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Provenance of the Saharan winter dust plume and its response to climatic variability over the last 200 kyr

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North Africa is very likely to warm over the coming century, but there is fundamental disagreement among climate model projections over the predicted response of rainfall to that warming. Geological records of wind-blown dust accumulating in marine sediment cores in the North Atlantic Ocean provide a way to assess the response of rainfall climate in the region to past intervals of global warmth.

Dust is transported to the North Atlantic Ocean from North Africa via two routes, a summer (northern) route and a winter (southern) route. Virtually everything we have learnt so far from marine sediment cores about North African hydroclimate has come from drill sites located beneath the summer (northern) dust plume. Here we report (i) geochemical records (radiogenic isotope ($^{87}Sr/^{86}Sr$ and e_{Nd}) and XRF core scanning) from Ocean Drilling Project (ODP) Site 662 in the eastern equatorial Atlantic spanning the last 200,000 years and (ii) new $^{87}Sr/^{86}Sr$ and e_{Nd} data from North African dust sources. We redefine existing dust Preferential Source Areas (PSAs) into three geochemically distinct (Western, Central and Eastern) source regions. We show that ODP Site 662 is well-situated to study the palaeo-history of the previously under-studied African winter (southern) dust plume. We find that the primary source of terrigenous material to Site 662 throughout the past 200,000 years is palaeolake Megachad in the Central source region. This palaeolake basin is often described as the largest single dust source on Earth but comparatively little is known on geological timescales about its history. We show that its dust contribution to ODP Site 662 varies on orbital timescales, and that it reaches a minimum during insolation maxima, such as the last African Humid Period, coincident with lake high-stands. Large excursions in radiogenic isotope data reveal extreme variability in the relative strength of aeolian dust and distal riverine sources of terrigenous material, associated with hydroclimate change over the last

200 thousand years.