Reconstructing modern African and South American precipitation regimes from major element ratios of Atlantic continental margin sediments

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Résumé

The recent drought in eastern Africa illustrates the vulnerability of populations to changes in precipitation. Past variations in tropical rainfall can be traced by changes in the terrigenous input into the Atlantic, on the basis of a variety of proxies determined from major element concentrations and ratios in the sediments. The choice and climatic interpretation of proxies however differ from site to site. This study aims to assess the factors influencing the geochemical composition of Atlantic hemipelagic sediments and the potential of commonly used elemental ratios (e.g. Fe/Ca, Ti/Al, Al/Si) to reconstruct changes in terrestrial climate conditions over Africa and South America. We measured by Energy Dispersive Polarization X-ray Fluorescence the major element (i.e. Al, Si, Fe, Ca, K, Ti) concentrations of 128 Atlantic surface sediment samples (36∘N-49∘S) that are influenced by a wide variety of continental climatic regimes and oceanographic conditions. High concentrations of terrigenous elements and low Ca concentrations along the African and South American margins reflect the dominance of terrigenous input in these regions. Single element concentrations and elemental ratios including Ca (e.g. Fe/Ca) are too sensitive to dilution effects (e.g. changes in biological productivity, carbonate dissolution) to allow reliable reconstructions of terrestrial climate. Other elemental ratios however reflect the composition of terrigenous material and mirror the climatic conditions within the continental catchment areas. The Ti/Al distribution in Atlantic surface sediments supports its use as a proxy for eolian versus

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fluvial input in areas not affected by volcanic input. The spatial distribution of Al/Si reflects the relative input of kaolinite-rich material from humid regions versus slightly weathered particles from drier areas. This ratio is suitable to trace the main African and South American continental precipitation regimes in regions of low biogenic opal content. Our results will benefit paleoclimate studies based on the geochemical composition of Atlantic sediments.