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INTEGRATING MARINE AND TERRESTRIAL RECORDS OF PAST ANTARCTIC ICE SHEET AND OCEAN BEHAVIOUR

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Preliminary analysis of abandoned Holocene penguin rookeries at South Shetland Islands, Antarctica

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Penguins are climatic sensitive seabirds that establish colonies along the marine coasts of Antarctica since the Paleocene (60 million of years ago) to which they return every year during the breeding season. Accumulations of bones, pebbles, and guano constitute rookeries, that condense and transform into ornithogenic soils preserving evidence of nesting constitution, penguins diet, and biological interactions in the past. We prospected the 25 de Mayo/King George Island (South Shetland Islands) looking for the reported rookeries in the Potter Peninsula (Pingüi could not be re-located following the published coordinates). Pingfo II corresponds to raised marine deposits with bones dated in 7780 ± 60 yr BP and 7600 ± 80 yr BP without modern colonies at the top. Ornithogenic soils were not detected, and the disarticulation and weathering of bones indicate transport and accumulation in a high energy beach. Pingfo I is a more elevated recolonized area within ZAEP 132 with hundreds of Pygoscelis adeliae at the top since 2012 (monitoring program Instituto Antártico Argentino). Seven levels yield bones dated in 5750 ± 40 yr BP and 5840 ± 40 yr BP. The abundance of bones of different ontogenetic stages, the presence of eggshells, seaweeds, and pebbles, and the lack of evidence of transportation suggest that the breeding colony was settled in this area. We continue with the sieved sediment and consolidated blocks rich in organic material processing in the lab, in the search for traces of penguins diet, and small organisms that could offer paleoclimatic, paleoecological, and pedological information.

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A probabilistic and model-based approach to the assessment of ice sheet change from glacial detritus.

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Detrital provenance methods are used to understand changing ice sheet conditions, often seeking to characterise eroding zones that may indicate the past location of the ice sheet margin, but interpretation is often ambiguous. We present a probabilistic approach to map the generation of detritus. First, a subglacial geology map is made from geophysical data, in which we estimate likelihoods for basement geology and cover sequence classes to be exposed at the base of the ice sheet. Second, using ice sheet models, erosion likelihood is estimated for four different ice sheet states. Third, spatial analysis is applied to determine the likelihood of erosion for each geological class in each ice sheet state. These likelihood estimates help to validate and constrain interpretations of detrital records. By also considering prior probabilities, our formulation allows a further qualitative interpretation mode in which indicator and contra-indicator classes are defined for each ice sheet model, allowing the support for different ice sheet states to be compared. Finally, given a relative prior probability for the ice sheet state and a transport effectiveness, the relative probability of different ice sheet states may be calculated quantitatively. An application in Wilkes Land demonstrates that observed detritus in recent strata is consistent with derivation from the modern-scale ice sheet model, and demonstrates the capacity to quantitatively discriminate the different ice sheet states from detrital occurences. Our new approaches support a more robust capacity interpret ice sheet change from the detrital record in both qualitative and quantitative ways.

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Antarctic impact on ocean circulation during late Messinian ocean circulation, insights from IODP Exp. 361 sites.

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Different models indicate a marked increase in ice-volume in Antarctica (approx. 50%) during the late Messinian, that culminate in large glaciations (TG22, 20 and 18) when the Antarctic ice-sheet was probably larger than today. Until recently there were only limited late Messinian records that could be used to investigate the influence of these Antarctic ice-sheet expansions on paleoclimatic and palaeoceanographic variability. A key location where this influence is poorly known is the boundary between the Indian and the Atlantic Ocean, which is an integral inter-ocean link in the global thermohaline circulation. In 2016 the International Ocean Discovery Program (IODP) Expedition 361 ("SAFARI") recovered a complete high-resolution Messinian sedimentary succession at 3 drilling locations on the southeast African margin and in the Indian-Atlantic Ocean gateway. Here we present results from Site U1475 (Agulhas Plateau), a location proximal to the entrance of North Atlantic Deep Water (NADW) to the Southern Ocean and South Indian Ocean. The site is located over sedimentary drift deposits in 2669 m water depth and comprised of carbonate-rich sediments (74 – 85 wt % CaCO3). Based on high-resolution data sets of density, velocity, natural gamma radiation, X-ray fluorescence (XRF) core-scanning data, colour reflectance, grain size distributions and planktonic foraminifera oxygen isotope data, we reconstruct major circulation changes in bottom current as well variations in orbitally-controlled climate variability that can be linked to the Antarctic ice-sheet expansions.

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High-resolution paleolimnological records from Larsemann Hills, East Antarctica over the last two millenia

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High-resolution sediment records from Antarctica are rare due to the depositional rates and conditions that prevail in this cold continent. The sedimentary records from the ice-free regions of Antarctica form important links between the ice-core and the marine sedimentary records. Recently, significant number of past-climate records from East Antarctic lacustrine sediments has exhibited the evolution of the lake ecosystem and the Antarctic climate. The resolution of the sedimentary records is generally coarse varying between 200 to 600 years owing to the slow depositional rates and conditions. High-resolution Holocene records are important to understand the response of lakes to the recent climate. Here, we present high-resolution sedimentary records from two coastal lakes viz., Discussion Lake and Mochou Lake located in Larsemann Hills of East Antarctica. . The radiocarbon dates sedimentary records span the last 2,000 years. The former is at an elevation of 5 m asl while the latter is at 10 m. We have generated multi-proxy sedimentary organic chemistry data (δ13C,δ15N, Corg content, Nitrogen content) along with diatom abundance to understand the impact of climate on the lake ecosystem. We compared our data with the recently reconstructed PAGES2K global climate data in order to find any distinct climate events within the last two millennia. Though a one-to-one correlation doesn't exist, distinct similarities can be drawn from the two data sets. At the outset, though the records mimic the global climate records (PAGES2K), there exists certain lag due to the high-resolution ice-core records and relatively low-resolution of the lacustrine sedimentary records.

