Spatial and temporal variations of sedimentary $^{231}Pa/^{230}Th$ in the equatorial Atlantic

H. C. NG[1]*, L. F. ROBINSON[1], J. F. MCMANUS[2], K. J. MOHAMED FALCON[3], A. W. JACOBEL[2] AND L. G. HENRY[2]

[1]School of Earth Sciences, University of Bristol, Bristol, UK (*correspondance: hn9381@bristol.ac.uk; Laura.Robinson@bristol.ac.uk)

[2]Department of Earth and Environmental Science, Lamont-Doherty Earth Observatory and Columbia University, Palisades, NY, USA (jmcmanus@ldeo.columbia.edu; jacobel@ldeo.columbia.edu; Lhenry@ldeo.columbia.edu)

[3]Department of Marine Geosciences, University of Vigo, Vigo, Spain (kmohamed@uvigo.es)

Sedimentary $^{231}Pa/^{230}Th$ has been widely used as a proxy of circulation rate in the Atlantic Ocean, though it can be influenced by opal and particulate scavenging. This study examines the proxy's controls by analysing Pa/Th and sedimentary composition in 20 core tops organised in 5 depth transects across the 5°N-15°N latitudinal range of the Atlantic Ocean both east and west of the Mid-Atlantic Ridge. Analyses were also made in 3 sediment cores back to 25ka.

A correlation between core top Pa/Th and ^{230}Th-normalised bulk vertical mass flux of $R^2 = 0.4$ is observed below 1400m water depth. The correlation between Pa/Th and opal and bulk vertical mass fluxes measured in the 3 sediment cores is lower than in the core tops ($R^2 < 0.1$). Findings above indicate that particulate and opal scavenging are not the main controls of the observed Pa/Th variations, pointing towards circulation rate as the key player of Atlantic Pa/Th changes.

Below 1400m, core top Pa/Th are less than the production ratio (0.093) and decrease linearly with water depth. Above 1400m, the values are markedly higher, reaching well above the production ratio at the shallowest sites. These observations are consistent with export of Pa from the site by North Atlantic Deep Water and import of Pa by intermediate water masses in the Equatorial Atlantic.

Our new western basin records (2714m and 3288m) show Pa/Th changes similar to published records, with the highest values observed during Heinrich Stadial 1. However, Pa/Th measurements from the eastern basin (3426m) suggest a different circulation structure between the East and West Atlantic throughout the last deglaciation.

Findings from this study improve our understanding of the driving mechanisms behind the Atlantic Pa/Th observations and provide a synoptic basin scale view of the rate proxy dynamics both at present and the past.