoms from sediment records have been used as indicators of past oceanic changes. If we are to improve paleo-reconstructions recent data show that variations : (1) in the isotopic fractionation of Si by diatoms must be taken into account, and (2) of other proxies (including the flux of opal buried in sediments) must be considered along with those of δ^{30}Si.