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A morpho-stratigraphic reconstruction of Edisto Inlet and Mc Robertson Bay based on high-resolution Holocene paleoclimate record, western Ross Sea (Antarctica)

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A high-resolution seismic-bathymetric survey was conducted in western Victoria Land in two fjords: Edisto Inlet (Cape Hallett) and Mc Robertson Bay (Cape Adare). Observed changes in the geometry and sedimentation patterns from late-glacial to present reflect the interactions between the dynamical fluctuations of local outlet glaciers systems and oceanic circulation. Both are key sites to investigate recent past polar amplification due to the late deglaciation climate warming. Edisto Inlet and Robertson Bay are, indeed, located along the route of main ocean bottom water masses forming into the Ross Sea continental shelf and of intermediate waters intruding from the open-ocean.

The data collected in 2005, 2017 PNRA and in 2015 KOPRI surveys, document peculiar environmental and ocean circulation conditions that have probably persisted for several thousand years, after the retreat of coastal glaciers since the last glacial maximum (21 ka). The sediments analysis suggests high paleo-productivity in the water column and the presence of bottom currents with relatively constant direction and intensity over time.

Here we present results of a preliminary integrated analysis of all geophysical and geological dataset aimed to understand relationship between the geometry and the spatial distribution of depositional and erosional features. Conclusions of this work are critical to reconstruct ice-sheet and bottom currents past history and to better constrain ice-sheet and ocean numerical simulations of the Holocene.

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Glacial history of the South Orkney Islands shelf (NW Weddell Sea): insights from new bathymetric and multi-channel seismic data

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The South Orkney Islands (SOI) are partially covered by modern ice caps. The SOI shelf was shaped during repeated ice sheet advances and retreats, as evidenced by presence of ice-rafted debris in the ODP Leg 113 (1987) sections since late Pliocene. Glacial geomorphological features of the SOI shelf include several erosional troughs and a continuous mid-shelf break, which marks the maximum extent of ice grounding at ~350m isobath (e.g. Dickens et al., 2014). In 2018 (63rd Russian Antarctic Expedition), ca. 500 km of new multibeam and multi-channel seismic (MCS) data were collected on the SOI shelf by the RV "Akademik Karpinsky". During the cruise, a detailed multibeam survey was performed across the Signy glacial trough. As a result, a 30m resolution bathymetric grid was compiled for the area of ca. 1500 km2, which allows to describe the trough morphology in greater detail, and to identify grounding-zone moraines on the flanks of the trough. Detailed reprocessing of the MCS data was performed to better resolve the upper part of the seismic record. Interpretation of time sections was improved with the help of multibeam depth profiles collected along the seismic lines. This allowed to distinguish erosional troughs and well-developed grounding zone moraines in the MCS sections. The mid-shelf break position at ~350m isobath is well recognized in the 2018 multibeam and MCS data. Additionally, we propose a more distal position of grounding ice at ca. 400m water depth.
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Glacial history of the Coats Land region, East Antarctica

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Satellite gravimetry is a widely-used technique of assessing ice sheet mass change. For its application it requires a correction for glacio-isostatic adjustment, which can be of an order of magnitude comparable to that of the 'raw' gravimetric signal. In order to improve these GIA corrections one powerful approach is to reduce uncertainties in the two main inputs: (i) the ice load history and (ii) the understanding of solid Earth structure in the loaded region. For the Antarctic ice sheet the largest differences between modelled GIA corrections occurs in Coats Land, that part of the East Antarctic Ice Sheet that drains into the north-eastern Weddell Sea Embayment. Here we report a multi-disciplinary study to improve our understanding of ice load and Earth structure in this region. We report here on a programme of glacial geology, GPS and seismometer deployment, and modelling; all aimed at improving GIA corrections and thus reducing the uncertainties in ice sheet mass balance in a key region.
We have mapped and sampled the glacial geological record of ice sheet fluctuations on a transect of nunatak sites stretching ~900 km from the Heimefrontfjella (74° 30'S) to the Whichaway nunataks (81° 30'). The glacial geomorphology is a consistent pattern of landforms and glacial deposits, which record a glacial (ice loading) history of the region that we have dated using two independent approaches of comsogenic Be-10 surface exposure dating and by radiocarbon dating of mumiyo (preserved stratigraphic deposits of proventricular stomach oil from snow petrels, Pagodroma nivea). We have deployed GPS receivers in a network to record contemporary surface motion, and at some sites have installed co-located seismometers to provide data for tomographic reconstructions of Earth structure. The glacial history provides constraints for our ice sheet modelling. Once we have preferred data-constrained simulations of ice sheet (load) history then we aim to run GIA models to provide updated GIA corrections for improved satellite gravimetry measurements of this region.

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Late Pleistocene environmental conditions in East Antarctica - evidence from snow petrel stomach oil deposits ("mumiyo")

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Sub-fossil stomach oil of snow petrels (Pagodroma nivea) forms unique deposits of so-called mumiyo in the vicinity of the bird's nests in ice-free areas of Antarctica. The deposits are indicators for un-glaciated terrestrial sites but also provide records of the occupation histories of the inland breeding localities by snow petrels as well as for productive foraging areas off the coast. Previous studies showed that mumiyo deposits can contain intact stratigraphy making them suitable for nearly continuous paleo-studies ranging back for more than 55 thousand years.

