What to do with extra electrons – how combating eutrophication may affect mineralization pathways

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Life on earth is based on redox-reactions *i.e.* transport of electrons in versatile metabolic reactions. In microbial metabolism organic carbon – serving the energy source for heterotrophic life – is the electron donor, whereas oxygen, nitrate, manganese and iron oxides and sulphate act as external electron acceptors. Eutrophication increases the amount of organic matter and its mineralization increases the flow of electrons to inorganic counterparts *i.e.* electron acceptors. As to the consequences of eutrophication, it is not insignificant where the electrons flow *i.e.* by which pathway organic carbon is mineralized in aquatic systems.

The pathway of electrons is dependent on the quantity and quality of organic matter as well as on the quantity and availability of electron acceptors present in specific system. Mineralization through oxygen can be considered favorable. However, in eutrophic aquatic systems the consumption of oxygen easily exceeds its transport to deep water layers giving rise to anoxic mineralization processes some of which can be considered favorable, too. For example nitrate reduction *i.e.* denitrification leads to formation of N_2. However, unfavorable processes may also emerge: iron reduction leads to release of both Fe and Fe-bound P and sulphate reduction forms toxic H_2S gas capable to reduce efficiently Fe oxides leading to blocking of Fe cycling. Methane formation, in turn, increases its release to atmosphere.

Considering eutrophication control remedies, there is also a need to assess the effects of measures on the fluxes of electron acceptors to understand the consequences of the measures. Some of the measures may affect the flux of electron acceptors, which may have an adverse or positive impact on the mineralization processes in recipient system. In this paper the above mechanisms are demonstrated against a set of current water protection measures, such as artificial oxygenation and erosion control.