BIOGENIC SILICA DISSOLUTION IN SOUTHERN OCEAN SEDIMENTS

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1 Introduction

Biogenic silica (BSi) is a major component in marine geochemical cycles and a suitable proxy for paleoproductivity. The Southern Ocean plays a key role in the biochemical cycle of silicon (Schlüter et al. 2001). To address questions of opal preservation and to assess the global biogenic silica cycle it is important to understand the processes controlling BSi dissolution.

2 Material and Methods

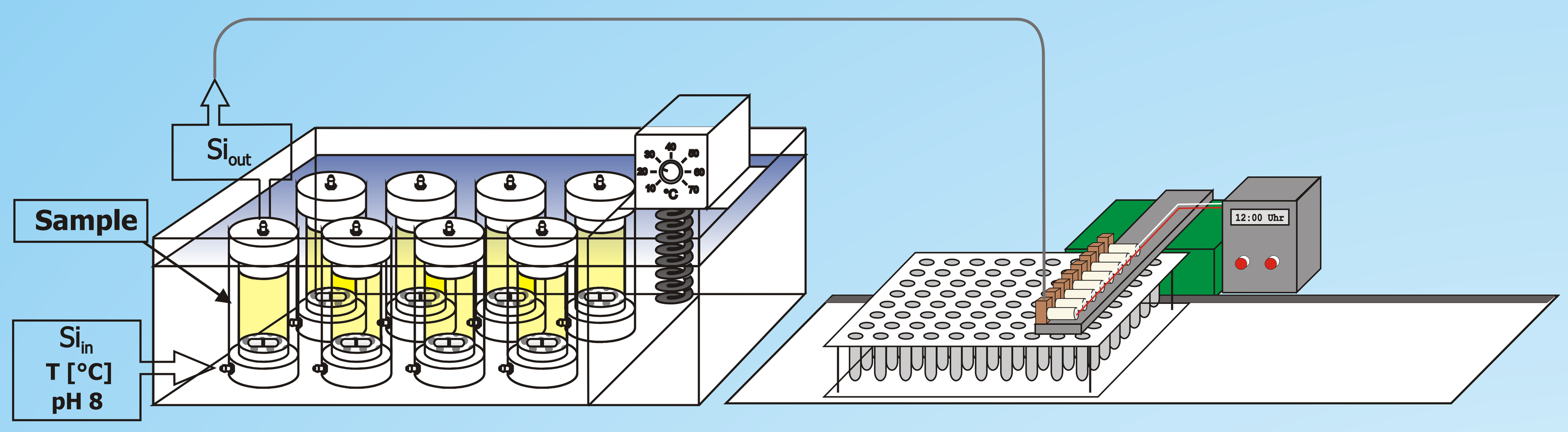

Fig. 1: Schematic illustration of stirred continuous flow-through (CFT) reactor technique coupled with a time-controlled microvalve fraction collector. Inflow solution is added to the reactors with a peristaltic pump. Tygon tubing is used for interconnecting all parts of the system.

Continuously stirred flow-through experiments are carried out to determine the kinetics and solubility of biogenic silica. Flow-through reactors allow quantification of dissolution rates and saturation concentrations under well-defined conditions. Dissolution rates of sediment samples are determined as a function of the degree of undersaturation by varying the silicic acid concentrationn and the flow rate of the inflow solution respectively. Artificial seawater is used as matrix, with defined Mg, Ca and K.