Due to the dominantly marine origin of the organic material in mumiyo deposits, they form an archive that integrates marine and terrestrial information of past environmental conditions. We suggest that changes in the oceanic foraging habitat of the snow petrels (e.g. with respect to nutrient availability, sea ice conditions, biogeochemical cycling) are represented in the composition of snow petrel stomach oil and finally in mumiyo deposits. In order to derive proxies for paleoceanographic and -climatic reconstructions from mumiyo deposits, we analyse lipid biomarkers (mainly fatty acids and alcohols) and stable isotopes ($\delta^{13}C$ and $\delta^{15}N$) on mumiyo from different regions in East Antarctica and covering a wide range of ages (fresh stomach oil, and sub-fossil material of up to 55 thousand years old). This allows for identifying spatio-temporal variations in composition and possible effects of post-depositional alteration.

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The use of meteoric 10Be from sub-ice shelf sediments as a proxy for the Holocene retreat and sub-shelf dynamics of the Amery Ice Shelf, post LGM

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Ice shelves are critical in 'buttressing' grounded ice by providing lateral back stress to ice streams and stabilising the mass balance of an ice sheet. They are susceptible to mass loss, leading to dynamic thinning and once removed, acceleration of grounded ice sheets. This is particularly important where ice sheets are grounded below sea level and prone to Marine Ice Sheet Instability, as is much of the East Antarctic Ice Sheet.

Sub-ice shelf environments are one of the few places where it is possible to observe past ice retreat inland of current ice sheet boundaries. Recently, meteoric ^{10}Be has been used to distinguish successfully between sub-glacial, sub-ice shelf and marine environments from core top samples below the Ross Ice Shelf and the Ross Sea.

This study aims to assess the viability of meteoric ^{10}Be as a proxy for paleo sub-ice shelf dynamics under the Amery Ice Shelf (AIS), during the Holocene. We sampled down four sub-ice shelf cores to observe whether the calving front retreated upstream from its present extent during a warm period from ~11.5-9.5 ka, when average global atmospheric temperatures were ~1°C higher than present.

Results indicate the AIS margin didn't retreat significantly beyond its present extent during the Holocene, suggesting the threshold for ice shelf destabilization lies between Holocene (+1°C) and Pliocene (+3-4°C) conditions. Furthermore, the concentration of ^{10}Be was successfully used to track the movement and intensity of sub-shelf currents, which in the Amery system have remained relatively consistent since ~ 5 ka BP.

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Central Scotia Sea bathymetry compilation and geological map international initiative (BATCESSEA)

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This new bathymetry compilation of the Central Scotia Sea (CSS) represents an international initiative coordinated by IGME (Spain), BAS (UK) and AWI (Germany) incorporating additional data from other partners. The planned bathymetrical and geological map will cover an area of 1492300 km2 between parallels 52ºS and 64ºS and between meridians 50ºW and 31ºW. In this area, the existing high resolution bathymetric data cover at least the 50% of the region with a 100 to 200 m cell resolution for the sea floor topography. This information was collected over the last 30 years on dozens of cruises onboard different Antarctic research vessels. The CSS is the natural prolongation to the east of the Drake Passage gateway, which connects the southeastern Pacific and the southwestern Atlantic oceans, interacting additionally with the Weddell Sea. Geological and oceanographic processes in this area influence mantle flow, oceanographic water mass exchanges and migrations of biota. The geodynamic evolution, seismic activity and tectonic data suggest a complex evolution where important continental fragmentation and oceanic spreading processes have configured a puzzle of sedimentary basins and submerged continental banks, as South Orkney, South Georgia and Discovery among others, permitting the present pattern of global ocean circulation to be established. This initiative is part of the IBCSO, an SCAR Expert Group, which recognizes the importance of regional compilations in areas of scientific interest in Antarctica. This map will enhance the BAS GEOMAP 2 Series products about the Scotia Arc, after the published Drake and South Sandwich maps and bathymetric compilations.

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Glacial/interglacial history of environmental and oceanographic change on the Adelie Land/Wilkes Land Margin, East Antarctica

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Geomorphological and sedimentological evidence is used to interpret the glacial/interglacial history over the last ~250 ka of the Adelie/Wilkes Land region comprising changes in productivity, ice sheet expansion, and oceanic circulation including the formation of Adelie Land Antarctic Bottom Water (ALBW). The slope and rise of the continental margin are currently made up of a series of large submarine channels. These channels are currently inactive and infilling, with the exception of the Jussieu Channel which is an active conduit for ALBW. Sediment cores from ridges between the submarine channels preserve two dominant modes of sedimentation. The first is interglacial hemipelagic deposition of massive, highly bioturbated silts with evidence for biological productivity and ice rafted debris (IRD), with some evidence for contourites. The second mode of sedimentation is glacial hyperpycnites and turbidites. These contain minimal biological productivity, varying bioturbation and negligible IRD. The hyperpycnites are interpreted to be sourced from turbid sediment-laden plumes of meltwater from beneath the East Antarctic ice sheet during the glacials, with ice streams extending to the edge of the continental shelf and may have formed large submarine channels on the continental slope during the glacials. There is some variation in sedimentation between the different glacials, which likely reflects the extent of the ice sheet across the shelf, and the presence or absence of sills on the shelf edge.

