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Key Points:
- Last interglacial dust composition in Taylor Glacier ice is distinct from MIS 1 record
- Sr and Nd isotope signatures indicate a young volcanic source
- Geochemical data suggest a change in provenance and atmospheric circulation between MIS 5e and MIS 1

Supporting Information:
- Supporting Information S1

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Dust Transport to the Taylor Glacier, Antarctica, During the Last Interglacial

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Abstract Changes in the composition of dust trapped in ice provide evidence of past atmospheric circulation and earth surface conditions. Investigations of dust provenance in Antarctic ice during glacial and interglacial periods indicate that South America is the primary dust source during both climate regimes. Here, we present results from a new ice core dust archive extracted from the Taylor Glacier in coastal East Antarctica during the deglacial transition from Marine Isotope Stage 6 to 5e. Radiogenic strontium and neodymium isotopes indicate that last interglacial dust is young and volcanic, in contrast to the observed preindustrial and Holocene (Marine Isotope Stage 1) dust composition. The dust composition differences from the last interglacial and current interglacial period at the site require a profound difference in atmospheric transport and environmental conditions. We consider several potential causes for enhanced transport of volcanic material to the site, including increased availability of volcanic material and large-scale atmospheric circulation changes.

Plain Language Summary Fluctuations in the isotopic composition of dust particles transported atmospherically and trapped in East Antarctic ice during glacial and interglacial periods provide glimpses into past earth surface conditions and atmospheric dynamics through time. Here we present new ice core records of dust from the Taylor Glacier (Antarctica), extending back to the transition into the last interglacial period (~130,000 years ago). Dust deposited at this site during the last interglacial period has a significantly more volcanic dust composition compared to the current interglacial dust, caused by a pronounced wind direction change and/or increased subaerial exposure of volcanic material. The distinct dust compositions during two separate interglacial periods suggest significant differences in conditions at the dust source areas and atmospheric dynamics to this peripheral Antarctic site.

1. Introduction

Documenting the climate of the last interglacial period is fundamental to understanding climate variations and dynamics during the current interglacial period, the Holocene (Marine Isotope Stage, MIS, 1). Comparing different interglacial periods provides an opportunity to obtain a direct and long-term perspective on Earth system feedbacks in relation to future climate change. The last interglacial period, also known as MIS 5e, arguably has been studied more than any previous interglacial period, primarily because of the abundance of existing and accessible global paleoclimate records (Andersen et al., 2004; Chen et al., 1991; Greenland Ice Core Project Members, 1993; Kukla et al., 1997; Muhs et al., 2002; Stirling et al., 1998; Yuan et al., 2004). MIS 5e experienced as warm as or perhaps warmer conditions than MIS 1 (Kukla et al., 2002)—potentially indicating the consequences of a greenhouse world, including increased storminess (Hearty et al., 2007), oceanographic reorganization (Hearty & Neumann, 2001; White et al., 1998), global ecological shifts (Kukla et al., 2002), and instability of the West Antarctic Ice Sheet (WAIS; Dutton & Lambeck, 2012; Joughin & Alley, 2011; Muhs et al., 2012). Given the warmer temperatures, sea level was at least 6 m higher than at present (Cuffey & Marshall, 2000; Dutton et al., 2015), although the stability of WAIS remains the subject of significant controversy (Holloway et al., 2016; Joughin & Alley, 2011; Mercer, 1978).

Determining the response and extent of the WAIS under increased global temperatures may provide insight into its future stability and has far-reaching implications for human populations. Sediment cores from beneath the WAIS indicate open marine conditions during the late Pleistocene, providing indirect

