DISSOLUTION OF BIOGENIC SILICA IN SOUTHERN OCEAN SURFACE 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: Photo of a wet alkaline extracion line. Water bath, sample vessels and stirrer on the left. An autoanalyser system in the middle with a flow through photometer on the right. Chemicals in the back.

Wet alkaline extraction experiments after Müller & Schneider (1993) were carried out to determine the biogenic silica content of surface sediment samples. The digital data of the leaching curves were run through a fitting procedure after Koning et al. (2002) to obtain an estimate of the reactivity of biogenic silica in sediments.

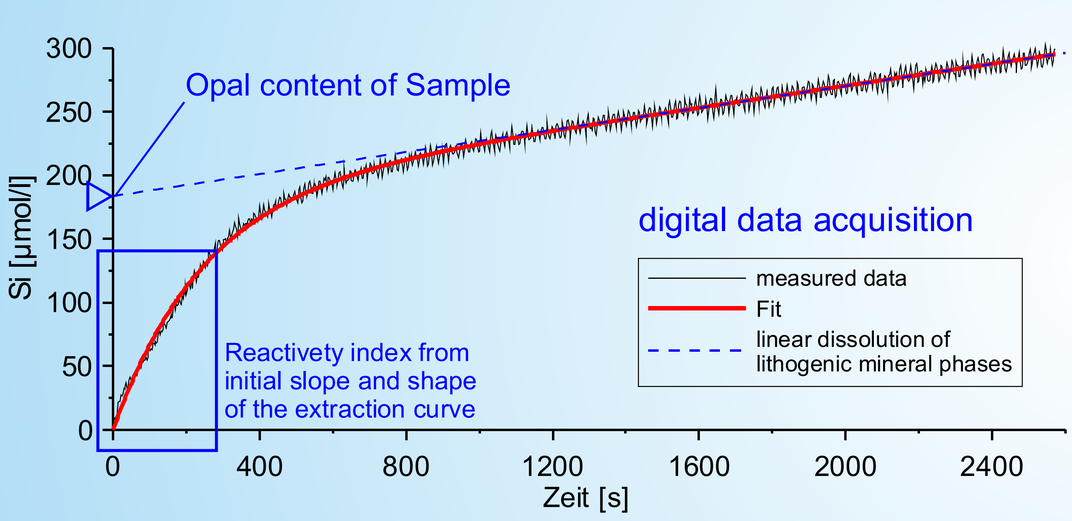

Fig. 2: Wet alkaline leaching curve with a fitted curve

During RV Polarstern cruises ANT-XX/2, ANT-IX/4 and ANT-X/4 multicorer and minicorer samples were retrieved. The opal content of 65 selected surface samples (typically 0-0.5 cm depth) were determined and a reactivity index were obtained by a fitting procedure of the leaching curves.

$$Si_{aq} = \left[Si_{extr}\right]_0 \cdot (1 - e^{-kt}) + bt$$

Equation 1: Model for fitting a leaching curve from Koning et al. (2002)

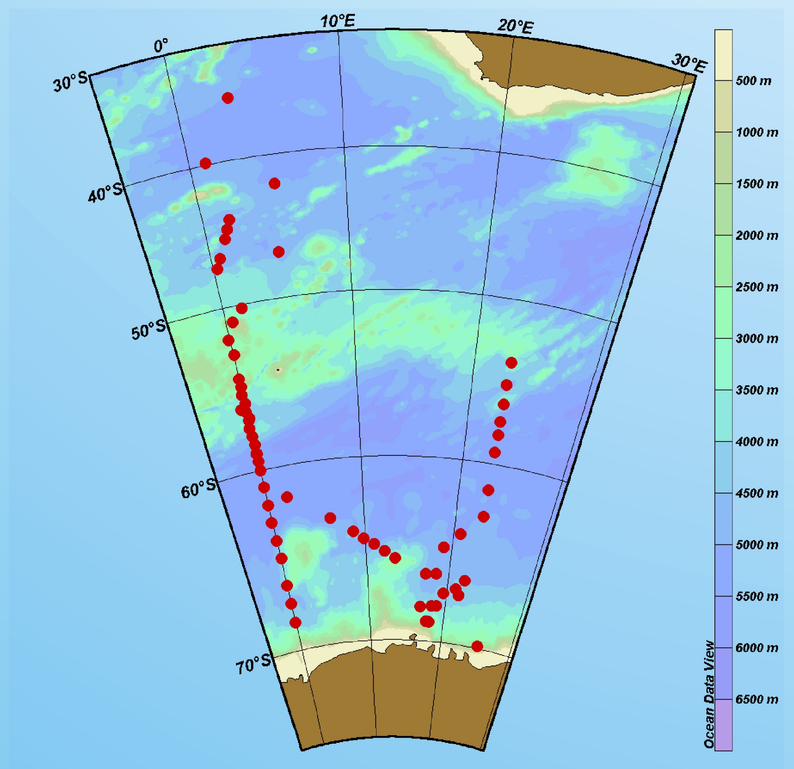

Fig. 3: Map of 65 sites surface sediment samples were considered from in this study

