

Figure F1. Overview map of working area, Site U1537. APF = Antarctic Polar Front, SACCF = Southern Antarctic Circumpolar Current Front, WSI = winter sea ice extent (white), SSI = summer sea ice extent. Blue arrows = main iceberg movement, green arrows = ACC flow, purple line = section shown in Figure F2. Fronts and sea ice according to Orsi et al. (1995).

Figure F2. Temperature section (purple line in Figure F1) and major water masses, Site U1537. AAIW = Antarctic Intermediate Water, NADW = North Atlantic Deep Water, WSDW = Weddell Sea Deep Water, AABW = Antarctic Bottom Water, SACCF = Southern Antarctic Circumpolar Front, PF = Polar Front. (Data replotted from Gouretski and Koltermann, 2004; location of SACCF and PF after Orsi et al., 1995.)

Figure F3. Age model, Site U1537. (A) Age–depth (core composite depth below seafloor scale) relationship based on shipboard age model (light blue); based on age model by Weber et al. (2022; brown); and new age model (red, used for this study) based on correlation between XRF data and (C) benthic $\delta^{18}\text{O}$ (Lisiecki and Raymo, 2005), (D) EDC deuterium (δD) ice core record (Jouzel et al., 2007), and (E) EDML ($\delta^{18}\text{O}$) ice core record (Bazin et al., 2013). B. XRF $\ln(\text{Zr/Rb})$ current speed proxy (dark blue = tuned according to new age model, light blue = according to old age model). E1–E3 = potential IRD events.

Figure F4. Downcore data and current speed, Site U1537. A. XRF Zr counts. B. XRF Rb counts. Both Zr and Rb show similar temporal pattern with higher values during glacial period and lower values during interglacial period; although, based on the values, Zr concentration is larger than Rb concentration. C. XRF (Zr/Rb) ratio depicts glacial–interglacial variations with higher values during interglacial periods and lower values during glacial periods, indicating negative correlation between Zr and Rb intensities to the Zr/Rb ratio at the site. D. XRF $\ln(\text{Zr/Rb})$. E. Current speed (U) derived from $\ln(\text{Zr/Rb})$ based on positive correlation with SS using $SS = 0.515U + 12.73$ (McCave et al., 2017).

Figure F5. Reduced major axis regression between SS and SS% used to determine sorting of sediments. A. Site U1537 only. B. Combined data from Sites U1537 and PS97/085-3 (Wu et al., 2021).

Figure F6. Reduced major axis regression between SS and $\ln(\text{Zr/Rb})$. A. Site U1537 only. B. Combined data from Sites U1537 and PS97/085-3 (Wu et al., 2021).

Figure F7. A. Site U1537 XRF $\ln(\text{Zr/Rb})$. Penultimate Glacial Maximum (PGM) $\ln(\text{Zr/Rb})$ average = 0.5, Last Glacial Maximum (LGM) $\ln(\text{Zr/Rb})$ average = 0.45. B. XRF-derived current strength (U). MIS 5e U average = 14.9 cm/s, PGM U average = 7.5 cm/s, Holocene U average = 13 cm/s, LGM U average = 6.8 cm/s.