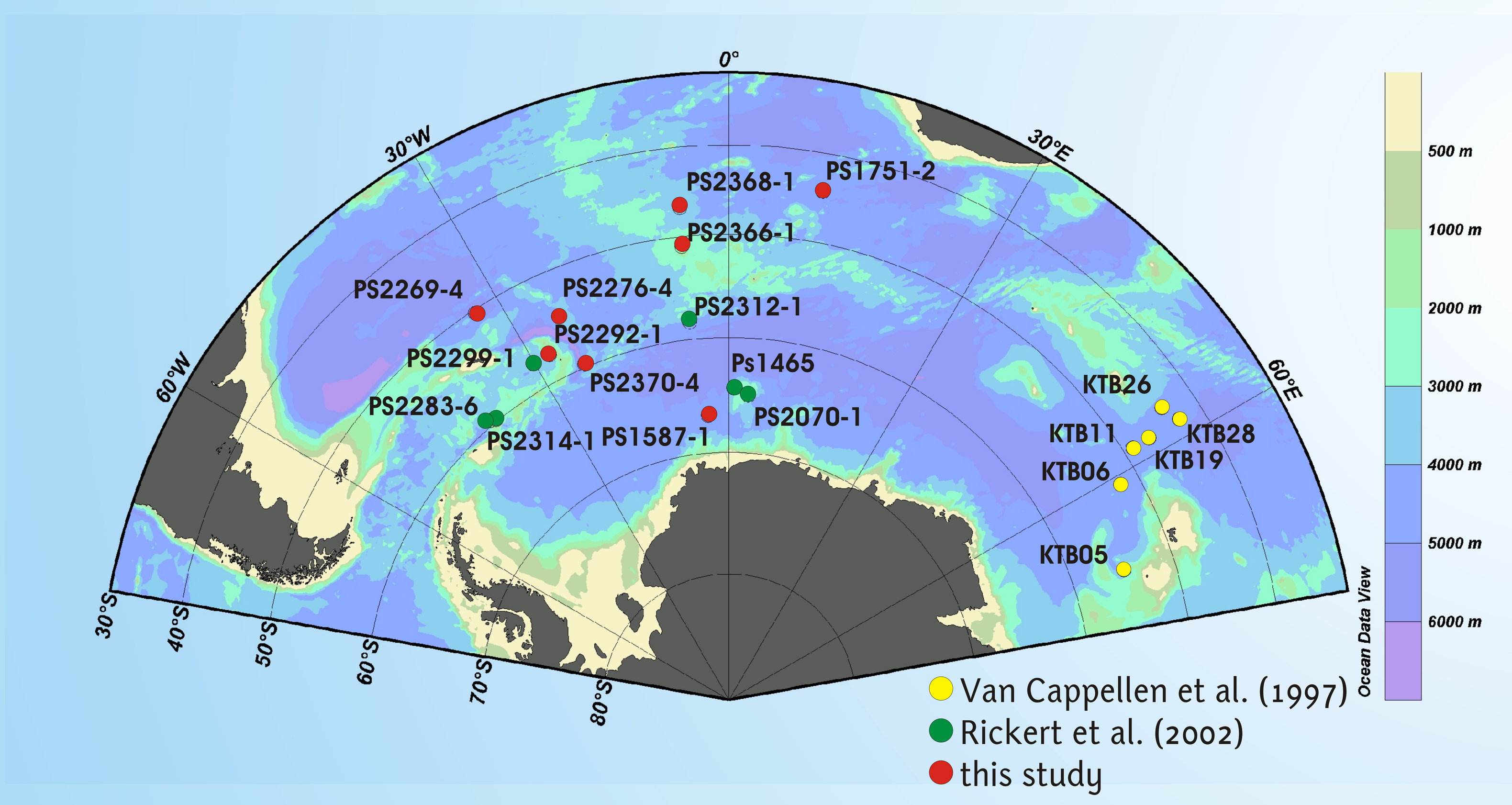

Fig. 2: Published and new sites for investigation of BSi dissolution in the Southern Ocean

For the Southern Ocean, data on BSi dissolution has already been published by e. g. Van Cappellen et al. (1997) and Rickert et al. (2002). We currently work on new samples (see map) to improve knowledge about the regional distribution of BSi dissolution kinetics .

