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Geochemical Fingerprinting of Trans-Atlantic African Dust Based on Radiogenic Sr-Nd-Hf Isotopes and Rare Earth Element Anomalies

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Mineral dust is an important component of Earth's climate system and biogeochemical cycles on a global scale. In order to understand the relationship between climate processes in the source areas and the properties of aerosols at distant receptor sites, we must be able to identify the source provenance of dust. Here we present a multiproxy study that characterizes the temporal variability in the geochemical composition of long-range African dust (LRAD) collected between 2003 and 2011 in the trade winds on the Caribbean island of Barbados. We find systematic differences between Sr-Nd-Hf isotopic composition and rare earth element anomalies of individual dust events and evidence of seasonal shifts in dust source activity and transport. These results indicate that coherent geochemical source signatures of LRAD can be preserved even after transport across thousands of kilometers. We investigated the possibility of identifying the potential source areas through comparisons with literature data. However, these data are almost entirely based on measurements of soil and sediment samples; this could lead to biases because of soil-aerosol particle size and composition differences. Nonetheless, our data suggest that many samples are linked to sources in Mali and sub-Saharan regions. Radiogenic Nd-Hf composition of aerosols can potentially be a useful proxy to study the proximity of mineral dust sources to depositional sites. In order to establish firmer links between LRAD and dust source areas, however, we require much more data on the geochemical composition of aerosols from potential source areas in North Africa.