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Orbitally-controlled variations of physical properties and sediment provenance in Indian-Atlantic Ocean gateway over the last 7 Ma

Jens Gruetzner (1), Francisco Jiménez-Espejo (2), Ian R. Hall (3), Leah J. LeVay (4), Gabriele Uenzelmann-Neben (1), Nambiyathodi Lathika (5), and the IODP Expedition 361 Scientists

(1) Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany (jens.gruetzner@awi.de), (2) Instituto Andaluz de Ciencias de la Tierra CSIC - Univ. de Granada, Armilla, Spain, (3) Department of Earth Sciences, Cardiff University, Cardiff Wales, United Kingdom, (4) International Ocean Discovery Program, Texas A&M University, College Station, USA, (5) Ice Core Laboratory, National Centre for Antarctic and Ocean Research (NCAOR), Head Land Sada, Vasco da Gama Goa, India

In 2016 the International Ocean Discovery Program (IODP) Expedition 361 ("SAFARI") recovered complete high-resolution Plio-/Pleistocene sediment sections at six drilling locations on the southeast African margin and at the oceanic connection between the Indian and South Atlantic Oceans. Site U1475 is located on the southern flank of the Agulhas Plateau, proximal to the entrance of North Atlantic Deep Water (NADW) to the Southern Ocean and South Indian Ocean. The site was drilled into a sediment drift in 2669 m water depth and comprises a complete carbonate rich (74 – 85%) stratigraphic section of the last ~7 Ma. The contourite deposits hold detailed information on past changes in the bottom water flow history in the Indian-Atlantic ocean gateway. Here we present results from the integration of physical properties, seismic reflection data, and major element records. The whole spliced sediment record (292 meters) of Site U1475 was measured using an X-ray fluorescence (XRF) core scanner to derive multi-centennial resolution records of major element intensities. Based on these measurements it is possible to derive biogenic (e.g. %$CaCO_3$) and siliciclastic (e.g. TiO_2, K_2O) mineral phases. Elemental log-ratios, such as Ca/Ti and K/Fe, reflect variations in biogenic ($CaCO_3$) vs. terrigenous supply and variability of the terrigenous provenance, respectively. While long-term changes in physical properties and elemental ratios can be linked to the seismic reflection patterns associated with deep water circulation changes, short-term cyclicities reflect Plio-Pleistocene climate variations at Milanlovitch-frequencies. Evolutionary spectra show that the orbital control on sediment composition was variable over time. During the last 4 Ma energy is concentrated at the 41ka band of obliquity and at lower frequencies. In contrast, the orbital precession cycle (19-23ka) is very prominent in a peculiar high sedimentation rate interval in the early Pliocene (~4 to 5 Ma) that is bounded by seismic reflectors and characterized by the development of sediment waves.