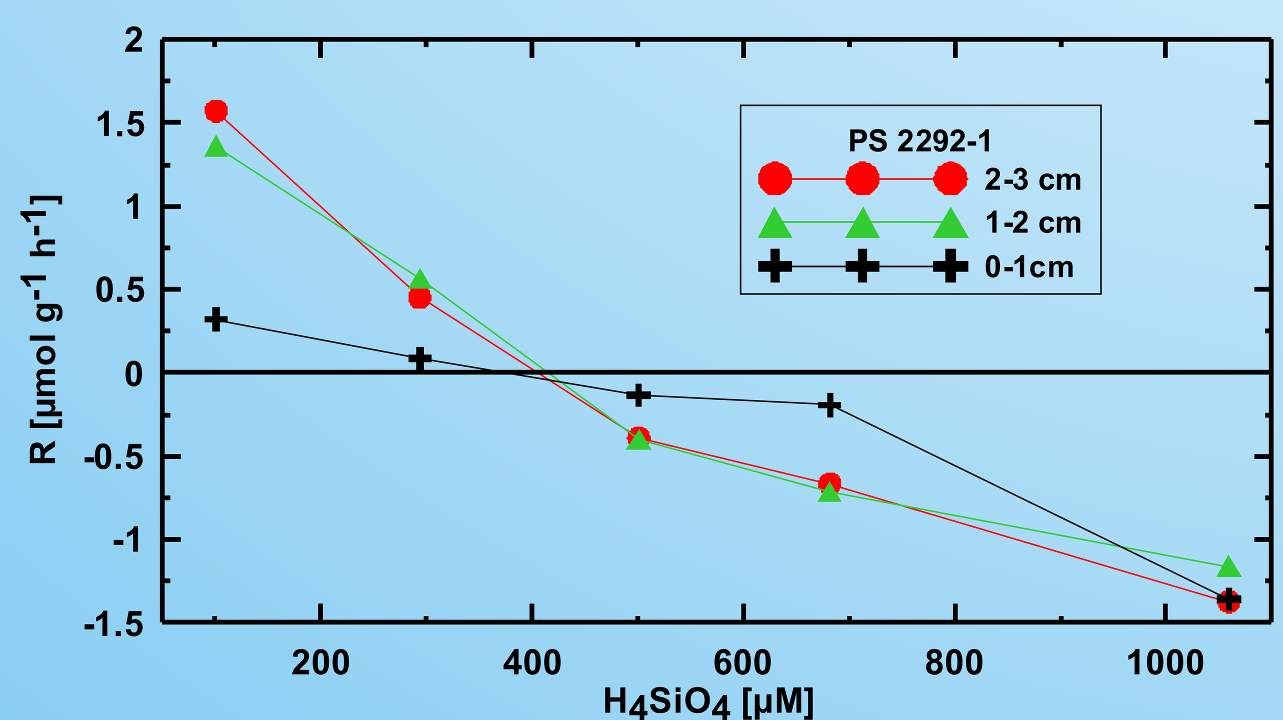

Fig. 3: Preliminary results for steady-state dissolution rates of sediment samples from the Multicorer PS2292-1 as a function of silicic acid concentrations of the outflow solution (T = 25°C, pH 8)

3 Diffusive Silicic Acid Fluxes and BSi Content

To assess BSi dissolution data with respect to regional distribution, additional parameters like diffusive silicic acid fluxes and BSi content are considered. For this purpose an up-to-date compilation of the mentioned parameters is generated by a Geo Information System.

