Rare earth element cycling in oxic pore waters from the Northeast Atlantic (MSM96): benthic fluxes and implications for the use of Nd isotopes as a past water mass proxy

S. Paul[1], M. Gutjahr[1], A. Xu[1], N. Fröhberg[2], E. Hathorne[1], F. Scholz[1,3], M. Frank[1], T. Schoening[1]

[1]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany | [2]Constructor University Bremen, Bremen, Germany | [3]University of Hamburg, Hamburg, Germany

INTRODUCTION

- Neodymium (Nd) isotopic signatures (εNd) have been widely used as a proxy to reconstruct past water mass mixing and ocean circulation
- These signatures are extracted from sedimentary archives

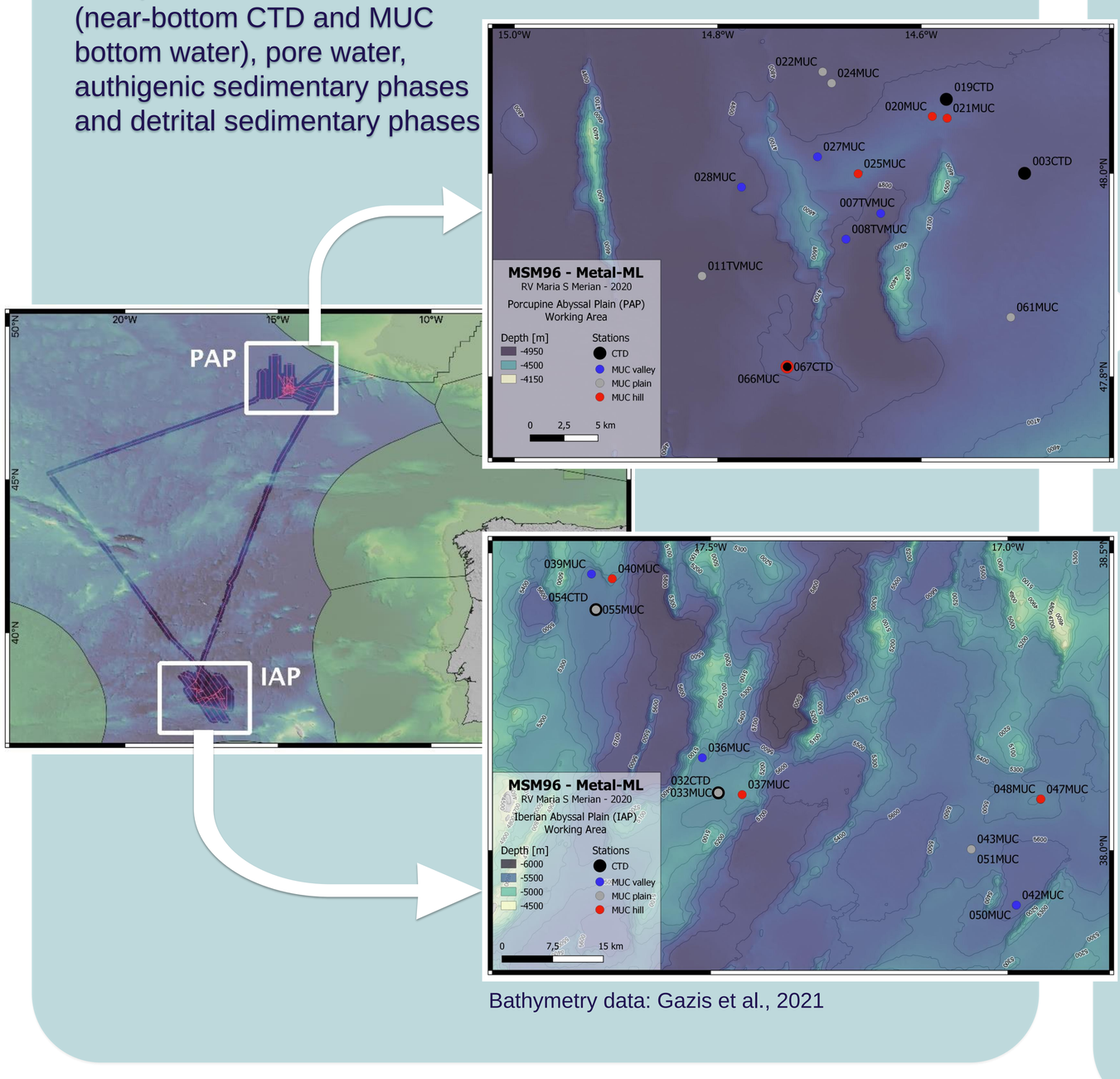
➢ **Which archives can be reliably used?**

➢ **In which settings are primary signatures likely overprinted?**

- Pore waters of marine sediments are *the* key environment in which early diagenetic exchange processes between seawater-derived Nd and terrigenous solid phases take place

WORK AREA and SAMPLING

- Porcupine Abyssal Plain (PAP) and Iberian Abyssal Plain (IAP)
- Surface sediments (ca. 25 cm) sampled with a multiple corer were studied
- Pore water was extracted using centrifugation
- For Nd isotope analyses, 3-6 MUC liners were pooled
- Comparison of seawater (near-bottom CTD and MUC bottom water), pore water, authigenic sedimentary phases and detrital sedimentary phases

