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Reading dust provenance in Epica Dome C ice core (East Antarctica): high-resolution, quantitative records from a new Rare Earth Elements (REE) mixing model

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Antarctic ice cores are invaluable, direct and high-resolution archives of the past atmosphere and the evolution of Earth's climate. These unique deposits have revealed tight interplays between dust and climate in Southern Hemisphere. We developed an algorithm (complemented with Monte Carlo simulations) using a large database of REE patterns measured in sediments/soils from well-known dust Potential Source Areas (PSAs) located in the Southern Hemisphere to determine respective contributions of these sources that best fit REE patterns measured in ice cores. We applied this methodology to Epica Dome C (EDC)[1] ice core and provide the first continuous, high-resolution record of dust provenance in Antarctica through the Last Glacial-Interglacial Transition (LGIT-2.9 to 33.7kyr BP).

Our reconstructed provenance record is consistent with (i) reported isotopic signature of Antarctic dust and (ii) the climatic evolution of the various PSAs contributing to Antarctic depositions. More importantly, our results compare well with our provenance record in Epica Dronning Maud Land (EDML)[2]. Both cores show a major shift in sources between 14 and 15kyr BP when the contribution of Patagonia (main supplier of dust) fell from ~55% and ~70% to 35% and ~50% in EDC and EDML, respectively. After 14kyr BP, dust from Southern Africa (and to a less extent Australia and New Zealand) became more prevalent from ~20% and ~8% to ~35% and ~23% in EDC and EDML, respectively. Intriguingly, this compositional shift occurs later than the decline in total dust flux observed between 16-18kyr BP in EDC and EDML. We ascribe this 14-15kyr BP shift in the relative contribution of dust from Patagonia and Southern Africa to (i) long-lasting changes in the hydrology of Patagonian rivers and (ii) a sudden acceleration of sea-level rise at 14.5kyr BP that submerged vast swathes of Patagonian continental shelf, triggering a decline in the supply of Patagonian dust to Antarctica and thus, letting the South African dust contribution to emerge. Overall, our tracing method and dust provenance record in ice core offer a new proxy for the reconstruction of atmospheric paleo-circulation and paleoclimate in the Southern Hemisphere.

[1]Gabrielli *et al.* (2010), *Quatern.Sc.Rev*. 29, 1-2.
[2]Vanderstraeten *et al.,* STOTEN, accepted.