

CIESM Congress Session : Large scale biogeochemical cycles

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Moderator's Synthesis

For some (e.g. microbiologists), **Large-Scale** means ~mms, whereas for others (geologists) it may mean 1000's of kms. Similarly large differences occur for defining **Biogeochemical Cycles**, partly predestined by disciplinary visions. A very general definition is: *a biogeochemical cycle is a pathway by which a chemical substance moves through both biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) components of Earth.* The C-cycle is often cited these days, and in relation to climate (past-present-future).

Biogeochemical processes are general, global and are directly related to environmental conditions. The latter are variable not only regionally, but also on short/long timescales; thus to understand such processes we need to study these under the largest possible range of environmental conditions. To understand biogeochemical process and cycles in the Mediterranean, we should not limit our exploration to this area alone, but need to explore also other areas. It was great to have at this CIESM congress in Kiel also contributions from Baltic (and Atlantic)! The Baltic, Black and Mediterranean seas have in common their semi-enclosed setting. In an ESF White paper it is stated that

“..some of the ocean sub-basins, ranking among the most vulnerable on Earth, are within the European realm: the Baltic, Mediterranean and Black Sea...” All of them have suffered or still suffer from anoxic deep-water conditions, to various degrees. These three basins also represent a large range in environmental factors such as salinity, temperature, oxygenation, deep-water residence time, excess evaporation,...

Although in this committee, we are in the biogeochemical community, clearly for such large-scale processes we need to know about large-scale physical/hydrological processes and of partly related climate conditions in particular run-off => these are of direct and dominating influence on nutrients and oxygen distribution and availability. This is directly evident when looking into the past. Thus the (eastern) Mediterranean is presently oxic but its deepwater has been repetitively anoxic for extended periods of time, the most recent period was 6-10 kyr BP. At that time, it was the largest anoxic basin on Earth; therefore for some aspects, the present Black Sea can be considered as a recent analogue.

It is not only the evidence of past anoxic conditions that is relevant, but even more so, the rate at which these seem to have been established (probably within a few decades). The latter may be due to self-enforcing processes => deep-water stagnation -> enhanced deep-water/sediment regeneration and subsequent phosphate-supply to surface mixed layer -> enhanced primary productivity -> enhanced Corg fluxes to deep basin -> enhanced O₂-depletion -> more enhanced phosphate-flux to surface mixed layer....->

Any environmental change will have impact on the delicate balances for the Baltic, Black Sea and Mediterranean seas, that are highly sensitive to even subtle changes. Such impact will thus have a major effect on biogeochemical processes, biological diversity and human use of these seas, including fisheries and recreation.

Several aspects of biogeochemical cycles related processes were briefly outlined by the speakers, whereas other relevant topics were not fully touched. Following these talks there was a vivid discussion where young and senior scientists participated; fortunately there was no subsequent session, allowing discussions to continue well beyond the sessions deadline.

- Why is there more/less pp; more/less preservation;
- Is Dust contributing to pp or is it removing nutrients from surface waters (ads.).. (!?)

Different dust sources/composition/... ?? =>

- Are rivers contributing to basin-wide pp (or only near-source ?!) (some interesting pictures by S. Salon, contribution.. but also on basin-wide nutrient availability and gradients)
- Is seasonal contrast important for biogeochemical cycles ? (and their preservation)
- (interesting contributions from G. Cossarini -> impact for global C-uptake; M. Giani for N. Adriatic Carbonate-system)
- Is the Mediterranean pp limited by NO₃ or PO₄, or Dissolved organic matter (DOM) (e.g. C. Santinelli-session-17) ..?? (or..?)

Is circulation/ventilation constant/variable// how to detect..? (interesting approach by M. Ayache: first talk, given by T. Arsouze)