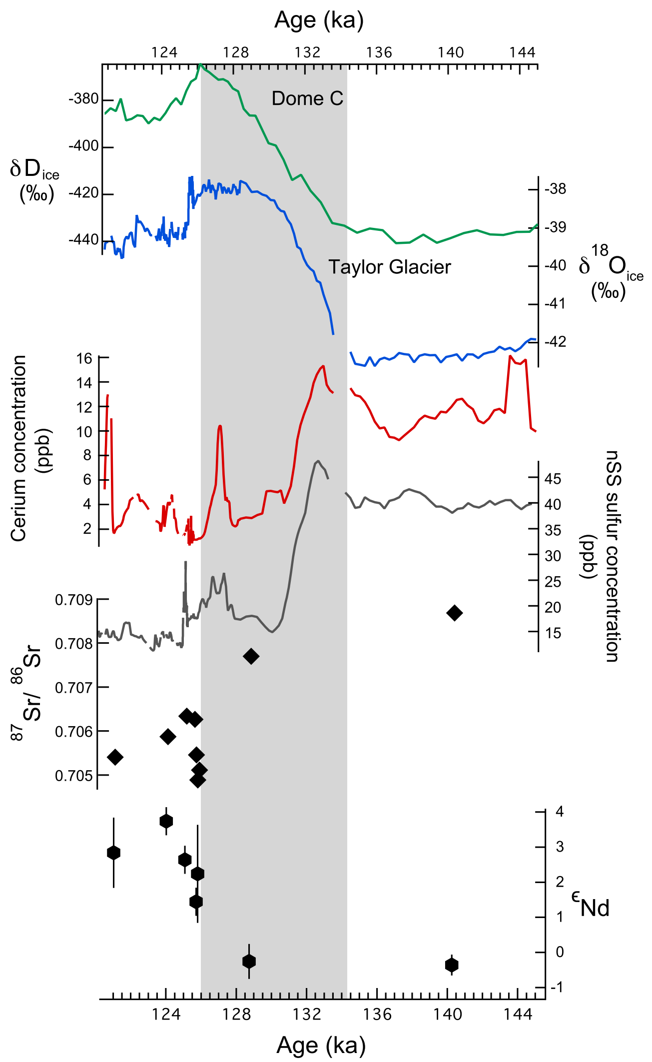

Figure 1. Continuous $\delta^{18}O$ composition of meltwater, Ce, and non-sea-salt sulfur (nssS) concentration, and discrete Sr (black diamonds) and Nd black hexagons) isotope compositions of dust from the Taylor Glacier compared to δD compositions from EPICA Dome C (Jouzel et al., 2007). Gray bar indicates deglacial period between MIS 6 and 5e. Note error bars for Sr are smaller than symbol size.

evidence of collapse(s) since the late Miocene, but the extent and exact timing remain relatively unconstrained (Scherer et al., 1998). Climate model simulations of MIS 5e suggest that the water isotope response in existing records indicate sea ice retreat rather than WAIS collapse (Holloway et al., 2016). Therefore, developing paleoclimate records of environmental conditions during this period is important to constrain future WAIS stability. The collapse of the WAIS would result in significant environmental changes such as shifts in surface wind directions across West Antarctica and the Ross Sea sector of East Antarctica (Steig et al., 2015). The mineral dust cycle in this region should reflect these changes, as chemical and physical properties of dust particles are influenced by variations in the atmospheric regime and dust source emissions (Aarons et al., 2017; Basile et al., 1997; Delmonte et al., 2008, et al., 2004; Grousset et al., 1992).

Because of the physical limitations imposed by traditional ice core samples (small sample size), recent studies exploit accessible surface ice exposed by ice dynamics and ablation at glacier margins and in blue ice areas (Bintanja, 1999; Sinisalo & Moore, 2010). Blue ice areas are unique sources of paleoclimate information allowing for very large sample sizes necessary for trace measurements in the ice core record (Buizert et al., 2014; Higgins et al., 2015; Petrenko et al., 2016; Schaefer et al., 2006). The surface of the Taylor Glacier (Figure S1 in the supporting information)—located within the McMurdo Dry Valleys, Antarctica—is a valuable source of high-volume samples for paleoclimate reconstruction (Aarons et al., 2017; Aciego et al., 2007; Baggenstos et al., 2017, 2018; Buizert et al., 2014; Petrenko et al., 2016). The oldest ice identified on the Taylor Glacier (120 ± 23 ka) is from MIS 5e, identified using ^{81}Kr radiometric dating of air entrapped in the ice (Buizert et al., 2014). The location of the Taylor Glacier near the intersection of the East Antarctic Ice Sheet (EAIS) and WAIS, Ross Ice Shelf, and Southern Ocean (Figure S1) provides an ideal sampling location for probing the stability of regional atmospheric dynamics throughout major climate transitions.

