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Oxygen isotopic composition of micrometer-sized quartz grains in EPICA-Dome C ice core: new frontiers towards Antarctic dust source fingerprinting

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The geographic provenance of aeolian dust in East Antarctica has been classically depicted through a geochemical approach based on the comparison of the $^{87}Sr/^{86}Sr$ versus $^{143}Nd/^{144}Nd$ isotopic signature of mineral particles extracted from Antarctic ice cores to that from Potential Source Areas (PSA) samples from the Southern Hemisphere. This allowed pointing out a dominant Southern South American provenance for dust in the EPICA-Dome C and Vostok ice cores during late Quaternary glacial stages. However, the Sr-Nd isotopic fields from other potential source regions did show a partial overlap with the South American and glacial dust fields, and complementary arguments had to be invoked to infer that their possible contribution is negligible.

Here we present a new approach for dust fingerprinting based on the $^{18}O/^{16}O$ ratios of micrometer-sized quartz grains entrapped in Antarctic ice. Micrometer-sized quartz grains, having typical sizes between 1 and 2 μm, were first identified through SEM/EDX in a sample from the EPICA-Dome C ice core dating back the last glacial maximum. O-isotopic measurements on 25 single grains were performed with the NanoSIMS ion microprobe at the Max-Plank-Institute for Chemistry in Mainz. $\delta^{18}O_{SMOW}$ values are between 2 and 43 per mil; however most $\delta^{18}O_{SMOW}$ values fall within a gaussian distribution with a mean $\delta^{18}O_{SMOW}$ of 25.5 per mil and standard deviation of 2.6 per mil (1σ). Despite $\delta^{18}O_{SMOW}$ values of quartz from Aeolian

sediments deflated from PSA are very scarce, these results suggest that a significant contribution from Australian and New Zealand sources seems very unlikely at that time.

Our studies show that O-isotopic measurements on Aeolian quartz in Antarctic ice by NanoSIMS are a potentially useful tool for investigating the geographic provenance of mineral dust in Quaternary times.