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Biogenic silica production and burial in the Ross Sea: A potential link between nutrient supply and CO2 drawdown during Miocene Climatic Optimum

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The Miocene Climate Optimum (MCO ~17-14.5 Ma) was the warmest climate interval of the last ~35 Ma and immediately preceded the Middle Miocene Climate Transition (MMCT; ~14 Ma), a major interval of Antarctic ice expansion and global cooling. Marine sediment records indicate that the MCO was associated with global-scale changes in carbon cycling possibly reflecting increased silicate weathering in Antarctica due to the orbitally-paced development of a temperate ice sheet. Yet there are relatively few records from ice proximal regions that constrain the dynamic ocean-ice sheet feedbacks; the response of the Antarctic ice sheets to warming during the MCO has the potential to provide insight for future warming scenarios. IODP Expedition 374 to the Ross Sea recovered a well-preserved early to middle Miocene diatom-bearing/-rich mudstone to diatomite sequence (Unit III) from continental shelf Site U1521. High biogenic opal concentrations (30-55%) in Unit III (85.34-209.17m CSF-A) represent a period of predominately open marine conditions from ~16.7 and 15.8 Ma (preliminary shipboard age model). However, high-magnitude fluctuations in biogenic opal concentration suggest variable marine primary productivity over the MCO, likely reflecting a dynamic ice sheet. Our working hypothesis is that high biogenic opal concentrations represent periods of increased nutrient supply, possibly as a result of enhanced terrestrial silicate weathering associated with Antarctic glacial advance/retreat. The subsequent burial of large amounts of biogenic opal, as well as the corresponding organic carbon, could serve as a major global carbon sink, and highlights the potential role of Antarctic silicate weathering in controlling atmospheric CO2 levels.

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PALEOSTRIP: a backstripping MATLAB© code applied to marine continental margins

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We present PALEOSTRIP, an open-source code developed for MATLAB© to perform 3D-backstripping of marine continental margins sediment body. Backstripping consists in decompaction of sediment layers through time. During decompaction, flexural or local isostatic correction can be applied. PALEOSTRIP also includes a module of post-rift thermal subsidence based on the McKenzie rifting model. Finally, paleo eustatic sea-level corrections can be applied to the backstripped sediment layers, following well-known eustatic sea level curves, or following user-prescribed 1D or 2D sea level corrections. Most of PALEOSTRIP parameters can be prescribed homogeneously or be spatially variable over the grid domain. The different set of corrections, including thermal subsidence, can be activated or deactivated, allowing for a full parametric study of backstripping uncertainty. PALEOSTRIP allows to backstrip wells (1D), 2D transects or 3D maps.

Here we apply the code to paleobathymetric reconstructions of the Ross Sea (Antarctica) from the Late Oligocene (25 Ma) to the Plio-Pleistocene. Compared to the pan-Antarctic reconstructions, in which geophysical parameters are usually homogeneous over the entire domain, the regional backstripping approach allows more refined reconstructions of the paleobathymetry. A set of tuned geophysical parameters is constrained by existing deep drilling sites, such as IODP leg 28 and IODP leg 374. Reconstructions are embedded in the recent pan-Antarctic reconstructions from Paxman et al. (2019). We use those reconstructions to force an ice sheet model and show the difference between backstripped pan-Antarctic or regional reconstructions.

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The Odyssea Contourite Depositional System (Ross Sea): a combined record of ice sheet and ocean activity.

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Contourite Depositional Systems are produced in areas where bottom currents play a dominant role in mobilizing sediment and therefore represent a precious continuous record of oceanic currents activity and sediment availability, both related to ice sheet advances/retreats in polar areas. This study focuses on the Odyssea Contourite Depositional System, located between the Iselin Bank and the Hillary Canyon. This area lies under the effect of the Antarctic Slope Current, flowing along the continental slope and carrying relatively warm waters, and of the cascading dense water masses that are produced on the continental shelf. The Hillary Canyon represents the main conduit for dense waters and sediments flowing down-slope but also a preferential pathway for the relatively warm waters to reach the continental shelf. During maximum glacial advances, when the Antarctic ice sheet had its grounding line close to the shelf edge, the intrusion of warm waters from the Hillary Canyon could have produced basal melting and affected the stability of the ice sheet.

The interpretation of the seismic lines acquired within the PNRA-ODYSSEA project by the research vessel OGS Explora in 2017 across the southeastern flank of the Iselin Bank allows to study the stratigraphic record of the Odyssea Contourite Depositional System. New data acquired in 2018 by IODP Expedition 374 will help in the reconstruction of the processes acting in the area since the late Miocene. In turn, the hypothesis coming out from the interpretation of wells and seismic data can be tested by numerical models.

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Fe-Si-oxyhydroxide deposits at Hook Ridge of Bransfield Strait, Antarctica

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Geological and geophysical investigations were carried out in Hook Ridge of Bransfield strait, Antarctica, during the R/V Xianghong No.1 cruise in 2017/2018. The seafloor hydrothermal fields was discovered which will help us to understand the fundamental processes controlling the exchange of material and energy between different spheres of the earth. In Hook Ridge, the Fe- and Si-rich oxyhydroxide deposits were recovered using the TV-grab. They mainly occur as the chimney at the seafloor associated with the fragments. There are no crystalline minerals in these deposits because of no identifiable peaks on the XRD patterns. The whole rock composition of these deposits is dominated by high Fe and Si contents. The contents of V, Ge, Sr, Mo and Ba are also relatively high in samples, while other trace elements concentrations are low(Cu+Co+Ni+Zn<30.32 wt%). The total rare earth element contents are low (41.847-47.077 ppm), and the chondrite-normalized distribution patterns show the notable negative Eu and Y anomalies. Sr isotopic compositions are slightly lower than those of seawater. Nd isotopic compositions of samples varies from Nd=+5.9 to +6.9, possible recording the mixing between seawater and basement rock. Pb isotopic compositions are closed to the Atlantic sediments. All these facts refer to the hydrothermal origin, with the minor contribution of biogenic processes.

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Miocene Initiation of the Complete Antarctic Circumpolar Current: A Causal Link to Late Miocene Climate Cooling?