In this study, we analyze, compare, and contrast several new dust archive climate proxies from the Taylor Glacier to evaluate the dust cycle response to deglaciation. Radiogenic isotopes of strontium (Sr) and neodymium (Nd) are used to trace the source of dust deposited on the Taylor Glacier following previously established methods (Aarons et al., 2016; Basile et al., 1997; Grousset & Biscaye, 2005; Grousset et al., 1992). We find a significant difference in dust composition in the MIS 5e record compared to MIS 1, signifying a young volcanic input similar in geochemical composition to the West Antarctic Rift System (WARS). Potential drivers of the unique dust composition during MIS 5e include a significant change in local atmospheric circulation, larger areal exposure of fine-grained volcanic material, and/or increased volcanism caused by rapid ice sheet unloading.

2. Materials and Methods

During the 2015 austral summer, we collected ~4 m of ice from the toe of the Taylor Glacier (77°44′11″S, 162°7′24″E) spanning the transition between MIS 6 and 5e. Drilling was performed with the Blue Ice Drill (Kuhl et al., 2014) provided by Ice Drilling Design and Operations. Sr and Nd isotope ratios are presented for 10 individual ice core dust samples (Figure 1 and Table S1 in the supporting information). Continuous flow analysis measurements of $\delta^{18}O_{ice}$ and concentrations of particle counts, Ce, and non-sea-salt sulfur (nssS) concentration were conducted on longitudinal sections of each sample. To determine insoluble particle contributions (Figure 1), we use a semiquantitative, laser-based particle counter that quantifies aerosol mass by size (0.8 to 10 μm) for continuous ice core measurements (McConnell et al., 2017) at the Desert Research following procedures previously established (Maselli et al., 2013; McConnell & Edwards, 2008; McConnell et al., 2007). Particle flux was determined using the concentration and accumulation rate from the Taylor Dome ice core (Morse et al., 2007). To detect small changes in particles, on the order of 1–5 μm, we used Coulter® counter measurements on discrete samples (Figure S4) at the University of Milano Bicocca. More detailed information on sampling, treatment of samples, analytical methods, and data used for the age synchronization (Bender et al., 2006; Blunier et al., 2004; EPICA Community Members, 2006; Grootes et al., 2001; Jouzel et al., 1987, 1993, 2003; Kaufmann et al., 2009; Lorius et al., 1995; Masson-Delmotte et al., 2011; Steig et al., 2000) are provided in Text S1 and Figures S2 and S3 in the supporting information.

3. Results and Discussion

3.1. Physical and Geochemical Characteristics of MIS 5e Dust

We observe a trend of more fine dust particles (distal source) during glacial periods and coarser particles during interglacial periods (proximal source; Figure S4; Albani, Delmonte, et al., 2012). Cerium (Ce) concentration can be used as a proxy for mineral dust input (McConnell & Edwards, 2008), as it is the most abundant rare earth element in the Earth's crust and ~99% is derived from continental dust, whereas nssS is primarily an indicator of marine biogenic sulfur species (Wolff et al., 2006). The large variations in Ce and nssS concentrations are likely reflections of the large differences in glacial versus interglacial accumulation rates. The Ce and nssS (and to a lesser degree insoluble particles; see Table S2) concentrations are correlated and inversely proportional to the $\delta^{18}O_{ice}$ (see gray bar, Figure 1). The radiogenic isotope compositions of $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ shift concurrently with those of $\delta^{18}O_{ice}$ (Figure 1). Here, Nd ratios are expressed in ε notation, or parts per 10,000 relative to a geochemical standard. The $^{87}Sr/^{86}Sr$ and ε_{Nd} compositions of the insoluble dust portion just prior to the transitional period (depth 966.5 cm below surface) between MIS 6 and 5e were, respectively, 0.708665 ($2\sigma = \pm 1.9 \times 10^{-5}$) and −0.4 ($2\sigma = \pm 0.3$), whereas after the transition into MIS 5e, the $^{87}Sr/^{86}Sr$ and ε_{Nd} compositions were 0.705094 ($2\sigma = \pm 2.2 \times 10^{-5}$) and 2.2 ($2\sigma = \pm 1.4$), respectively (Table S1). For more discussion regarding dust concentration and size distribution see Text S1 in the supporting information.

