Tracing changes in the East Asian Monsoon using the Mg isotope record in a loess-paleosol sequence from Luochuan, China

JOSH WIMPENNY[1], QING-ZHU YIN[1]*, DARREN TOLLSTRUP[1], LIE-WEN XIE[2] AND JIMIN SUN[2]

[1]Department of Geology, University of California, Davis, CA
[2]Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

We present Mg isotope data from a loess-paleosol sequence from Luochuan in the central Chinese Loess Plateau. The alternating loess-paleosol layers result from changes in climate and weathering intensity; loess layers representing cooler, drier periods when the winter monsoon was strong, while paleosol layers form during warmer, wetter periods with a stronger summer monsoon. Bulk δ^{26}Mg analyses show that both loess and paleosol layers are enriched in the light isotopes of Mg relative to the bulk continental crust. On average, loess layers contain lighter δ^{26}Mg values than the paleosol, with average values of -0.57‰ ± 0.19 (2σ), and -0.37‰ ± 0.18 (2σ) respectively. These light δ^{26}Mg values are a direct result of high amounts of carbonate in the sediment layers (up to ~15%) and the fact that carbonate is enriched in light Mg relative to silicates. The higher chemical weathering intensity subjected to the paleosol layers means more carbonate has been leached away, hence the remaining sediment is isotopically heavier than the loess layers where more carbonate remains. The high amplitude changes in δ^{26}Mg related to alternating loess-paleosol layers at Luochuan closely match changes in other weathering tracers including magnetic susceptibility, grain size and Na/Ca ratios. This suggests that all of these proxies are controlled by the same process, i.e. changing climate related to changes in northern hemisphere circulation. In addition, our δ^{26}Mg analyses also record a longer term change in chemical weathering, manifested as a shift to more positive δ^{26}Mg values ~500 to 900Ka. This coincides with the approximate timing of a strengthening in the summer monsoon and a reduction in the seasonality of precipitation. Thus, Mg isotopes record weathering changes on two different timescales in Chinese loess, that have implications for our understanding of how the East Asian Monsoon may have behaved over the last 2.6Ma. We suggest that the sensitivity of Mg isotopes to the presence of carbonate, and to the formation of secondary silicates makes the Mg system a powerful tool that can be used to enhance our understanding of past weathering processes.

Carbon isotopes in DIC trace benthic and pelagic processes in tidal areas of the North Sea

VERA WINDE[1], PETER ESCHER[1], NICOLE KOWALSKI[1], OLAF DELLWIG[1], BERND SCHNEIDER[1], MATTHIAS SCHULTZ[1], PHILLIP BÖNING[2], JUSTUS E.E. VAN BEUSEKOM[3], GERD LIEBEZEIT[2] AND MICHAEL E. BÖTTCHER[1]*

[1]Leibniz IOW, D-18119 Warnemünde, Germany. (*michael.boettcher@io-warnemuende.de)
[2]ICBM, CvO University of Oldenburg, D-26382 Wilhelmshaven/ D-26111 Oldenburg, Germany
[3]AWI Wadden Sea Station Sylt, D-25992 List, Germany

We investigate the spatial gradients and temporal dynamics of the dissolved inorganic carbonate system in tidal areas of the North Sea. We aim for an understanding of the impact of benthic processes on the production of alkalinity and its subsequent export to the open North Sea, as well as the role of benthic processes, e.g. the interaction (destruction, formation) of surface pore waters with sedimentary calcium carbonate. These processes in turn have the potential to modify the pore water and the bottom water composition that exchanges with the shallow North Sea. The benthic and pelagic processes may change in the future as the North Sea is facing increasing atmospheric CO_2 pressures, and decreasing pH and changes in nutrient inventories are expected.

Water column and pore water samples were taken at different seasons, during tidal cycles and on transects through different tidal basins of the German Wadden Sea (Jade Bay, Sylt, Spiekeroog) for measurements of alkalinity, DIC, pH, salinity, temperature, δ^{13}C(DIC), besides major and trace elements. The carbonate system demonstrates significant tidal, and spatial, as well as seasonal variations in the water column. Such variabilities reflect mixing processes with freshwater via coastal tributaries and the influence of benthic and pelagic (e.g. primary production) processes, changing with season. Results from the East-Frisian Wadden Sea are compared to measurements in the North-Frisian Wadden Sea system. Locally, pore waters in sandy sediment, influenced by upward methane fluxes and AOM, reveal steep physico-chemical gradients. Low-tide drainage of anoxic pore waters leads to the liberation of ^{12}C-enriched DIC, TA, nutrients and (H_2S, CH_4).

Field data will be integrated in a modelling environment of the North Sea carbonate system. Research is supported by BMBF within the BIOACID project, IOW, AWI, and ICBM.