Terrigenous evidence from marine sediments for deglacial climate variability in Africa

J.M. COLE[1], P.B. DEMENOCAL[1], S.L. GOLDSTEIN[1], AND S.R. HEMMING[1]

[1] Lamont-Doherty Earth Observatory of Columbia University; jcole@ldeo.columbia.edu, peter@ldeo.columbia.edu, steveg@ldeo.columbia.edu, sidney@ldeo.columbia.edu

The arid regions of northwest Africa today provide one of the largest sources of dust to the atmosphere. As we look back in time, this region has responded in tempo to global climate changes with large shifts in dust production. Marine sediments cores are useful archives of terrestrial paleoclimate, and ODP Hole 658C situated off Mauritania has provided a wealth of information concerning African paleoclimate. For example, large changes in the proportion of marine carbonate and silicate relative to terrigenous detritus have been observed over the past 25,000 years. It is thought that these changes have resulted in large part from humid to arid shifts in terrestrial vegetation. Consequently, African Humid Periods (AHP) have been noted throughout the core by decreased terrigenous detritus, with the most recent occurring from about 14,800 to 5,500 years ago.

In an effort to better understand the sources of terrigenous input to the marine record over the last deglaciation in northwest Africa, we measured radiogenic isotopes and major and trace elements in the decarbonated fine fraction (<63μm). Our results show that Nd isotopes are unchanging through the core, with an average ε_{Nd} of about -14.5. There are small changes in Pb isotopes, but in combination with Nd isotopes, we conclude that the geological provenance of terrigenous inputs have not changed in any substantial way over the past 25,000 years.

In contrast, we observe large and abrupt changes in Sr isotopes and major and trace element concentrations. Sr isotopes are significantly less radiogenic during the AHP, compared to the more arid periods, such as the latest Holocene and the last glacial maximum (Sr and Nd values from the core top are identical to modern dust from traps). Samples from the AHP also have higher chemical indices of alteration (CIA = molar ratio of $[Al_2O_3 / (Al_2O_3 + CaO_{(sil)} + Na_2O + K_2O)] \times 100$), while samples from more arid times have compositions approaching average shale. The combined Sr isotope and elemental constraints imply a two component mixture between average shale and a newly formed clay mineral (possibly palygorskite). This newly formed phase dominates the terrigenous detritus fraction during the AHP. Our interpretation is that increased vegetation during the AHP decreased total terrigenous flux to the ocean, but clays formed in association with ephemeral lakes could be picked up during seasonal drying, and therefore dominated the terrigenous component.