Figure F1. Walvis Ridge bathymetry, hotspot age models, and drill sites. Solid line = central plume track of O'Connor and le Roex (1992) hotspot model (solid circles = 10 Ma). Dashed black line = Torsvik et al. (2008) fixed hotspot model (open circles = 10 Ma). Dashed yellow line = moving hotspot model of Doubrovine et al. (2012) (stars = age in Ma). Squares = DSDP/ODP holes. Red circles = Expedition 391/397T drill sites. Inset shows location of Walvis Ridge (WR) in the South Atlantic. MAR = Mid-Atlantic Ridge. Plotted bathymetry is the Global Multiresolution Topography (GMRT) data set (Ryan et al., 2009).

Figure F2. Bathymetry map of the northern Guyot Province, showing Tristan, Gough, and Center track edifices and Expedition 391/397T sites (red circles). Heavy lines = AWI seismic profiles, thin lines = R/V *Thomas G. Thompson* Cruise TN-373 track, blue line = Seismic Line TT-01 from that cruise. Green circles = DSDP Sites 525 and 528 (Leg 74 transect; Moore et al., 1984). Plotted bathymetry is the SRTM15+ predicted bathymetry data set (Tozer et al., 2019). Contour interval = 1 km.

Figure F3. Walvis Ridge age progression from radiometrically dated igneous rocks. Samples with enriched mantle one (EMI)-type composition follow a tight linear trend. High U/Pb (HIMU)-type composition yields ages ~30–40 My younger than the underlying EMI-type basement. Blue shading = Expedition 391/397T site estimated ages (see Homrighausen et al., 2019 for sources of age data). EMORB = enriched mid-ocean-ridge basalt.

Figure F4. Seismic Line AWI-20060660 over Site U1584 (top) and its interpretation and coring location (bottom). Location of seismic line section is shown in Figure F6. Vertical column indicates the section cored. Horizontal line in the column estimates the level at which coring began. TWT = two-way traveltime, CMP = common midpoint, VE = vertical exaggeration, SF = seafloor, B = acoustic basement.

Figure F5. Predicted paleolatitude drift of the TGW hotspot, hotspot models, and true polar wander. Estimated paleolatitudes are calculated from the global average African plate apparent polar wander path (Torsvik et al., 2008), based on a plate motion model with moving hotspots (Doubrovine et al., 2012). This polar wander path was constructed with 20 My window length, averaged every 10 My. Bottom: Pink square (525) = paleolatitude determined for 60–75 Ma sediments from Site 525 (Chave, 1984). Its paleolatitude may result from inclination shallowing, common for sediments (Verosub, 1977). Triangle (NPB), square (CPB), and diamond (SPB) = north, central, and south Paraná flood basalts (Ernesto et al., 1990; 1999); star (MC) = Messum gabbros in the Etendeka province (Renne et al., 2002). Blue shading (VK92) = hotspot drift estimated by Van Fossen and Kent (1992). Blue arrows = estimated ages of drill sites from an age progression model (Homrighausen et al., 2019, 2020). Thin vertical lines = 95% confidence limits based on paleomagnetic data scatter only. Top: Red = paleolatitudes estimated from paleomagnetic data (same as lower plot). Black = seamount drift if formed at the Tristan hotspot location, assuming a fixed hotspot model (Torsvik et al., 2008). Blue = same for a moving hotspot model (Doubrovine et al., 2012). Green = Tristan hotspot drift from a mantle flow model (Doubrovine et al., 2012), indicating ~7° southward motion over 120 My. Orange = African plate drift in a moving hotspot model (Doubrovine et al., 2012). It is less than the fixed hotspot model because the Tristan hotspot is modeled as moving south. Adding hotspot motion to the moving hotspot model, absolute motion is the total northward motion indicated by the morphology of the TGW chain and the fixed hotspot model. All absolute motion models indicate that the African plate moved nearly monotonically northward, so they do not explain the rapid southward shift in paleolatitudes during the Late Cretaceous or the northward offset of paleolatitudes during the early Cenozoic. The difference between modeled and observed paleolatitudes implies significant true polar wander (purple curve) (Doubrovine et al., 2012).

Figure F6. Bathymetry map of the Gough track guyot ridge and Site U1584. Seismic Line AWI-20060650 dots are plotted every 200 common midpoint (CMP). Plotted bathymetry is the swath bathymetry data from *Polarstern* Cruise ANTXXIII-5 merged with SRTM15+ predicted bathymetry data set (Tozer et al., 2019). Contour interval = 500 m.

Figure F7. Multibeam bathymetry map, Site U1584 (red circle). Detailed bathymetry swath around Seismic Line AWI-20060660 was merged with the SRTM15+ bathymetry grid (Tozer et al., 2019).

Figure F8. Lithostratigraphic summary, Site U1584.

Figure F9. Representative core images from Hole U1584A. A. Subunit IA unconsolidated pale white to pale pinkish gray bioturbated nannofossil ooze. B. Subunit IB pale brown bioturbated silty sand with volcaniclastic and clay component and foraminifera. C. Subunit IC reddish brown bioturbated silty sandstone with volcaniclastic and clay components and foraminifera. D. Subunit IIA lithified greenish yellow pumiceous lapillistone with whitish mixture of carbonate and zeolite cement; contains a minor component of brownish volcaniclasts and larger (5–10 mm) oxidized lithic fragments. E. Subunit IIB lithified olive-brown volcanic breccia consisting of oxidized pumiceous lapillistone and brown volcaniclastic fragments with roughly equal content of oxidized (reddened) pumice and altered basaltic. Interstitial matrix is fine-grained gray ash-like material and zeolite.