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Initiation of a complete Antarctic Circumpolar Current (ACC) has been regarded as dependent on the opening of deep seaways south of Tasmania and South America. The late Eocene to early Oligocene age of these tectonic events has led to the suggestion of a causal link to Antarctic glaciation through the thermal isolation of the continent by the current. The timing of the first oceanic lithosphere in Drake Passage between South America and the Antarctic Peninsula is well established at ca. 30 Ma. However, geochronologic and geochemical study of rocks dredged in the central Scotia Sea has led to the hypothesis that an 'ancestral South Sandwich arc' (ASSA) could have formed a barrier to easterly throughflow of deep water from this gateway even as it opened (Pearce et al., 2014). Recent seismic tomography resulting from the United States Antarctic component of the international Polar Observing Network (POLENET) project has now provided independent evidence for the existence of the ASSA by imaging of an anomalously fast region in the mantle transition zone beneath the west-central Scotia Sea. The ASSA is comparable to the active South Sandwich arc to the east where subduction of the South American plate is imaged (Lloyd et al., 2019). Might the mid-late Miocene removal of this final barrier to a complete ACC be causally linked to the intensification of global cooling and formation of a cold-based Antarctic ice sheet?
Lloyd, A., et al., International Symposium Antarctic Earth Sciences, 2019
Pearce, J., et al., Global and Planetary Change, 2014

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Miocene paleobathymetric reconstruction of the Ross Sea (Antarctica)

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Today the continental shelf of the Ross Sea is overdeepened (average 500 m at the shelf edge), and landward deepening, as the result of erosion by multiple ice sheet advances over the seabed and deposition of morainal banks at the continental shelf edge. In fast-flowing areas, the amount and rate of the erosion at the ice sheet base depends on the thickness of the ice, the ice velocity, the occurrence of basal meltwater, the nature of the bed, the duration of ice sheet advance, etc. At the grounding line, the water-saturated sediments entrained at the base is released and deposited on the seabed.

Since the onset of Antarctic glaciations, erosion of the continental shelf and sediment deposition at the continental margin gradually shaped the Ross Sea bed through time. Reconstructing the evolution of the sea bed morphology and depth can therefore help inferring ice sheet extent and flow regime, and represents boundary conditions to numerical simulations of past ice sheet dynamics.

We present the preliminary results of backstripping modelling applied to the Ross Sea. Depth converted maps of some principal Miocene unconformities, based on the entire set of international seismic data, are used to reconstruct the Ross Sea paleobathymetry changes around the Miocene. Reconstructed paleodepths show a gradual deepening and seaward widening of the Ross Sea. The depth maps have been restored after removing sediment load, assuming isostatic compensation, post-rift thermal subsidence and accounting for geological constraints from DSDP leg 28 and IODP Exp. 374 sites.

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Vegetation and environments during early history of the East Antarctic ice sheet: High-resolution palynological insights from Sabrina Coast, East Antarctica

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The Aurora Subglacial Basin contains an estimated 3.5 m of global sea level equivalent ice and is primarily drained by the Totten Glacier system, which terminates at the Sabrina Coast, East Antarctica. Thinning of the Totten Glacier indicates this region is highly susceptible to oceanographic and atmospheric changes. A paleoclimate perspective on these changes will improve understanding of East Antarctic Ice Sheet (EAIS) dynamics in this sensitive system. Here we present high-resolution palynological data from NBP 14-02 jumbo piston cores (JPC) JPC-54 and JPC-55, which enable reconstruction of regional environments during EAIS development. The Sabrina Flora is dominated by angiosperms, with Gambierina spp., often exceeding 40% of the assemblage. Diverse Proteaceae, Battenipollis spp., Nothofagidites spp., and conifer palynomorphs are also notable. Pristine preservation and the frequent occurrence of Gambierina spp. clusters indicate the majority of the Sabrina Flora assemblage is deposited penecontemporaneous with sedimentation. Biostratigraphic results indicate JPC-55 and JPC-54 as latest Paleocene and early-mid Eocene sediments, respectively. Biomarker evidence of plant wax n-alkanoic acid yields average $\delta^{13}C_{30}$ values of -30.2±0.5‰ (JPC-54 only) consistent with open canopy woodland or shrubby tundra. δD_{30} values were stable across JPC-54 and 55 with a mean -215±4.5‰. A fractionation of ~-100‰ indicates δDprecip of -128‰, slightly more positive than coastal snow in the same region today, suggesting sourcing of plant biomarkers from close to the coast. Integration of biomarker and palynological results are consistent with a drier, more open type of coastal vegetation rather than the closed rainforest vegetation often envisaged for Paleocene-Eocene Antarctica.

1512

Diatom paleoproductivity as impacted by evolving cold-climate conditions during the Pliocene-Pleistocene transition along Wilkes Land, East Antarctica

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Marine-based glaciers fronting the East Antarctic are vulnerable to warming sea-temperatures. During the Mid-Pliocene Warm Period (MPWP), an analog for current global warming, the retreat of the East Antarctic Ice Sheet into the Wilkes Subglacial Basin contributed 3-10 meters of sea-level rise (Cook et al., 2013). A few degrees cooler or warmer than pre-industrial temperatures dictate the presence of large ice sheets, the strength and position of global circulation patterns, and the survival of ecosystems. The diatom assemblage from IODP site U1361, located on the Wilkes Land Margin continental rise, demonstrates the changes in the Southern Ocean environment that occurred when the Earth cooled by 2-3^{o}C following the MPWP. Shifts in the assemblage link to the intensification of global glaciation between 2.4-2.73 Ma, the stabilization of EAIS, and rearrangement of circulation features. Diatoms are a dominant Southern Ocean phytoplankton whose silica-structure is well preserved in sediments. The environmental preferences of specific species are derived from modern studies that characterize the distribution of extant taxa in the Southern Ocean. The biogenic silica content of the bulk sediment (BSi) correlates to primary productivity in the photic zone and/or the influx of terrigenous material. High BSi (> 15 wt%) corresponds to interglacials and shifts in the periodicity of BSi, i.e. the frequency and duration of primary productivity, occur concurrently with major environmental shifts.

