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Determining the source location of transatlantic dust transported to South America and the Caribbean using lead isotopes

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Aeolian dust is produced perennially across numerous potential source areas (PSAs) in North Africa. This dust is thought to alleviate nutrient limitations in receptor ecosystems, fueling net primary productivity and sequestering carbon dioxide into the biosphere. It is important to identify the source location of dust because it controls the magnitude, mineralogy, and solubility—a proxy for bioavailability—of associated nutrients such as phosphorus (P). The seasonality of dust transport to the western hemisphere is changes depending on the season, with dust being transported to Barbados in boreal summer and to South America in winter. It has been suggested that there may be a seasonality to North African dust emissions, resulting in changes in the dominate dust PSA, and associated nutrients, transported westward throughout the year. Our recent work has suggested that both Central North Africa and part of Western North Africa (near the borders of Mali, Niger, and Algeria) provide dust to the Amazon with the dominate source area controlled by the prevailing meteorology, which suggests that the dominate PSA can vary seasonally. Yet this work was only based on strontium and Neodymium (Nd) isotopes. Here, we extend this record by including three radiogenic lead (Pb) isotopes, which similar to Nd isotopes, may be a more accurate representative for distinguishing dust source provenances due to the fact that these isotopes are not affected by grain-size fractionation. We see that Pb values in samples collected at our field sites in Cayenne do not show notable overlap with limited measurements from samples from the Bodele Depression and the nearby areas. Assessing the impact of the Bodele requires a more comprehensive Pb isotope profile of samples from the Bodele region for a better comparison with receptor sites. Dust collected in Barbados between 2004-2011, in contrast, may suggest some transport from the Bodele; samples collected mostly in the spring season across two years show similarities in their Pb isotopic ratios. Overall, these results suggest that Pb isotopes can be used to distinguish the source location of dust collected in receptor sites in the Western hemisphere, provided the source areas are characterized better.