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Unraveling Antarctic Dust Sources: Geochemical Insights from Allan Hills Sediment Samples

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Tracing the origin of mineral dust preserved in Antarctic ice cores can provide valuable insights into past Earth surface conditions and predominant wind directions. Reconstructing shifts in large scale atmospheric circulation and ice sheet extent is vital for refining Earth System models and understanding climate dynamics. As the Earth transitions between glacial and interglacial periods, the concentration and geochemical composition of dust may shift as a byproduct of changes in sediment availability and atmospheric transport patterns. By analyzing the rare earth element concentration and radiogenic isotope compositions of ice core dust and comparing them to potential source areas, we can effectively fingerprint the source(s) of dust to Antarctica. While the potential dust sources from Southern Hemisphere land masses are relatively well-documented, there is limited information on the geochemical signature of smaller scale, local Antarctic sources.

This project establishes a signature for local material at the Allan Hills, East Antarctica, a blue ice region where more than >2 Ma old ice has been discovered [1]. Establishing a local sediment and bedrock geochemical and isotopic composition of Allan Hills material is crucial to parse out the relative contributions of local versus distal dust entrained in this ice core record. Fourteen sediment samples were collected along isolated moraines from weathered rock at the Allan Hills. Following established digestion methods, these samples were processed using ion-exchange chromatography for separation of strontium, neodymium, and lead. Additionally, rare earth element concentrations were measured. The Allan Hills sediment is characterized by the enrichment in heavy rare earth elements and depletion in light rare earth elements. Comparing the Allan Hills sediment to ice core dust spanning the transition from Marine Isotope Stage 6 to 5e (~147-120 ka, [2]), reveals distinct differences in normalized element abundances. These findings suggest that the ice core dust originated from sources other than the local material found at the Allan Hills, which is consistent with recent ice core research [2].

[1] Yan et al. (2019) *Nature* **574**, 663–666

[2] Carter et al. In review *Science Advances*.