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The response of Antarctic vegetation to Oligocene and Neogene climate variability

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Over the course of the Cenozoic, Antarctic vegetation has transformed from temperate and near-tropical forests, to a very sparse macroflora inhabiting the ice-covered continent of today. The timing of the demise of vegetation in Antarctica has been long debated and is inferred to have occurred in response to climate cooling during the late Miocene or Pliocene. Here we use plant wax abundances, distributions and compound specific isotopes ($\delta^{13}C$ and $\delta^{2}H$) from onshore and proximal marine Antarctic outcrops and drill cores to investigate how Antarctic vegetation responded to, and survived, climate variability in the Oligocene and Neogene. Plant wax isotopic trends are sensitive to an array of environmental forcings, including water availability, temperature and seasonality. In particular we focus on three key climate transitions; the extensive Mi-1 glaciation at the Oligocene/Miocene boundary (23 Ma) which marks a key step in Cenozoic Antarctic ice sheet history from relative warmth in the late Oligocene to large temperature and ice volume fluctuations in early Miocene, the Miocene Climate Optimum (17-15 Ma) when atmospheric CO_2 and temperatures were at levels similar to those projected for the coming century, and the Miocene Climate Transition (14-13 Ma) where ice in Antarctica increased, temperature cooled and CO_2 levels dropped.

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The modern circum-Antarctic distribution of biogenic opal accumulation and lessons for paleoceanography

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The Southern Ocean has been identified to represent a major sink of biogenic-bound silicon (BSi) and to play a key role in controlling the global ocean silica cycle. The major deposition of biogenic opal ($BSiO_2$) in the Southern Ocean occurs in a near-circumantarctic band, the so-called “Antarctic opal belt”, roughly bounded by the winter sea ice edge to its South and the Subantarctic Front to its North. Major contributors to the $BSiO_2$ deposition are siliceous hardparts of diatoms. Here we present new $BSiO_2$ concentration data and ^{230}Th-normalized flux data to enhance the data coverage in the Southern Ocean. This allows for the generation of a circum-Antarctic map of biogenic opal deposition from more than 1250 sites. As such, we improve the knowledge on the $BSiO_2$ deposition pattern in the Southern Ocean and augment the robustness of estimates concerning modern BSi flux rates, which is substantial for the understanding of silica cycling in the world ocean. With this we address the ongoing debate whether the Southern Ocean represents a major exporter of Si or it only imports Si to compensate for the BSi burial in the sediments. Another goal of our study is the improvement of the baselines needed to apply Southern Ocean $BSiO_2$ deposition as a proxy for paleoceanographic reconstruction. This requires understanding of the physical and biological processes governing the production, accumulation and distribution pattern of $BSiO_2$, together with the paleoceanographic significance of the related distribution pattern of main diatom species building the majority the Southern Ocean $BSiO_2$ deposition.

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Establishment of the modern Antarctic Circumpolar Current

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Key words: Neodymium isotopes, Sortable silt, Circumpolar Deep Water, Antarctic Circumpolar Current

The Antarctic Circumpolar Current (ACC) plays today a key role in the global ocean, the Antarctic ice sheet and thereby the global climate system. The timing of the onset of the strong, deep-reaching ACC flow remains controversial, representing a fundamental gap in our understanding in the evolution of the global ocean circulation, and its role on the paleoclimate. Here, we present coupled records of neodymium isotope ratios (εNd) generated from fossil fish teeth/bone debris, biogenic silica and mean grain size of sortable silt from pelagic sediments recovered from the Deep Sea Drilling Project Site 278 on the South Emerald Basin. Our data provide critical insights on the establishment of the modern-like strong, deep-reaching ACC through changes in the evolution of the Circumpolar Deep Water on the Pacific side of the Tasmanian Gateway, from the middle Oligocene to the Pleistocene (~31-1 Ma). Around the Pliocene-Pleistocene transition, the εNd values at Site 278 converge with the values of the present-day Circumpolar Deep Water. This is nearly coeval with a major step-like increase in the mean grain size of sortable silt and biogenic silica records suggesting a causal relationship between the development of the modern-like homogenous Circumpolar Deep Water εNd values in the Southern Ocean and the establishment of the strong, deep-reaching ACC.

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Submarine canyons off Cape Darnley, East Antarctica

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The Antarctica continental slope off Cape Darnley is known as a major pathway of colder, less saline, and denser bottom water, which is produced in the Cape Darnley polynya and known as the Cape Darnley Bottom Water (CDBW). The mooring observations showed that significant signals of the CDBW occurs at the center of the Wild Canyon (Ohshima et al., 2013). Intensive erosion and material transports from shallow regions to deep ocean can be expected here, but the relationship between bottom water and submarine canyons is still debated. Here we present new observations from large networks of submarine canyons off Cape Darnley. We conducted underway geophysical mapping, multichannel reflection seismic survey, bottom rock and sediment sampling during the R/V Hakuho-maru KH-19-1 and KH-20-1 cruises. Multibeam bathymetry, sub-bottom profiler, total and vector magnetic fields, and gravity data were acquired along ship tracks. New bathymetric map reveals that a large channel network of submarine canyons exists in the pathway of known CDBW area. Sub-bottom and multichannel seismic reflection profile show sub-seafloor structure of submarine canyons and surrounding sedimentary layers. Based on collected rocks, sediments, and deep-sea camera observations, it is shown that seafloor surface is covered with angular clast and sand in the shallower part of the channel. Furthermore, sandy silt with current ripple morphology is deposited in the deeper part of the channel. These results imply that a main stream of the CDBW may contribute to erosion, transportation, and sedimentation at the submarine canyons, shaping the seafloor off Cape Darnley continental slope.

