The AMOC during Pleistocene interglacials: Clues from foraminifer isotope records at IODP Sites 1305 and 1302/03 (Labrador Sea)

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Cores raised during IODP Expedition 303 off southern Greenland (Eirik Ridge site 1305) and off the Labrador Coast (Orphan Knoll site 1302/1303) yielded plantic vs benthic foraminiferal isotope records, respectively for the 'inner' and 'outer' basins of the Labrador Sea (LS), which provide information on the Atlantic Meridional Overturning Circulation (AMOC), notably with regard to the intensity of the Western Boundary Under Current (WBUC), which is tightly controlled by the production of Denmark Strait Overflow Water (DSOW), and the production of Labrador Sea Water (LSW), in the inner basin, through winter cooling and convection. The upper 184 m of sediment at Eirik Ridge spans marine isotope stages (MIS) 32 to 1. At this site, two distinct regimes are observed: prior to 800 ka, the isotopic record resembles that of the open North Atlantic records of the interval, whereas a more site-specific pattern is observed afterwards. This later pattern was characterized by i) high DSOW production rates during interglacial stages, as indicated by sedimentation rates, ii) large amplitude $\delta^{18}O$-shifts from glacial stages to interglacial stages (>2.5‰) and iii) an overall range of $\delta^{18}O$-values significantly more positive than before. At Orphan Knoll, the 105 m record spans approximately 800 ka and provides direct information on linkages between the NE-sector of the Laurentide Ice Sheet and the North Atlantic. At this site, a shift towards larger amplitude glacial/interglacial ranges of $\delta^{18}O$-values occurred after MIS 13, although isotopic records bear a typical North Atlantic signature, particularly during MIS 5, in contradiction to those of Eirik Ridge, where substages 5a to 5c are barely recognized. Closer examination of $\delta^{18}O$-records in planktic and benthic foraminifera demonstrate the presence of distinct deep-water masses in the inner vs outer LS basins during MIS 11 and more particularly MIS 5e. Data confirm that the modern AMOC, with LSW formation, seems mostly exclusive to the present interglacial, and also suggest some specificity of each interglacial with respect to the production rate of DSOW.

Geochemical variations in German Buntsandstein and Rotliegend sandstones – The main CO_2 reservoir rocks in Germany

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Due to their geological and industrial capability and proposed high volume storage capacity for injected CO_2, Buntsandstein saline aquifers and depleted natural gas reservoirs of Rotliegend are main targets for CCS research in Germany.

We investigated by geochemical and mineralogical means original red bed sandstones and their bleached modifications of Buntsandstein and Rotliegend deposits from a well site in central Germany. Aim of this study was to examine the effect of assumed participation of CO_2-bearing fluids in the bleaching-/alteration reactions and to verify differences in element content in red bed and bleached rock types.

The involvement of CO_2-bearing fluids in bleaching reactions is indicated by e.g. the occurrence of later diagenetic carbonate minerals, the (partial) dissolution of feldspars and alteration phenomena of lithoclasts.

Major and trace element (including REEs) analysis reveals strong variations between Buntsandstein and Rotliegend rocks. In the red and bleached Buntsandstein sandstones element content is almost similar, but differences are well pronounced in Rotliegend rocks. In Rotliegend all elements are (strongly) depleted in the bleached rocks, except for carbonate forming elements (Ca, Sr, Ba, Mn).

We propose, that these differences in element mobilization in Buntsandstein and Rotliegend rocks were coupled with bleaching reactions and are due to (a) the high rock maturity/low content of potentially reactive mineral phases in Buntsandstein, contrary to Rotliegend sandstones, which contain high amounts of these labile components and (b) the more pronounced impact of a proposed magmatic, hydrothermal system on Rotliegend sediments.