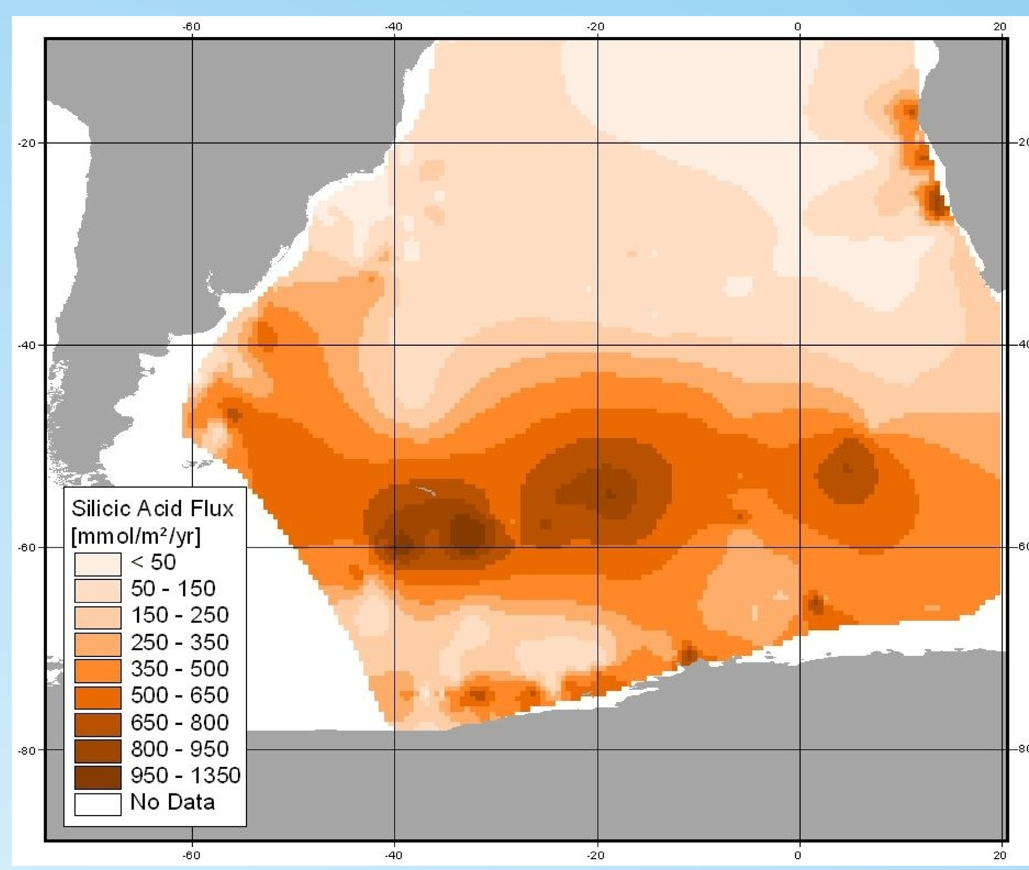

Fig. 4: Diffusive Silicic Acid Flux in the South Atlantic

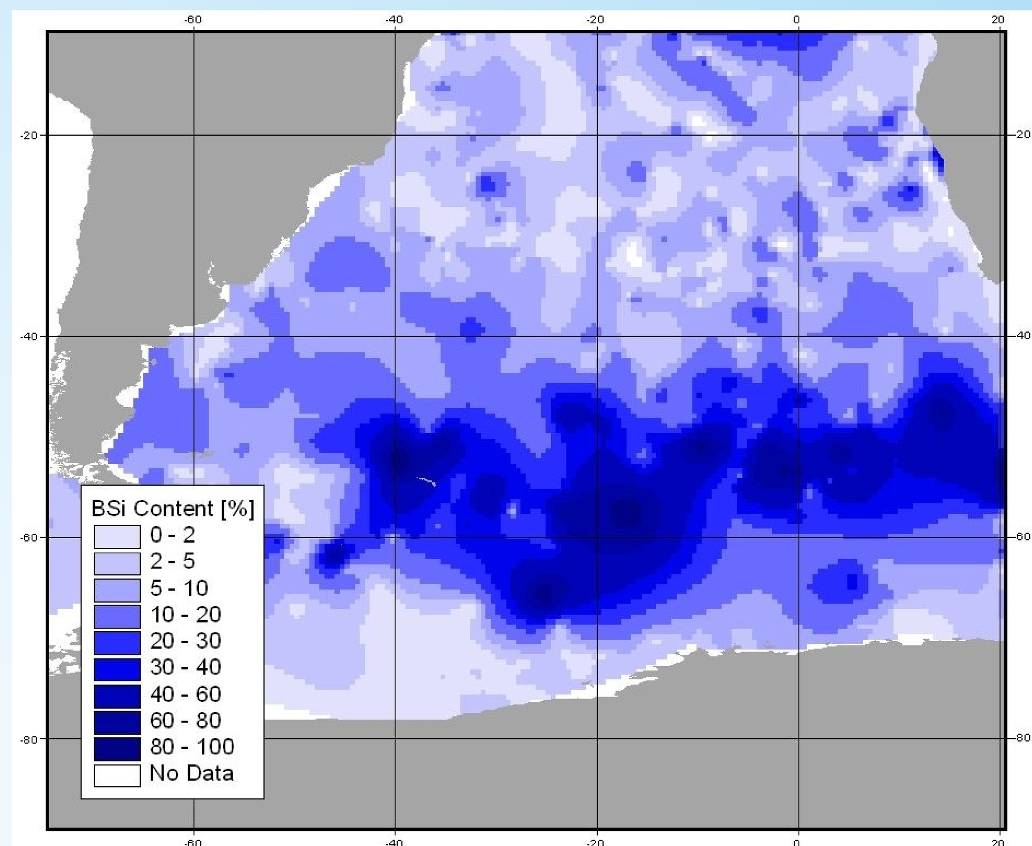

Fig. 5: BSi content in the South Atlantic

4 Future Work

The combination of results from laboratory measurements and the regional distribution of parameters affecting the benthic silica cycle will help us to decipher processes regulating the BSi burial and to provide a more detailed understanding of the dissolution of BSi in surface sediments within certain regions of the Southern Ocean. Therefore, it is important to consider detailed information on diatom assemblages and sediment composition, e. g. clay mineralogy published by Petschick et al. (1996).