3.2. Sources of Dust to Antarctica

Sediment and eolian dust have unique radiogenic isotope compositions similar to their source rocks, which depend on the initial composition of the source rock and geologic age (DePaolo, 1981). Previous studies have shown that the dominant source of dust to the EAIS in glacial periods during the past 800 ka was southern South America (SSA; Albani, Delmonte, et al., 2012; Delmonte et al., 2008; Grousset et al., 1992; Vallelonga et al., 2010). However, dust provenance during interglacial periods is less clear (Delmonte et al., 2013, 2010). During MIS 1, the source of dust to Taylor Glacier likely a mix of older (>100 Ma), local Victoria Land sources with background dust input from SSA (Aarons et al., 2017). Ice-free areas at the current margin of the EAIS also could supply dust, especially at coastal ice core sites where ice-free areas are more common (Talos Dome and Taylor Dome). Recent work significantly expanded the geochemical database of Antarctic potential source areas (Blakowski et al., 2016; Winton et al., 2016, 2014), aiding in distinguishing the transoceanic and local to regional dust inputs to Taylor Glacier. Significant differences in isotope composition (Blakowski et al., 2016) distinguish Taylor Valley sources (sediments from the Beacon Supergroup and granites and gneisses from the Ross Orogeny; Stump & Fitzgerald, 1992) from late Cenozoic WARS volcanic sources (Delmonte et al., 2007; Sims et al., 2008; see Figure 2a). Here we classify WARS as the McMurdo Volcanic Group, Melbourne, and Hallet Volcanic Provinces in close proximity to Talos Dome, volcanoes within West Antarctica (Hole & LeMasurier, 1994; Panter, Blusztajn, et al., 1997; Panter et al., 2000; Panter, Kyle, & Smellie, 1997), and recently discovered subglacial volcanoes below the WAIS (Iverson et al., 2017).

3.3. Dust Source Variations on Glacial-Interglacial Timescales

The sources of dust deposited in East Antarctica during glacial periods appear relatively stable and well constrained, in particular during MIS 2 (Delmonte et al., 2017). Conversely, dust provenance during MIS 1 and 5e remains unclear in large part because extremely low dust concentrations limit geochemical analyses (Aarons et al., 2017; Basile et al., 1997; Delmonte et al., 2013, 2010, 2007). Delmonte et al. (2007)