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Geo-paleontological re-significance of the Cockburn Island (James Ross Basin, West Antarctica)

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Cockburn Island is located in the northwest of the Weddell Sea between Marambio/Seymour and James Ross islands, less than a hundred kilometres from the Antarctic Peninsula. The stratigraphic units recognized were already correlated with the known sequence of the James Ross Basin, including the Snow Hill Island Formation (Cretaceous), the lower allomembers of La Meseta Formation (Paleocene-Eocene), and Neogene rocks unconformable lying at the top. The upper plateau is formed by a Miocene–Pliocene flat level of volcanic rocks of the James Ross Island Volcanic Group and small pockets of the Pliocene Cockburn Island Formation ("Pecten−conglomerate"). Framed in a geo-paleontological project focused on the James Ross Basin, the firsts prospecting activities were carried out during the last austral summer. Specimens collected during this first stage from the Pecten-conglomerate, allows the preliminary identification of new taxa as Cheilostomata bryozoan cf. "Anasca" and cf. "Ascophora". Subsequently, our project will focus on the Cockburn Island through: 1) A comprehensive study of fossil specimens from the "Pecten-conglomerate" to test the hypothesis of environmental conditions consistent with an interglacial period, and an ice-free coastline, 2) The evaluation of Cockburn Island Formation as a Geo-Heritage topic, and 3) Paleontological fieldwork in the almost vertical cliffs with Cretaceous and Paleogene units. Particularly the Paleocene-Eocene levels, which in contrast to the deltaic/estuarine outcrops of La Meseta Formation in Seymour Island, should have a more continental influence due to its proximity to the source area.

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Glacially driven shelf-to-rise transport from seismic stratigraphy linked to IODP Expedition 379 drill sites in the Amundsen Sea, West Antarctica

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The Amundsen Sea sector of the West Antarctic Ice Sheet is currently losing large amounts of ice, driving hypotheses on collapses during past warm times with similar climatic conditions as predicted for the near future. IODP Expedition 379 aimed to collect sediment cores from the continental shelf and rise of the Amundsen Sea Embayment in order to analyse records of changes in glacially driven sedimentation to decipher and analyse major phases of intense ice sheet advances and retreats across the shelf. The existing seismic network is linked to the two sites drilled on the continental rise during Expedition 379. These drill sites are located on one of the major sediment drifts with one site being near the top of the drift, recovering high-resolution Pleistocene to late Miocene records. An adjacent deep-sea channel and other channels meander from the foot of the continental slope and have transported suspended sediments from the outer shelf into the deep sea, thereby supplying much of the drift deposits. Several connected seismic lines extend from the rise onto the shelf. Our seismic correlation with marker horizons at the drill sites shows that the major progradational sequences of the outer shelf were deposited by glacial advances in the Pliocene, indicating that the WAIS did not advance to the shelf break of the Amundsen Sea Embayment before the Pliocene. Since the build-up of the progradational wedge, deep-sea channel systems developed to large extent and contributed to the formation of most of the sediment drifts on the continental rise.

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Stratigraphy of the Marie Byrd Land sector of West Antarctic Continental Margin: evaluating trends in depositional and oceanographic setting

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Understanding the past evolution of the West Antarctic Continental Margin is critical for informing predictions regarding the future of the West Antarctic Ice Sheet. The climatic and oceanographic setting of the margin is known to have influenced the growth and retreat of the WAIS over time, including potential ice sheet collapse during the Pliocene. However, large uncertainties remain in reconstructions. Two recent IODP expeditions to the Ross and Amundsen Seas acquired core from as far back as the Miocene to revise and constrain models of ice sheet change. However, direct stratigraphic correlation between the two sectors was limited by the lack of geophysical data.

For this reason in 2019, concurrent to IODP-379, the RV «Academic Alexander Karpinsky» undertook an expedition to the Marie Byrd Land sector of the margin, collecting 2260 km of geophysical data. Eight seismic reflection profiles were combined with previously acquired data, to produce a stratigraphic model which could be directly correlated to the IODP sites.

Stratigraphic and geomorphic analysis shows that the sedimentary package has been affected to varying degrees by both downslope processes and depositional processes from oceanographic currents. Notably, there is a strong east-west pattern of deposition which reflects differences in the dominant sedimentary processes between the Amundsen and Ross Seas. These regional differences in the oceanographic setting could revise our current understanding of how the WAIS reacts spatially to climatic changes. Further analysis will look at evidence for ice sheet collapse in the Pliocene and any indication of asynchrony across the margin.

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Seismic characterisation of the seafloor stratigraphy beneath the Ross Ice Shelf near the Kamb Ice Stream grounding line

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Seismic data collection during three recent seasons has resulted in almost 75 km of seismic profiles covering a region just seaward of the Siple Coast grounding line of the Kamb Ice Stream. This region is the focus of ongoing research efforts on the southeastern part of the Ross Ice Shelf supported by Antarctica New Zealand. Seismic imaging in this region is being used to position drilling efforts through the ice shelf and into the underlying seafloor. The layout of the lines was designed to provide regional coverage of the sub-ice-shelf ocean and sediments in a region where Rosetta airborne-gravity data identified a gravity low. Data acquisition through the three surveys seasons has been similar, with a 96-channel seismic system recording symmetric shot records with a 10 m geophone spacing. Shots, frozen in at a consistent depth of 25 m below the surface, vary from 2.4 kg to 0.8 kg, with the lower charge size having significantly improved frequency content. Processed seismic data show a relatively flat seafloor lying beneath the ocean cavity. Subseafloor reflectivity suggests the presence of a subhorizontally layered sedimentary succession at least several hundred metres thick with a number of erosional contacts between stratigraphic sequences clearly identified. There is no clear evidence of a basement reflection in the seismic data. The regularity of the seafloor and underlying sediments suggests that the Rosetta gravity low must have a geological, rather than bathymetric, origin.

