Miocene aridity and sabkha development: Southeast Indian Ocean offshore western Australia

*Cecilia M McHugh[1], Gabriel Tagliaro[2], Craig S. Fulthorpe[2], Michelle Kominz[3], Jeroen Groeneveld[4], Yuxin He[6], Hideko Takayanagi[5]

1. School of Earth and Env. Sciences, Queens College City University of New York, USA and Lamont-Doherty Earth Observatory of Columbia University, NY, USA, 2. Institute for Geophysics, John A. and Katherine G. Jackson School of Geosciences, The University of Texas at Austin, TX, USA., 3. Department of Geosciences, Western Michigan University, Kalamazoo, MI, USA, 4. Faculty of Geosciences, Bremen University, Bremen, Germany, 5. Department of Earth Science, Tohoku University, JP, 6. School of Earth Sciences, Zhejiang University, Zheijang, China

Little is known about the climatic history of Western Australia and its relationship to regional and global events. International Ocean Discovery Program (IODP) Expedition 356 “Indonesian Throughflow” drilled a latitudinal transect of sites along the modern shelf of Western Australia allowing us to better document the impact of Miocene to Recent paleoclimatic and paleoceanographic changes. We present lithologic evidence for aridity and changes in precipitation during the Middle to Late Miocene based on petrography, bulk mineralogy, biomarkers and delC-13 analyses coupled to downhole wireline logs and chronology developed from biostratigraphy.

Extreme arid conditions and sabkha facies similar to those occurring in the Red Sea today were present at northernmost Site U1464 (264 m water depth) during the Middle Miocene (~14-11.6 Ma). The sabkha to shallow subtidal facies are 100 m thick and occur within dolomitic limestone. Anhydrite nodules with chicken wire texture, gypsum nodules, dissolution features and tidal structures manifest evaporative conditions. Load casts, ball and pillow structures and parallel laminae are interpreted to represent the intertidal environment of a coastal sabkha. At least two intervals of black, organic-rich, carbonate-poor dolostones, each a few cm thick, suggest extreme evaporation and possible subaerial exposure in lagoonal settings. In addition, recent studies of multichannel seismics along the NW shelf, calibrated with ages obtained from Sites U1462, U1463 and U1464, reveal evidence for shelf exposure and extensive karstification consistent with a lowering of sea level at the end of the Middle Miocene between ~11.6 - 12 Ma. Siliciclastic deposition followed shelf exposure and further intensified in the Late Miocene.

In contrast, at southernmost Site U1459 (192 m water depth) there is evidence of fluvial discharge related to wet climatic conditions that become more pronounced from the Middle to the Late Miocene (~13-6 Ma). The section is 120 m thick and the main lithology is dolomite, but siliciclastic minerals (quartz, k-feldspar) increase up-section. Intervals of quartz sandstone and glauconite deposition are interbedded in the dolomite. These results support increased fluvial discharge.

Our results indicate that the contrasts between the extreme Miocene aridity and wet conditions documented in northern and southern Western Australia respectively were related to large-scale changes in global circulation, sea level and glaciation in Antarctica.

Keywords: Middle Miocene sabkha facies, Southeast Indian Ocean, Western Australia, Miocene paleoceanography and paleoclimate, Middle Miocene climate extreme arid and wet conditions, Miocene global circulation