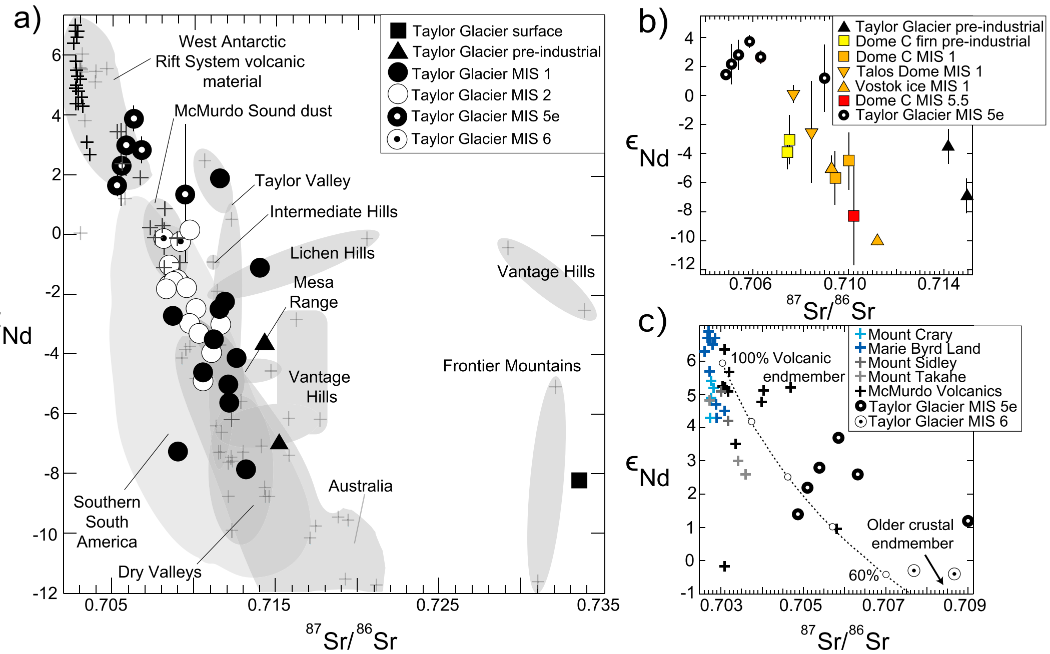

Figure 2. (a) Combined Sr-Nd isotope compositions of dust in MIS 6 and 5e Taylor Glacier ice in the context of regional Ross Sea sector (Blakowski et al., 2016; Delmonte et al., 2013, 2010; Winton et al., 2016, 2014) and Southern Hemisphere potential source areas (Delmonte et al., 2004; Gaiero, 2007). Gray crosses are individual data points. For map locations of regional Ross Sea Sector sources refer to Blakowski et al. (2016) and Winton et al. (2016, 2014). (b) Zoom in of (a) with combined Sr-Nd isotope compositions of MIS 5e dust from Taylor Glacier ice (this study); MIS 1; preindustrial dust from the Taylor Glacier (Aarons et al., 2017); MIS 5.5 from EPICA Dome C (Delmonte et al., 2007); Dome C firn (Delmonte et al., 2013); and MIS 1 ice from Dome C (Delmonte et al., 2007), Talos Dome (Delmonte et al., 2010), and Vostok (Basile et al., 1997). (c) Zoom in of (a) with Sr-Nd isotope compositions of the Taylor Glacier MIS 6 and 5e dust compared to those of WARS volcanic sources (Hole & LeMasurier, 1994; Panter, Blusztajn, et al., 1997; Panter et al., 2000; Panter, Kyle, & Smellie, 1997). Isotope mixing model (White, 2013) also shown for volcanic and older crustal endmember (see supporting information for details on model). Note: error bars for (a) are shown only for MIS 5e dust, and error bars for Sr in both (a) and (b) are smaller than the symbol size; the range on *x* and *y* axes are different for (a)–(c). MIS = Marine Isotope Stage.

presented Sr and Nd isotope compositions for ice from central East Antarctica during MIS 1 and 5.5, but these are not in agreement with compositions presented here for MIS 5e, likely due to different atmospheric conditions over the central EAIS. In this work, we observed a clear shift in $^{87}Sr/^{86}Sr$ and ε_{Nd} isotope compositions during the MIS 6-MIS 5e transition (Figures 1 and 3a). The MIS 6 dust ranges from $^{87}Sr/^{86}Sr = 0.707$ to 0.708, and from $\varepsilon_{Nd} = -0.4$ to -0.3, similar to that observed during MIS 2 (Aarons et al., 2017) and confirming a South American source for dust deposited during glacial periods (Figure 2a).

MIS 5e dust has a different composition, where $^{87}Sr/^{86}Sr = 0.704$ to 0.708, while $\varepsilon_{Nd} = 1.2$ to 3.7. These data correspond closely to volcanic sediment from the WARS (Figure 2a). The isotope composition observed in the MIS 5e dust cannot be achieved with mixing between SSA and >100 Ma Victoria Land material (e.g., sediment from Taylor Valley, Intermediate Hills, Lichen Hills, Mesa Range, Vantage Hills, and Frontier Mountains in Figure 2a). A large proportion of a young volcanic source is required in the dust mixture to reach the observed isotope compositions. The Taylor Glacier MIS 5e dust is significantly different in composition with respect to both MIS 6 and 2 glacial dust and preindustrial MIS 1 dust (Figure 2b). Compared to East Antarctic ice cores from previous interglacial periods and preindustrial firn dust, the signature of the Taylor Glacier MIS 5e dust is clearly distinct (Figure 2b). An isotope-mixing model between WARS volcanic and older Victoria Land source endmembers indicates the observed compositions of MIS 5e dust are consistent with ~80% input from WARS volcanic sources.

