THEME 4:
The Earth's Surface

Session 4:1
Ocean water and its interactions with sediments and atmosphere

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This session welcomes contributions on the thermodynamics, kinetics, and biogeochemistry of marine systems and processes. Topics may include, but are not limited to: dissolution and precipitation of minerals, mineral-water interface processes, (organic) complexation of trace elements, (stable) isotope biogeochemistry, early diagenesis, biogeochemical cycling of carbon, nitrogen, phosphorus, silica, iron, etc. This session welcomes contributions on the oceanic interior and internal cycling processes, as well as studies on fluxes across and processes within oceanic boundaries. The latter may include shelf and ocean margin systems, marine sediments and marine atmospheric boundary layer. Contributions reporting results from laboratory experimentation, field observations, field experimentation, as well as modelling approaches are encouraged. We invite in particular contributions relevant to further understanding of marine carbon cycling.

4.1.11

Assessment of methane emission from bubble plumes in the Black Sea by noble gases

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Although methane is a major control of atmospheric greenhouse the origin and the quantification of the natural CH_4 input to the atmosphere is still under discussion. The Black Sea is known to emit large quantities of methane. Some of the high-intensity gas seeps produce bubble plumes that inject CH_4 directly to the atmosphere.

Analysis of dissolved noble gases - in contrast to standard oceanographic measures - does not only allow to trace plume activity but it also potentially yields quantitative information on the emitted gas volume.

Dissolved atmospheric noble gas concentrations in the deep water of lakes and oceans are expected to be in equilibrium with the physical conditions of the water because the noble gas abundances are preset during equilibrium gas partitioning at the air / water interface. As noble gases are geo-chemically inert any observed deviation from equilibrium has therefore to be interpreted in terms of physical processes being able to fractionate (noble) gases. Formation of gas bubbles will force a secondary (noble) gas re-partitioning between the ascending gas phase and the surrounding water. Therefore injection of (pure) methane from the sediment into the open water will strip noble gases and will cause the open waters to be depleted in noble gases.

In vicinity of high intensity CH_4 plumes deep waters of Black Sea are observed to be characteristically depleted in dissolved noble gases. The depletion systematically increases with decreasing atomic mass. The resulting fractionation pattern is indicative for noble gases degassing from the water into the bubbles of the moving gas phase. The depletion is only present in the depth range of the gas plumes. Above the top of the plumes noble gases concentrations approach the unfractionated background values.