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Extending the Antarctic dust record: Geochemical and physical constraints from 4000-500 ka ice at the Allan Hills Blue Ice Area

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Mineral dust records from Antarctic ice cores offer insights into past atmospheric circulation and Earth surface conditions. Late Pleistocene records consistently show South America as the dominant dust source to Antarctica during glacial periods, while interglacial periods exhibit greater regional variability. However, data on dust provenance prior to Marine Isotope Stage 6 are sparse, and no records exist from before the Mid-Pleistocene Transition (MPT), when the periodicity of glacial-interglacial cycles shifted from 40,000 to 100,000 years. The ALHIC1901 ice core drilled at the Allan Hills Blue Ice Area (BIA) in East Antarctica provides a unique opportunity to examine older discontinuous ice ranging in age from 4000-500 ka. Here we present a discrete record of insoluble particles from ALHIC1901 for the bottom 25 m of the ice core. We investigated the particle mass concentration, size distribution, and mineralogy to assess the preservation of dust records in BIAs with complex flow histories. We measured the radiogenic strontium and neodymium (Sr-Nd) isotope compositions of the mineral dust at select depths to determine the source of material deposited at the Allan Hills BIA across the MPT. The insoluble particle concentration appears altered possibly by entrainment of basal sediment at a depth of 5 m above bedrock, where the particle sizes shift toward coarser diameters. For shallower depths less affected by subglacial input, the dust concentration record lacks the characteristic see-saw pattern expected with glacial peaks and interglacial troughs. Similarly, the Sr-Nd isotope compositions of the dust suggest time-averaged contributions from glacial and interglacial sources. Some particles also show evidence of mineral weathering and/or *in situ* production of secondary minerals, and insoluble particle concentration correlates well with non-atmospheric carbon dioxide, which could be due to processes such as microbial respiration or oxidation of carbonate minerals. These findings provide the first isotopic constraints on Antarctic dust sources preserved in ice older than 800 ka and highlight the importance of identifying signs of basal ice-rock interactions and/or postdepositional effects when interpreting the paleoclimate record preserved in ice cores from BIAs.