The uniform dust sources during glacial periods and divergence following the Termination I and II deglaciations are presented in Figure 3. The Taylor Glacier dust composition between MIS 2 and 6 is similar for both Sr and Nd isotopes (Figure 3). These glacial dust values are well within the range of glacial compositions

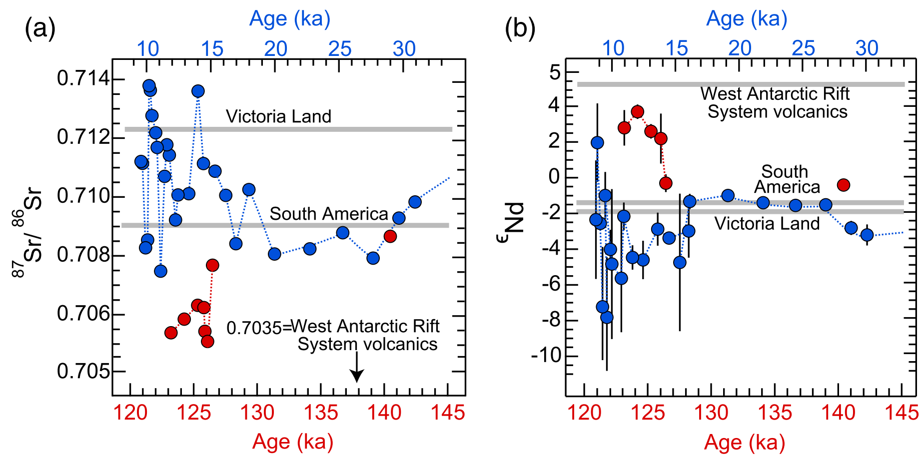

Figure 3. Comparison of the Taylor Glacier dust (a) Sr and (b) Nd isotope compositional changes during Termination II and Termination I. The Sr and Nd isotope compositions for Termination II are shown as red symbols and dashed lines in (a) and (b) with age on the lower *x* axis. Sr and Nd isotope compositions for Termination I (Delmonte et al., 2008) are shown as blue symbols and dashed lines in (a) and (b) with age on the upper *x* axis. Average compositions of >100 Ma Victoria Land, southern South America, and West Antarctic Rift System potential source areas (gray bars) from Blakowski et al. (2016), Delmonte et al. (2008), and Sims et al. (2008, and references therein).

observed here (Figure 3) and in agreement with SSA sources. Conversely, differences during the respective interglacial periods in Sr and Nd isotope compositions point to two very different dust sources. In particular, the background dust mixture during MIS 5e appears to be dominated by a WARS volcanic component.

3.4. Explanation for Distinct MIS 5e Dust

These first Sr and Nd isotopic data for dust transported to the EAIS during the transition from MIS 6, 5e highlight the marked differences in dust sources between Termination I and II. Dust deposited during MIS 5e is compatible with a Cenozoic volcanic signature from the WARS and is very different from MIS 1 data from the Taylor Glacier and from previous interglacial data from central Antarctic ice cores. The compositional difference between the Taylor Glacier and central Antarctic ice cores is likely related to regional atmospheric and/or environmental changes in this coastal sector of East Antarctica, as the background dust composition at all East Antarctic sites reflects long-range dust transport. The driving factor behind the unique MIS 5e dust signature found in the Taylor Glacier may be attributed to several possibilities discussed in sections 3.4.1–3.4.3. It is important to note that more than one of these hypotheses may have been at play, and all mechanisms are related to the deglacial conditions and reduction of the WAIS.

3.4.1. Change in Wind Trajectory

The atmospheric circulation in Antarctica is largely driven by katabatic winds, the cold air masses originating over interior Antarctica move toward the margins of the ice sheet. Current meteorological data indicates that ~50% of air masses reaching the Transantarctic Mountains and Victoria Land originate from the Antarctic interior and ~30% originate from the Ross Sea region (Scarchilli, 2007). Dust transport to East Antarctica is controlled by large-scale atmospheric circulation patterns, with the westerly circulation delivering dust originating primarily from SSA (Delmonte et al., 2010). During glacial periods, increased extension of sea ice in the Southern Ocean shifts the Westerlies northward resulting in stronger glacial and fluvial erosion, and a colder and drier climate in the dust source region (Petit et al., 1999). Higher amounts of sea ice extending north from Antarctica would also result in a steeper meridional temperature gradient (Petit et al., 1999), resulting in more vigorous atmospheric circulation and more efficient transport of dust. Dust transported to the Taylor Glacier during the current interglacial (MIS 1) is a mixture of background SSA input, local late Cretaceous Victoria Land material, and possibly Australian dust (Aarons et al., 2017; Albani, Mahowald, et al., 2012; Li et al., 2008). Because a volcanic signature was not found in the Taylor Glacier or the Taylor Dome records (Aarons et al., 2016, 2017) during Termination I, despite locally active volcanism (Narcisi et al., 2012), an additional atmospheric and/or environmental change in this region is likely.

