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On-site isotopic analysis of dissolved inorganic carbon using an isotope ratio infrared spectrometer

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An Isotope Ratio Infrared Spectrometer (IRIS) has been adapted to perform measurements of δ13C of dissolved inorganic carbon (DIC) in marine pore waters. The resulting prototype allowed highly automated analysis of δ13C isotopic ratios and CO_2 concentration. We achieved a throughput of up to 70 samples per day with DIC contents as low as 1.7 μmol C. We achieved an internal precision of 0.066 ‰ and an external precision of 0.16 ‰ which is comparable to values given for Isotope Ratio Mass Spectrometers (IRMS).
The prototype instrument is field deployable, suitable for shipboard analysis of deep sea core pore waters. However, the validation of the prototype was centered around a field campaign in Eckernförde Bay, NW- Baltic Sea. As a proof of concept, a shallow site within an area of submarine groundwater discharge (SGD) and a site outside this area was investigated. We present profiles of δ13C of DIC over 50 cm exhibiting well understood methane turnover processes (anaerobic oxidation of methane).
At the lowest point below the seafloor, microbial reduction of CO_2 to CH4 dominates. $12CO_2$ is reduced preferentially over $13CO_2$, leading to more positive δ13C values in the remaining DIC pool; in layers closer to the surface, the oxidation of CH4 to CO_2 becomes more prominent. Since the CH4 pool is enriched in 12C a shift to more negative δ13C can be observed in the DIC pool. In the upper 15 cm, the pore water DIC mixes with the sea water DIC, increasing δ13C again.
Finally, we will present recent developments to further improve performance and future plans for deployments on research cruises.