Southern Africa: The Missing Piece to the Dust Provenance Puzzle of East Antarctica?

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Text S1

Details on the analytical methodology for Rare Earth Elements and isotope data

The REE, strontium, neodymium and lead isotopes sample preparation were performed in a clean room at the Université Libre de Bruxelles, following previously established procedures in Vanderstraeten et al. (2020). Briefly, samples were digested in teflon vials using a HNO3 +HF + HCl mixture. After digestion, an aliquot of the samples was analyzed for REE compositions using a Quadrupole ICP-MS Agilent 7700. The rest of each sample was chemically separated using ion-exchange column for the Sr, Nd and Pb isotopic analysis which were analysed on a Nu II Plasma (233) High Resolution-MC-ICP-MS.

REE: Quantification of REE was done based on an external calibration curve using a mix of mono-elemental standard solutions. Along with the samples, blanks, and replicates, international reference materials (BHVO-2, AGV-2, BCR-CRM723, ATD) with certified and published geochemical compositions were also measured. The REE concentrations obtained for the reference materials agreed within uncertainty (1 stdv) with those certified and published values (Jochum et al., 2016).

Lead: All Pb analyses were conducted in dry plasma mode. The ^{202}Hg beam intensity, was monitored to correct for interferences of ^{204}Hg on ^{204}Pb. Pb isotope ratios were corrected for mass fractionation by adding a Tl solution to standards and samples, normalizing to a ^{205}Tl/^{203}Tl value of 2.3885 (Weis et al. 2006). The Tl-corrected values were further adjusted to the NBS981 standard values applying the values of 36.7219 (^{208}Pb/^{204}Pb), 15.4963 (^{207}Pb/^{204}Pb) and 16.4905 (^{206}Pb/^{204}Pb) from Galer and Abouchami (1998). During the course of the study, repeated analyses of NIST SRM 981 provided average values of 36.7220, 15.4963, 16.9405 (2s, n=48), respectively for ^{208}Pb/^{204}Pb, ^{207}Pb/^{204}Pb and ^{206}Pb/^{204}Pb. These results are in line with the long-term laboratory measurement repeatability of NBS-981 values and also data reported by Weis et al. (2006).

Neodymium: Nd and the Rennes Nd calibrator solution (Chauvel and Blichert-Toft 2001) were run at ~25 ppb concentrations in 0.05% HNO_3 reaching ~2.5 V on the ^{144}Nd mass. ^{147}Sm and ^{140}Ce were monitored through every run. Neodymium isotopic compositions were corrected by internal normalization to the value of ^{146}Nd/^{144}Nd = 0.7219 (Hamilton *et al.* 1983); the correction was applied relative to its internationally accepted value (^{143}Nd/^{144}Nd = 0.511961 ± 0.000013, Chauvel and Blichert-Toft 2001). An average value of ^{143}Nd/^{144}Nd = 0.511962 ± 0.000010 (2s, n=42) was obtained for the Rennes Nd calibrator during our sessions. For convenience, Nd isotope data is reported in units of (εNd(0) =([^{143}Nd/^{144}Nd(meas.)/^{143}Nd/^{144}Nd(CHUR)] −1]*10^4), where the CHUR (Chondritic Uniform Reservoir) value is 0.512638 (Jacobsen and Wasserburg, 1980).

Strontium: Sr and Sr NBS 987 calibrator solution were performed in wet mode with an intensity of 6.0 V measured on the ^{88}Sr mass. ^{83}Kr was monitored through every run to correct for interference on ^{84}Sr and ^{86}Sr. Interference of Rb on ^{87}Sr was also monitored through measurement of ^{85}Rb. Data was corrected using an ^{87}Sr/^{86}Sr value of 0.710252 ± 0.000013 from Weis et al. (2006). ^{86}Sr/^{88}Sr = 0.1194. Repeated analyses of Sr NBS 987 yielded an average value of ^{87}Sr/^{86}Sr = 0.710246 ± 0.000025 (2s, n=45).