To assess this point, we use previously modeled wind direction changes induced by a retreat of the WAIS during MIS 5e (Steig et al., 2015), to evaluate the potential for atmospheric transport differences between

Termination I and II. The effects of WAIS collapse upon atmospheric circulation, temperature, and ice core stable isotope ratios were evaluated using the European Centre for Medium-Range Weather Forecasts data set from 1979–2016 (Dee et al., 2011) and four general circulation model simulations (Steig et al., 2015), all of which indicated a disruption in the katabatic wind circulation, leading to an increased cyclonic flow over areas of ice loss (Figure S5a). The cyclonic flow occurred as topography lowered (i.e., WAIS collapse), and a fundamental feature was observed in all four models: the advection of warm temperature anomalies in West Antarctica, toward adjacent areas of coastal East Antarctica. This scenario is much different than currently observed wind directions in the Ross Sea sector (Figure S5a). Separate climate simulations also indicated changes to WAIS orography lead to profound changes in atmospheric circulation, most notably a weakening of the polar jet (Justino et al., 2015), and an increase in southward energy transport toward Antarctica (opposite to current conditions; Singh et al., 2016).

To achieve the Sr-Nd isotope composition revealed in the MIS 5e dust, between 70–80% of WARS volcanic material and 20–30% input from local continental reworked Victoria Land material is needed (Figure 2c). When viewed in the context of current air mass trajectory (Scarchilli, 2007), this increased input of WARS dust suggests an almost complete reversal in the proportion of air masses originating from interior East Antarctica versus the Ross Sea sector. This high proportion of dust input originating from a direction opposite to the current wind regime is a strong indicator of WARS volcanic material re-suspension and mobilization toward the Taylor Glacier.

3.4.2. Increased Subaerial Exposure of Volcanic Material

West Antarctica is a prominent volcanic region due to divergent plate boundaries and presence of rift zones (LeMasurier, 2013). The WARS extends from the Ross Sea to the base of the Antarctic Peninsula (Behrendt et al., 1991). Geochemical characterization of potential source areas from the McMurdo Sound sector of Antarctica indicates the presence of a large amount of volcanic material in close proximity to the Taylor Glacier (e.g., Ross Island; Blakowski et al., 2016; Winton et al., 2016, 2014). It is possible that the EAIS and/or WAIS configuration during MIS 5e was different than currently observed; however, based on Sr-Nd isotope compositions of potential source areas in the Ross Sea Region (Blakowski et al., 2016), it is unlikely that the dust composition observed in the Taylor Glacier MIS 5e dust is indicative of any changes in grounded EAIS coverage. Sediment from till deposits in the Dry Valleys, and the Ross and Wilson drifts are compositionally similar (Blakowski et al., 2016) and lack a volcanic signature. Increased exposure of McMurdo Sound glacial drift material could provide dust signatures typical of young volcanic material similar to that measured in the MIS 5e ice.

As yet, the presence of Cenozoic age volcanic material has not been detected in ice from the Taylor Glacier spanning from MIS 2 to 1 (46.7–8.7 ka), or in preindustrial or surface ice (Aarons et al., 2017). Cenozoic age volcanic material has been detected in distinct tephra layers in the Taylor Dome ice core (Dunbar et al., 2003); however, visible tephra layers in the Taylor Glacier ice were not observed. Dunbar et al. (2008) also found evidence of tephra layers in blue ice from Mount Moulton, dated to MIS 1 and 5e. Other active Antarctic volcanic centers in West Antarctica (Mount Berlin and Mount Takahe) have contributed to the deposition of tephra at Talos Dome (Narcisi et al., 2016). Both remote sensing (Lough et al., 2013) and geochemical (Frisia et al., 2017; Iverson et al., 2017) evidence points to extensive West Antarctic subglacial volcanism associated with WARS. However, a pronounced shift in wind directions is still required to bring a sustained input of material from either West Antarctica or from more proximal volcanic sources (e.g., McMurdo Sound drift material).