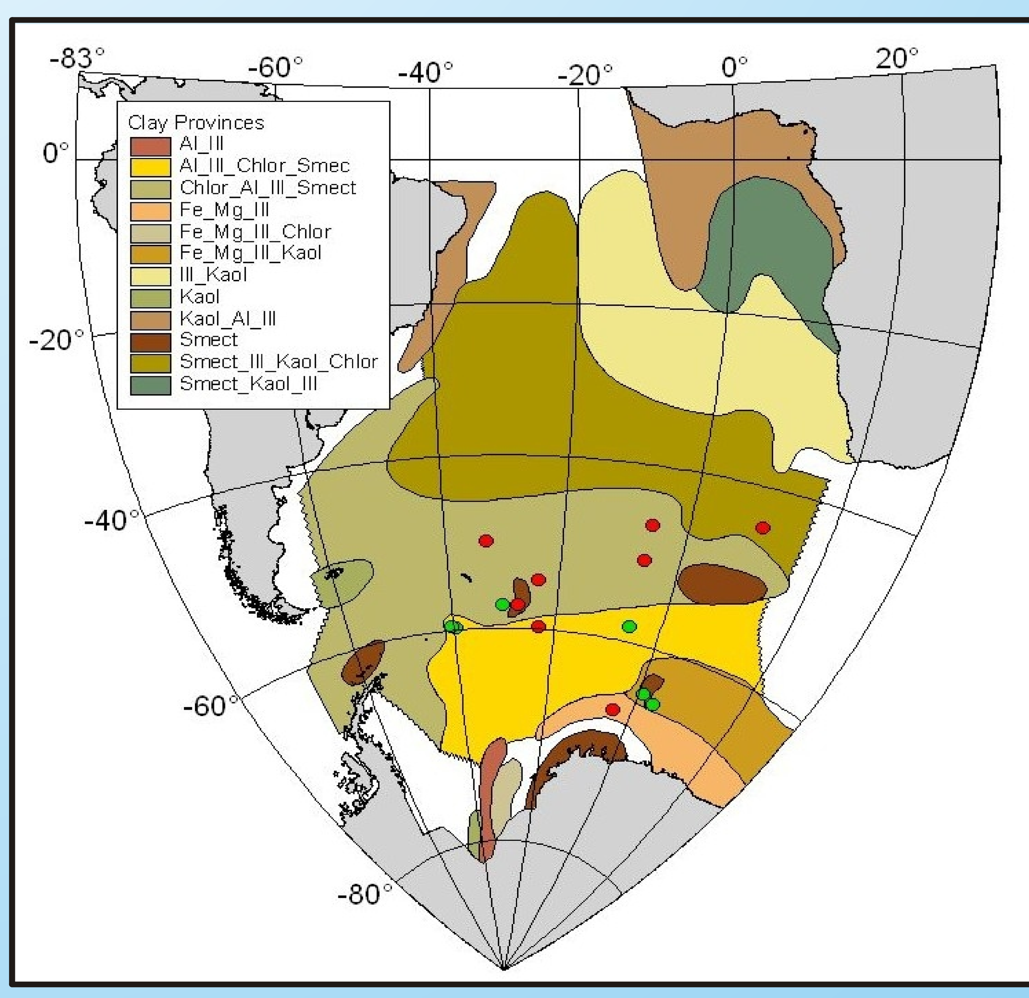

Fig . 6: Clay Provinces after Petschick et. al. (1996) as an example of variation in sedimentary mineral composition.

References:

Petschick, R. et al.(1996). "Clay mineral distribution in surface sediments of the South Atlantic: sources, transport, and relation to oceanography." Marine Geology 130(3-4): 203-229.

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Van Cappellen, P. & L. Qiu (1997). "Biogenic silica dissolution in sediments of the Southern Ocean. I. Solubility." Deep Sea Research Part II: Topical Studies in Oceanography 44(5): 1109-1128.