Biogeosciences Discuss., 11, C1144–C1146, 2014
www.biogeosciences-discuss.net/11/C1144/2014/

Biogeosciences
Discussions
Open Access

Interactive comment on "Silica cycling in the ultra-oligotrophic Eastern Mediterranean Sea" *by* M. D. Krom et al.

Anonymous Referee #1

Received and published: 17 April 2014

The eastern Mediterranean Sea (EMS) is one of the most oligotrophic parts of the ocean due to small nutrient inflows and almost complete export of nutrients with outflowing intermediate waters. This has been explored for macro-nutrients N and P and their recently published budgets may be considered closed. A seeming imbalance exists in the silica budget, an important nutrient for diatoms, because the current best outflow estimates (Ribera d'Alcala, M., Civitarese, G., Conversano, F., Lavezza, R., 2003. Nutrient ratios and fluxes hint at overlooked processes in the Mediterranean Sea. Journal of Geophysical Research 108, 1-16) are much higher than best estimates of inputs. A further incentive to study the silica budget, and a hint towards a possible explanation for the imbalance is the fact that existing data (e.g., in the MedAtlas data set, or in the papers by the co-author N. Kress) suggest an increase in the silicic acid concentrations along the flow path of Mediterranean Deep water towards

the Levantine Basin.

The present paper by Krom and colleagues attempts to reconcile the discrepancies by not only re-examining the dissolved silicic acid budgets, but also taking particulate biogenic silica (BSi) fluxes into account. This is done by collating published and unpublished data, making reasonable assumptions, or extrapolating from global relationships between BSi and dissolved Si transports in rivers. They thus calculate a new budget of inflows and outflows across the sill at Sicily for winter and summer seasons and for river inputs, and add estimates for contributions from groundwater discharge and dissolution of silicates (or BSi) in dust reaching the EMS. Novel and, as it turns out, quantitatively significant is their estimate of silicic acid reflux from pelagic sediments, for which the authors use previously unpublished pore water data (that date back some 40 years). In the present manuscript, this source is attributed to dissolution of aluminosilicates in the pelagic sediment, and that interpretation certainly is a viable, but not the only, option.

The estimate for a significant contribution of silicic acid fluxing out of sediments is based on pore water profiles from 3(4) locations in the eastern basin. (Note that the coordinates given in table 1 place core 10 on the island of Crete; in the text it is in the Cretan Basin north of Crete, where volcanic ash is a significant sedimentary component. Although it is not included in the estimate of sediment efflux, the fact that the fluxes here are highest may mean that indeed ash is the source; see below). Two cores (6 and 7) are in the Ionian Basin, where the increase in bottom-water silicate is not obvious from the profiles of silicic acid in Fig. 2. Core 8 is on the Mediterranean Ridge at 2700 m water depth and probably not in the flow path of deep water. Because none of the locations is ideally placed to estimate the full magnitude of the sediment flux contribution, for example in the massive pile of fine-grained and clay-rich sediments of the Nile cone, the 57 gigamol Si/a calculated for this source is probably at the very low end. A second (speculative) option alluded to in the text (paragraph 4.2.2.) is dissolution of (fossil) biogenic silica, which may have originated from diatom blooms reported

to have occurred at pre-Aswan times in the Nile plume. A third option (not discussed) is dissolution of volcanic ash. The authors argue that the different dissolution rates of the lithogenic and biogenic carriers would be mirrored in different diffusion profiles, but a contribution by ash dissolution can probably not be separated from clay mineral diagenesis. I suggest that this option is at least discussed, and that in the outlook, the improvement of the sediment contribution to the budget is more prominently placed. This is probably where the largest uncertainty is. I also wonder if Al-concentrations have been measured in the pore waters? This would probably indicate whether SA origin is from diatoms or silicates. The paper is well written, arguments are clearly presented, figures are clear and of good quality, and tables contain relevant and necessary information. Once published, the paper will certainly be of interest to a wide readership and will be a benchmark contribution in the literature on the unusual ecosystem of the Mediterranean Sea.

Interactive comment on Biogeosciences Discuss., 11, 4301, 2014.