3 Results

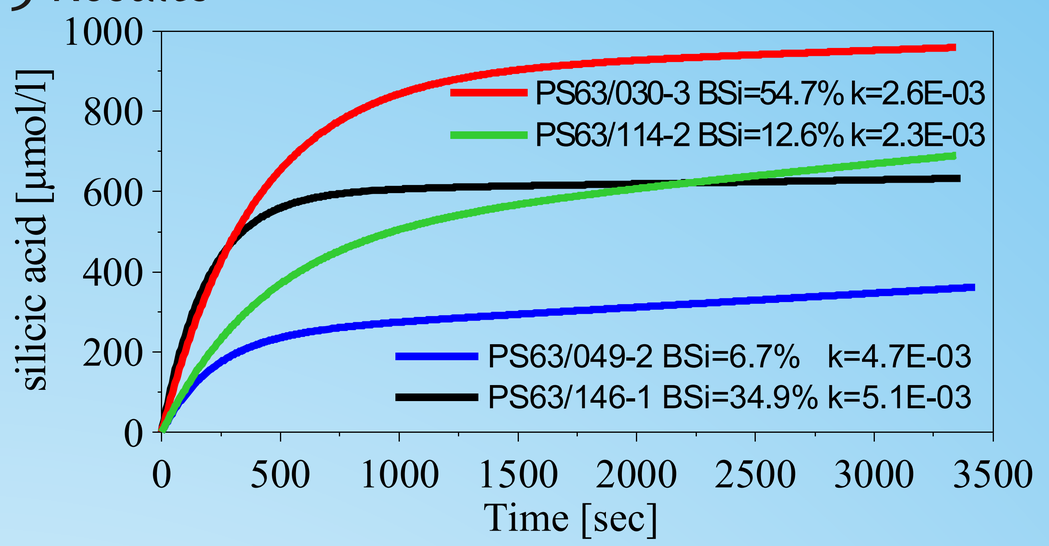

Fig. 4: Four selected fitted leaching curves, with different opal content and reactivety index

Comparing the opal content and the reactivity index spatial differences exists. Regions with high opal content and low reactivety can be found as well as regions with high opal content and medium reactivety. This is for example seen under the circum polar current. A region with low opal content and high reactivity is south of the ACC on 0° longitude.

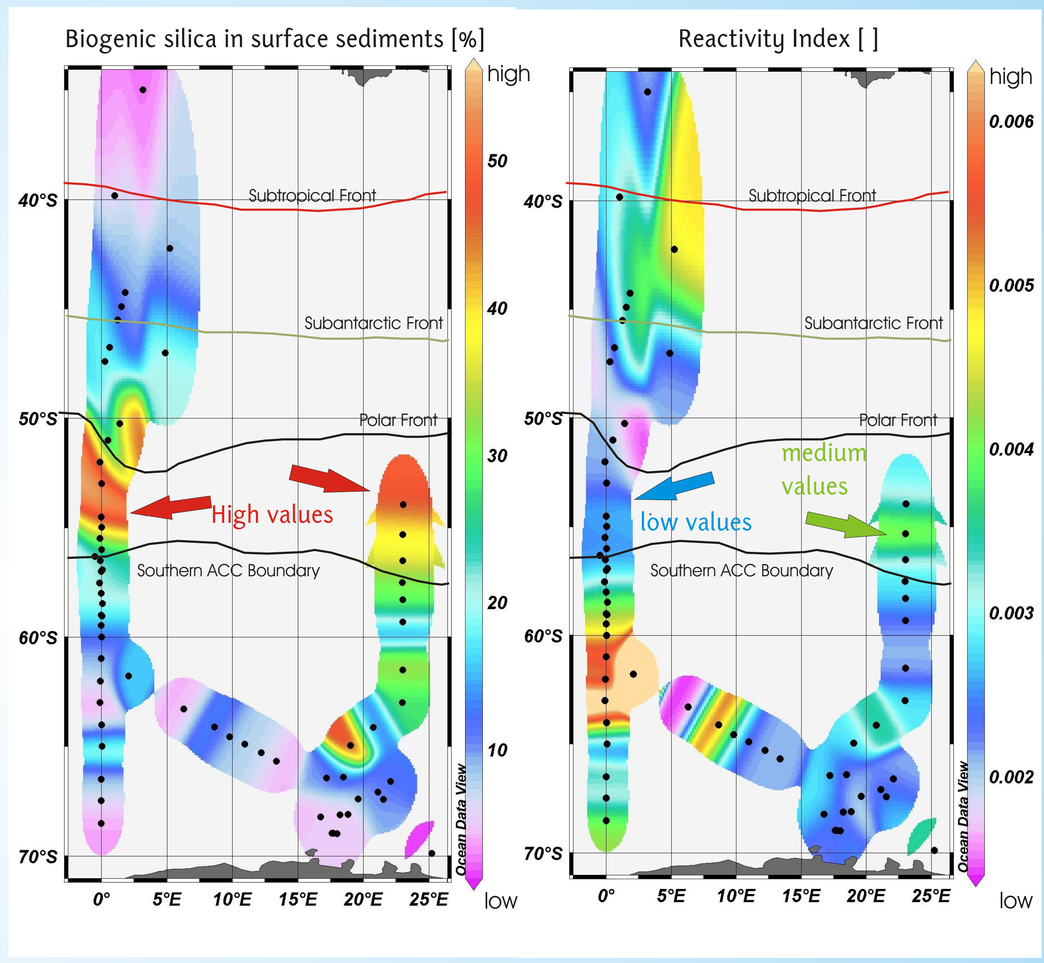

Fig. 5: Maps of Bsi content and reactivety index in surface sediments in a sector of South Atlantic

4 Work in progress and future work

To get detailed information on kinetics and solubility of biogenic silica, continuously stirred flow-through experiments are in progress. Use of flow through reactors allow quantification of dissolution rates and saturation concentrations under well defined conditions. Dissolution rates of sediment samples in stirred flow-through reactors were measured as a function of the degree of undersaturation by varying the silica acid concentrations or the flow rate of the inflow solution. By taking samples out of the reactors during the experiments we also get information about changes in species composition and how the shell structures dissolve.

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).

References:

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