



Land - Ocean Climate Linkages and the Human Evolution – New ICDP and IODP Drilling Initiatives in the East African Rift Valley and SW Indian Ocean

R. Zahn (1), C. Feibel (2), and ICDP/IODP co-PIs (3)

(1) Institutó Catalana de Recerca i Estudis Avançats, ICREA; Universitat Autònoma de Barcelona, Institut de Ciència i Tecnologia Ambientals and Depto. de Geologia, Campus UAB, E-08193 Bellaterra (Cerdanyola), Spain; email rainer.zahn@uab.cat, (2) Department of Anthropology, Rutgers University, Douglass Campus, 131 George Street, New Brunswick, NJ 08901-1414, USA; email feibel@rci.rutgers.edu, (3) *

The past 5 Ma were marked by systematic shifts towards colder climates and concomitant reorganizations in ocean circulation and marine heat transports. Some of the changes involved plate-tectonic shifts such as the closure of the Panamanian Isthmus and restructuring of the Indonesian archipelago that affected inter-ocean communications and altered the world ocean circulation. These changes induced ocean-atmosphere feedbacks with consequences for climates globally and locally. Two new ICDP and IODP drilling initiatives target these developments from the perspectives of marine and terrestrial palaeoclimatology and the human evolution. The ICDP drilling initiative HSPDP ("Hominid Sites and Paleolakes Drilling Project"; ICDP ref. no. 10/07) targets lacustrine depocentres in Ethiopia (Hadar) and Kenya (West Turkana, Olorgesailie, Magadi) to retrieve sedimentary sequences close to the places and times where various species of hominins lived over currently available outcrop records. The records will provide a spatially resolved record of the East African environmental history in conjunction with climate variability at orbital (Milankovitch) and sub-orbital (ENSO decadal) time scales. HSPDP specifically aims at (1) compiling master chronologies for outcrops around each of the depocentres; (2) assessing which aspects of the paleoenvironmental records are a function of local origin (hydrology, hydrogeology) and which are linked with regional or larger-scale signals; (3) correlating broad-scale patterns of hominin phylogeny with the global beat of climate variability and (4) correlating regional shifts in the hominin fossil and archaeological record with more local patterns of paleoenvironmental change. Ultimately the aim is to test hypotheses that link physical and cultural adaptations in the course of the hominin evolution to local environmental change and variability. The IODP initiative SAFARI ("Southern African Climates, Agulhas Warm Water Transports and Retroflection, and Intercean Exchanges"; IODP ref. no. 702-full) aims at deciphering the late Neogene ocean history of the SW Indian Ocean. SAFARI specifically targets the Agulhas Current in the SW Indian Ocean that constitutes the strongest western boundary current in the southern hemisphere oceans. The Current transports warm and saline surface waters from the tropical Indian Ocean to the southern tip of Africa. Exchanges with the atmosphere influence eastern and southern African climates including individual weather systems such as extra-tropical cyclone formation in the region and rainfall patterns. Ocean models further suggest the "leakage" of Agulhas water around South Africa into the Atlantic potentially modulates the Atlantic meridional overturning circulation (MOC) with consequences for climate globally. The SAFARI drilling initiative aims to retrieve a suite of long drill cores along the southeast African margin and in the Indian-Atlantic ocean gateway. SAFARI will shed light on the history of Agulhas Current warm water transports along the southeast African margin during the late Neogene and its linking with ocean-climate developments. Specific objectives of SAFARI are to test (1) the sensitivity of the Agulhas Current to changing climates of the Plio/Pleistocene, including upstream forcing linked with equatorial Indian Ocean changes and Indonesian Throughflow; (2) the Current's influence on eastern and southern Africa climates, including rain fall patterns and vegetation changes; (3) buoyancy transfer to the Atlantic by Agulhas leakage around southern Africa, and (4) the contribution of variable Agulhas Leakage to shifts of the Atlantic MOC during episodes of major ocean and climate reorganizations of the past 5 Ma. These studies will provide insight into the Current's influence on eastern and southern African terrestrial climates, including its possible impact on the late Neogene evolution of large mammals including hominids.

The ICDP and IODP drilling campaigns will enable us to establish the linkages between the ocean climatology of the SW Indian and terrestrial climates of Eastern Africa during key periods of global climate change. Combining the ICDP records of East African terrestrial climate at key hominin sites with IODP records of marine climate variability at the SE African continental margin will help to test if pulses of hominin evolutionary innovation were linked with periods of enhanced variability of local terrestrial environments and marine climatology of the Indian Ocean.

* co-PIs of the ICDP initiative HSPDP are A.S. Cohen, R. Arrowsmith, A.K. Behrensmeyer, C. Feibel, R. Johnson, Z. Kubisa, D. Olago, R. Potts, R. Renaut

* co-PIs of the IODP initiative SAFARI are R. Zahn, I. Hall, R. Schneider, M. Á. Bárcena, S. Barker, A. Biastoch, Chr. Charles, J. Compton, R. Cowling, P. Diz, L. Dupont, J.-A. Flores, S. Goldstein, S. Hemming, K. Holmgren, J. Lee-Thorp, G. Knorr, C. Lear, A. Mazaad, G. Mortyn, F. Peeters, B. Preu, R. Rickaby, J. Rogers, A. Rosell-Mele, Chr. Reason, V. Spiess, M. Trauth, G. Uenzelmann-Neben, S. Weldeab, P. Ziveri