Text S2

Details of the CESAM simulation chamber

Samples of airborne mineral dust aerosols from the Huab bulk sediments were obtained through experiments performed in the CESAM (French acronym for Experimental Multiphasic Atmospheric Simulation Chamber) atmospheric simulation chamber, at LISA, Créteil (Wang et al., 2011). CESAM consists of a stainless-steel chamber with a volume of 4.2 m^3, with a design that allows working at levels of concentration representative of processes occurring in the natural atmospheres. The generation of airborne dust was made using a vibrating plate and a Büchner flask containing the soil sample. About 15 g of soil sample was placed in the flask and shaken for ~15 min at 100 Hz to mimic the saltation and sandblasting processes responsible for the release of mineral dust in natural conditions (Caponi et al., 2017).

Prior to each experiment, the chamber was evacuated and kept at a pressure of $3 \times 10-4$ hPa. Then, the reactor was filled with a mixture of 80 % N_2 and 20 % O_2. The dust suspension in the flask was injected into the chamber by flushing it with N_2 at 10 L min^{-1} for about 10–15 min, whilst continuously shaking the soil. The dust aerosols were left in suspension within the chamber for a time period of ~ 180 min. Dust samples were collected on polycarbonate filters (47 mm Nuclepore, Whatman, nominal pore size 0.4 µm) by extracting air from the chamber over the course of each experiment. Dust samples were recovered in acid-cleaned (HCl) 0.2 µm Teflon filters. All experiments were conducted at ambient temperature and relative humidity < 2 %. The chamber was manually cleaned between the different experiments to avoid any contamination.

Figure S1

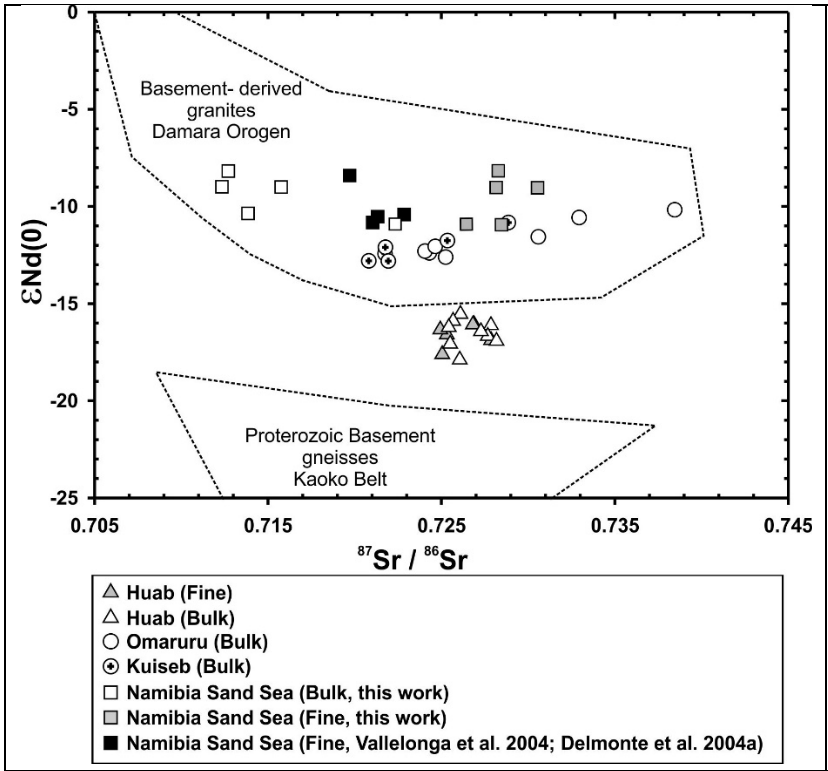

Figure S1. Relationship between $^{87}Sr/^{86}Sr$ and ƐNd(0) for surface sediments from the Southern Africa potential source areas compared with similar information for the most abundant igneous-metamorphic rocks present in the area. Rock data is from GEOROC database, http://georoc.mpch-mainz.gwdg.de.

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