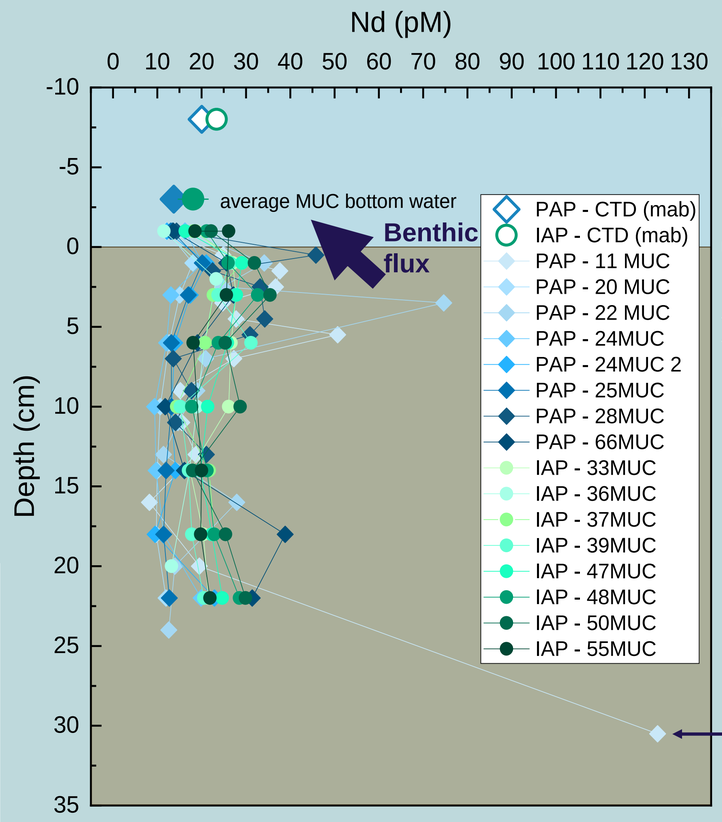


Bathymetry data: Gazis et al., 2021

SETTING

- oxic sediments
- dissolved Mn and Fe in seawater conc. range (low nM) → no reductive dissolution of Mn oxides and Fe oxyhydroxides
- TOC 0.3-0.4 wt.%
- $CaCO_3$ ca. 50-80 wt.%

RESULTS: BENTHIC FLUX

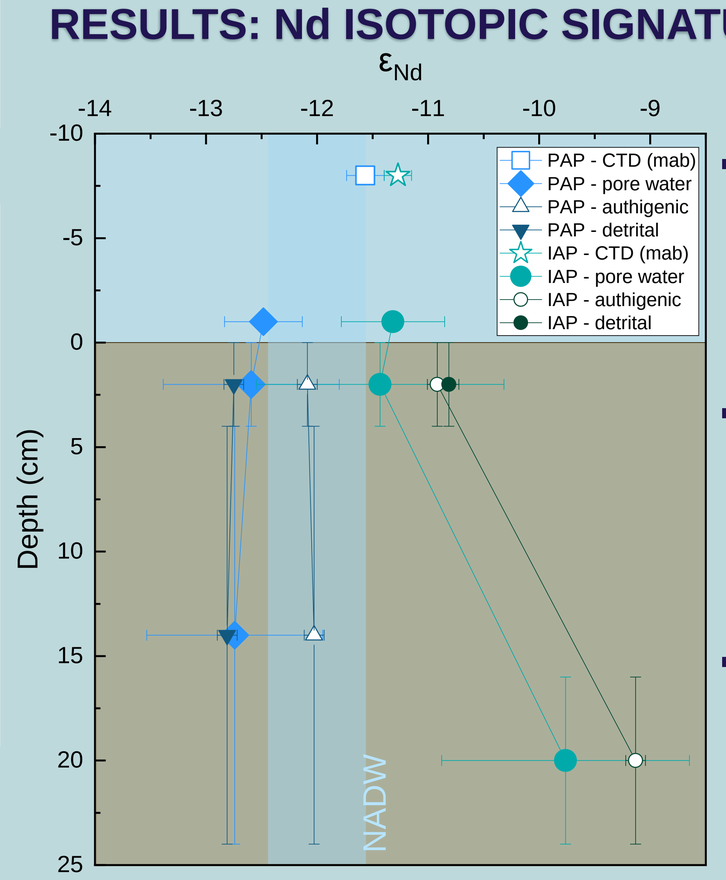


- PAP: -0.9 pmol cm^{-2} yr^{-1} Nd in the PAP (n=10 cores)
- IAP: -0.6 pmol cm^{-2} yr^{-1} Nd (n=9 cores)

➢ Considerably lower compared to ocean margin sites: e.g., -13 pmol cm^{-2} yr^{-1} (Abbott et al., 2015)

Also Mn increase at this depth!

RESULTS: Nd ISOTOPIC SIGNATURES



- Seawater, pore water, authigenic and detrital solid phases are more radiogenic at the IAP than PAP
- The detrital phase is more unradiogenic at PAP than the authigenic phase → impact on pore water?
- No clear difference between near-bottom seawater, pore water and authigenic phases

CONCLUSIONS

➢ Small but widespread benthic fluxes of REE at PAP and IAP

➢ εNd of the pore water is within error of the near-bottom seawater and also of authigenic and detrital solid phases

➢ The small benthic fluxes suggest little Nd input into bottom seawater, making alteration of seawater prior to archiving in the sedimentary record unlikely

REFERENCES

- Abbott A N, Haley B A, McManus J and Reimers C E, The sedimentary flux of dissolved rare earth elements to the ocean. Geochimica et Cosmochimica Acta 2015, 154, 186–200.
- Gazis, I.-Z., Mohrmann, J., Schoening T., and Wölfl, A.-C. 2021. Multibeam bathymetry processed data (Kongsberg EM 122 working area dataset) of RV MARIA S. MERIAN during cruise MSM96. PANGAEA, https://doi.org/10.1594/PANGAEA.930063.

ACKNOWLEDGEMENTS

We thank the DFG for funding cruise MSM96 (cruise proposal GPF 20-3_88, Metal-ML) and the sceintific party and crew of MSM96 for excellent help during sampling.