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Tracing African and South American terrigenous input from the modern distribution of major elements in Atlantic surface sediments (35°N-50°S)

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Simultaneous drought in the eastern Sahel and flooding of northeastern Brazil during June 2010 illustrates the vulnerability of populations to changes in rainfall and the need for better constraints on the climatic processes controlling precipitation. Past variations in tropical rainfall can be traced by terrigenous inputs into the Atlantic, on the basis of a variety of proxies determined from the concentration and ratio of major elements in the sediments. However, the interpretation of these proxies in terms of eolian versus fluvial inputs differs from site to site.
This study aims to assess the influence of eolian and fluvial inputs on the modern distribution of major elements in Atlantic surface sediments and to identify the most useful elemental ratios with which to reconstruct changes in humidity over Africa and South America. We measured the concentrations of major elements (i.e. Al, Si, Fe, Ca, K, Ti) by energy dispersive polarization X-ray fluorescence (EDP-XRF), in ∼130 samples of surface sediment (multicore) from the Atlantic distributed between 35°N and 50°S.
Our results indicate opposite patterns in the elemental distribution of Ca and of the terrigenous elements Al, Si, Fe, K, and Ti. Fuzzy C-means analysis of the element proportions highlights three main groups: (1) a marine dominated group (characterized by a high proportion of Ca) located off Namibia and on the mid-Atlantic ridge; (2) a terrigenous dominated group (characterized by high proportions of terrigenous elements) located off Africa between 17°N and 17°S and off the mouth of the Rio de la Plata; (3) an intermediate group (moderate proportions of terrigenous elements) located off Africa to the north of 17°N and off South America to the north of 35°S. While the second group reflects fluvial inputs from regions where rainfall is particularly high and river discharge strong, the third group is not only representative of eolian inputs. Although dust dominates terrigenous input off northwestern Africa, there is no significant dust originating from Africa or Patagonia which deposits on the South American margin between 0° and 35°S. The third group hence reflects terrigenous inputs from relatively drier areas. The distinction between fluvial and eolian components is thus not obvious from the concentrations of major elements in Atlantic sediments.
The spatial distribution of elemental ratios indicates that (1) Ti/Ca and Fe/Ca are mostly related to river discharge, and (2) Al/Si and the integrated (Fe+Al+Ti)/(K+Si) ratios are the most appropriate to trace the intensity of continental precipitation around the Atlantic basin.
Our results imply a careful interpretation of elemental ratios obtained from XRF core scanners to reconstruct past changes in continental humidity, and offer a solid basis for future investigations of African and South American climate.