Figure F10. Key elements in selected subunits, Hole U1584A. A. Subunit IB dipping arenaceous carbonate-rich layer. B. Subunit IIA densely packed, subangular to subrounded greenish yellow pumice lapilli (5–10 mm) with irregular, angular volcaniclastic lithic fragments. C. Subunit IIA closely packed, unaltered, subrounded greenish yellow pumice lapilli (3–5 mm) with whitish zeolite cement and minor lithics. D. Subunit IIB closely packed mixture of oxidized (brownish) and unaltered, subangular pumice lapilli (3–5 mm) and subrounded zoned lapilli (right mid-center) with whitish zeolite cement.

Figure F11. Photomicrographs, Hole U1584A. Scale bars = 1 mm. A. Thin section (TS) of pumice-dominated Subunit IIA (plane-polarized light [PPL]) (9R-1, 47–51 cm, TS5). B. Irregular-shaped green glassy pumice fragment with dense internal bubble texture, set in recrystallized calcite cement (cross-polarized light [XPL]) (9R-1, 47–51 cm, TS5). C. Fine-grained basaltic lithic fragment with orientated plagioclase laths surrounded by micritic carbonate cement (XPL) (9R-1, 47–51 cm, TS5).

Figure F12. Larger basalt clasts, Hole U1584A. A. Highly olivine phyric basalt clast with iddingsite replacing basalt. B. Vesicular basalt clast with calcite filling larger vesicles in the center of the clast. Vesicles near the outer rim of the clast are lined by or devoid of secondary minerals. C. Vesicular olivine phyric basalt clast with calcite infilling in both small and large vesicles. D. Aphyric basalt clast with iddingsite-replaced olivine microphenocrysts.

Figure F13. Photomicrographs, Hole U1584A. A. Thin section (TS) of olivine phyric basalt clast (7R-1, 122–123 cm, TS2; XPL). B. Aphyric basalt clast (7R-2, 76–77 cm, TS3; PPL). C. Altered olivine in a plagioclase-clinopyroxene-phyric groundmass (7R-1, 122–123 cm, TS2; scale bar = 1 mm). D. Aphyric basalt showing plagioclase microphenocrysts and groundmass plagioclase with altered groundmass olivine (7R-2, 76–77 cm, TS3; scale bar = 1 mm).

Figure F14. Paleomagnetic results, Hole U1584A. In the inclination plot, gray and black dots denote measurements by SRM for NRM and after 20 mT demagnetization, respectively. Red circles = inclinations from discrete samples. Polarity column: White = reversed polarity, gray = zones where it was impossible to determine polarity.

Figure F15. Representative AF demagnetization plots for Hole U1584A samples. (A) 4R-1, 44–46 cm, and (B) 5R-1, 116–118 cm. From left: equal-area stereonet showing vector endpoints at the demagnetization steps; orthogonal vector (Zijderveld) diagrams showing magnetization endpoint on two orthogonal planes (steps are in mT); magnetization intensity plots, normalized by the NRM value, vs. alternating field.

Figure F16. IRM acquisition for two representative sediment samples, Hole U1584A.

Figure F17. A. Total alkali vs. silica classification (Le Bas et al., 1986) with alkalic-tholeiitic division (MacDonald and Katsura, 1964). In contrast to the tholeiitic samples from Sites U1575–U1577, Site U1584 samples are alkali basalt similar to the Site U1578 samples. B. Ti vs. V classification diagram after Shervais (2022) shows that all basaltic lavas from Site U1584 lie within the ocean-island basalt (OIB) field. This is distinct from Walvis Ridge Sites U1575–U1577 but similar to Site U1578 and other Guyot Province samples. MORB = mid-ocean-ridge basalt. Data sources: Le Maitre, 1962; Richardson et al., 1984; Weaver et al., 1987; Le Roex et al., 1990; Gibson et al., 2005; Class and le Roex, 2008; Salters and Sachi-Kocher, 2010; Rohde et al., 2013; Homrighausen et al., 2018, 2019.

Figure F18. Mg# vs. SiO_2, TiO_2, K_2O, Al_2O_3, Ni, V, Zr, and Sr, Site U1584. Major element compositions are normalized to 100 wt% totals on a volatile-free basis. Data from Site U1584 generally lie outside of the compositional array of samples recovered during Expedition 391 (Sites U1575–U1578). The major and trace element variations are in general accordance with crystal fractionation and accumulation of the phenocryst phases. Data sources: Le Maitre, 1962; Richardson et al., 1984; Weaver et al., 1987; Le Roex et al., 1990; Gibson et al., 2005; Class and le Roex, 2008; Salters and Sachi-Kocher, 2010; Rohde et al., 2013; Homrighausen et al., 2018, 2019.

Figure F19. Lithostratigraphy, core recovery, and physical properties, Hole U1584A. IU = instrument units, cps = counts/ second, gantry = discrete sample by caliper.