3.4.3. Increased Volcanism

Potential sources of volcanic material to the Taylor Glacier site include volcanoes from both West and East Antarctica. Mount Berlin and Mount Takahe in Marie Byrd Land Province in West Antarctica have been cited as potential sources of volcanic input to Antarctic ice cores such as Talos Dome (Narcisi et al., 2016). In East Antarctica, volcanoes in Northern Victoria Land such as The Pleiades volcano, Mount Rittmann, Mount Melbourne, and Mount Erebus are also possible contributors of volcanic material to Antarctic ice (Narcisi et al., 2016). A recent record of volcanic activity at Talos Dome in Antarctica found visible tephra layers corresponding to the final stages of MIS 5e, and an absence of tephra layers in ice core sections corresponding to the previous glacial period (Narcisi et al., 2016). The Talos Dome tephrostratigraphy from MIS 5e shows an abundance of Antarctic explosive volcanic events both from Northern Victoria Land and only a subset of shards within a layer from the more distant Marie Byrd Land Province in West Antarctica (Narcisi et al., 2016). It is possible that spikes in particle concentration observed in the Taylor Glacier record during MIS 5e (121.6 and 123 ka; Table S2) correspond with volcanic events observed in the Talos Dome ice core at 120 and 123.3 ka, attributed to input from the Mount Melbourne and The Pleiades volcanoes (Narcisi et al., 2016). Mount Erebus is in close proximity to the Taylor Glacier and is another potential contributor of volcanic ash to the site, as englacial tephra dated to ~40 ka has been detected in blue ice areas in the Transantarctic Mountains (Iverson et al., 2014). The Mount Melbourne volcanic succession reveals an eruptive history during both MIS 5e and 1 (Giordano et al., 2012); however, a detailed particle morphology and bulk geochemical comparison is needed to identify this as the source of the MIS 5e volcanic signature observed here.

Large-scale conclusions regarding the link between volcanic eruption frequency and climate conditions cannot be drawn from this study; however, the results support a possible link between ice sheet loading/unloading and the volume, timing, and explosiveness of volcanic eruptions observed in the Greenland Ice Sheet (Zielinski et al., 1996), Iceland (Sigvaldason, 2002; Slater et al., 1998), and globally (Huybers & Langmuir, 2009). An increase in volcanism following deglaciation could be precipitated by increased magma production due to mantle decompression following rapid ice sheet retreat (Huybers & Langmuir, 2009; Nyland et al., 2013). A positive relationship between volcanism and ice minimum extent has also been recognized for Antarctic continental volcanism (McConnell et al., 2017; Nyland et al., 2013). Volcanic material from the regions described above could have supplied atmospheric dust with a young volcanic signature to the surrounding areas, although use of Sr-Nd isotopes does not allow the distinction of individual volcanic centers to the south or west within the current record. Major element compositions of the volcanic component of dust present in Antarctic ice would aid in providing more reliable reconstructions of past wind trajectories. The evidence published thus far concerning volcanic activity during glacial-interglacial periods indicates no increase of volcanic activity during MIS 5e with respect to MIS 1 (Narcisi et al., 2012); and therefore, the volcanic hypothesis is very unlikely. This supports a shift in wind trajectory and/or increased exposure of volcanic material as the cause of the volcanic dust signature observed at Taylor Glacier during MIS 5e.

4. Conclusions

Our analysis indicates that atmospheric transport mechanisms and environmental conditions at the Taylor Glacier varied significantly during MIS 5e compared to interior East Antarctic sites, which is in contrast to the uniform conditions observed during different glacial periods. The proximity of the Taylor Glacier to the coast and WAIS provides an ideal testing ground for reconstructing the regional climate variations that occur during deglacial conditions. We have presented a reconstructed history of dust transport to the Taylor Glacier during MIS 5e and highlighted the difference in dust transport compared to the current MIS 1. Results unequivocally indicate a presence of volcanic material at the Taylor Glacier during MIS 5e; however, our data do not allow volcanic source identification. We put forth several different scenarios to explain this result, which are compatible with increased exposure of volcanic material accessible for transport and profound atmospheric circulation reorganization. These results provide new insight into the atmospheric dynamics and paleo-environmental conditions of MIS 5e at a coastal East Antarctic site. Further work is needed determine the exact source and cause of the volcanic dust signature observed at this site during MIS 5e.

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