The nitrogen cycle of Lake Kinneret (Sea of Galilee) – The possible role of "marine snow"

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This study focuses on the nitrogen cycle in Lake Kinneret (LK). Temporal variations of the nitrogen species nitrate (NO_3^-), nitrite (NO_2^-), ammonium (NH_4^+) and dissolved oxygen (DO) in the water column of LK were studied to quantify the nitrogen cycle of the lake. LK's hypolimnion inventories of DO and the nitrogen species (Fig. 1) show substantial consumption of DO at the onset of stratification (March-April) with no significant change in the nitrogen species. This phenomenon is in contrast to the expected negative correlation between oxygenic respiration (DO decrease) and remineralization of organic matter (increase in oxidized nitrogen species). In order to explain this apparent paradox, we propose that oxidation of the organic matter occurs in two consecutive steps: 1) Remineralization of the organic nitrogen to nitrate; and 2) Denitrification of the product (nitrate) to N_2. This explanation leaves an open question which is why and how denitrification, which uses the increasing oxidized nitrogen, operates in oxidizing hypolimnion? We explain this apparent paradox by low oxygen microenvironments provided by "marine snow" sinking through the water column of LK. According to this mechanism, the existence of chemical microhabitats around macroscopic particles permits local processes requiring low oxygen, including denitrification. In mid-April, water column DO decreases below ~5 mg/L driving marked denitrification dramatic decrease in nitrate and DO and increase in NH_3, reaching anoxic conditions in the beginning of May.

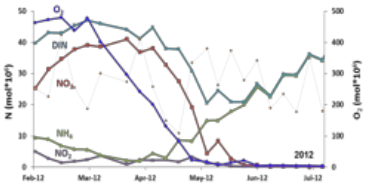

Figure 1: Temporal variations of hypolimnetic inventories amounts of oxygen and nitrogen species in Lake Kinneret during 2012.