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The Polar Rock Repository: A Resource for Glacial Studies

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The Polar Rock Repository (PRR) at the Byrd Polar and Climate Research Center (BPCRC) is an NSF funded facility that provides access to rock, terrestrial drill core, glacial deposits and marine dredge samples from Antarctica and the southern oceans. Currently >54,000 samples are available as no-cost loans for research.

The collection contains more than 700 samples from the Cenozoic Sirius Group. In addition, > 800 specimens are available from other glacial deposits with a concentration in the Dry Valleys. The dredge collections include samples that contain corals/marine invertebrates and marine plants. The PRR online database contains information useful to glacial geologists and biologists by noting locations with biological activity in ancient lakes, soil horizons, dry valleys and glacial surface features.

Typical sample information includes formation, age, weight, surface features, minerals observed, magnetic susceptibility, specific gravity (on request), logistics, publications, field notes, photographs etc. Scientists may request samples and conduct research using destructive techniques. In addition to the physical samples, the PRR archives supporting materials: eg. field maps and photos, air photos, thin sections and any associated bibliography/DOI's.

Researchers may search for samples using the PRR website which uses an advanced search engine to allow scientists to "drill down" into search results using categories and look-up object fields similar to websites like Amazon. Results can be viewed in a table, downloaded as a spreadsheet, or plotted on an interactive map that supports display of satellite imagery and bathymetry layers. Samples can be requested by placing them in the 'shopping cart'.

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Facies characterization of early Holocene deglaciation record, IODP Site 1357A, East Antarctic Wilkes Land margin

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We aim to contribute to the understanding of the processes and drivers of marine-based East Antarctic Ice sheet (EAIS) loss and its contribution to global sea level rise and biological impacts during the Holocene deglaciation that followed the Last Glacial Maximum (LGM) (~24 kyr-12 kyr). Holocene sediments above the LGM diamicton at Site U1357 (IODP Expedition 318), located on east Antarctic Wilkes Land margin continental shelf, are 180 m thick, being one of the highest resolution (annual to millennial) sedimentary records in the Southern Ocean close to Antarctica over the last ~12 kyr. Preliminary facies analysis of the Holocene deglaciation sediments (cores 19-20H, 160.22 – 185.45 mbsf) reveals two pulses of sand/silt sediments with ice rafted debris (IRD). These pulses are intercalated within a rhythmic laminated diatom ooze above the poorly sorted gravelly siltstone diamicton. To infer past ice-sheet dynamic, facies characterization is based on high resolution digital images, CT Scans, grain size analyses, and physical properties while congruent paleo-environmental conditions are reconstructed through continuous X-Ray Fluorescence (XRF) geochemical data, diatom counts, HBI biomarkers and biogenic silica data. In addition, additional 14C ages are being processed to constrain the age model.

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Holocene sediment deposition in the Drygalski Basin of the western Ross Sea

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Two gravity cores (GC01 and GC03B) and two box cores (BC01 and BC03) were obtained, respectively, at site DG12-01 (74°43.6'S, 166°42.2'E, 1,028 m) located in the northeastern flank and site DG12-03 (75°12.7'S, 164°14.1'E, 1,244 m) located proximal to the Drygalski Ice Tongue in the Drygalski Basin. Comparison of preliminary data between the box core and the upper part of gravity core confirms that the core-top loss of gravity cores is negligible. Sediment facies of GC01 consists of the faintly-laminated gravelly muddy sand at lower part and the bioturbated mud at the upper part. GC03B consists of the muddy sand with scattered mud chips at the lower part, the sandy mud as the transition interval, and the bioturbated mud at the upper part. In both cores, the bottom sediments are characterized by relatively high MS, large mean grain size, high C/N ratio, low water content, low TOC, low TN, and low biogenic opal. In contrast, the sediment properties of the upper part are opposite to the lower part. Absence of diamicton at the bottom of both cores indicates the Holocene sediment deposition after the retreat of glacier in the Drygalski Basin. Abundant sand and occasional mud chips in the muddy sand facies of GC03B and large number of gravels in the gravelly muddy sand facies of GC01 reflect the continuous supply by floating glaciers during the retreat of glacier. The bioturbated mud facies at both sites signifies the complete retreat of glacier and the seasonal sea ice condition.

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Unique oceanographic and climatic conditions in the Early Oligocene Australian Antarctic Basin: Did enhanced productivity tip the climatic scales towards colder climates?

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The Early Oligocene (~34-27 Ma) is a time of major transformation in the Southern Ocean. The growth of the continent-wide ice sheet at the Eocene/Oligocene Boundary as well as the establishment of a circum-polar water mass exchange modified pre-existing ocean current and sedimentation patterns. This crucial timeframe for understanding the transition and manifestation towards colder climates is not well observed in the deeper Southern Ocean. Our understanding mainly hinges on sparse drill sites located on bathymetric highs. We re-examined all available seismic reflection data in the Antarctic-Australian basin, detecting an enormous, up to 2.1 km thick sedimentary package on the abyssal plain offshore Wilkes Land. By tying this interpretation to adjacent drill sites, we report compacted sedimentation rates of up to 30 cm/kyr during the Early Oligocene. The clear lack of downslope transport mechanisms in the seismic data coupled with clockwise oceanic circulation in the Australian-Antarctic basin point to a non-terrigenous origin of the strata. This depocentre is exceptional within Southern Ocean, considering its size, location and composition. We propose that this massive accumulation of potentially biogenic material is the result of spatial and temporal unique oceanographic and climatic conditions in the Australian- Antarctic corridor. For a brief period, the combination of a newly glaciated continent increasing nutrient supply, a clock-wise ocean circulation transporting warmer waters and creating an upwelling cell, lead to enhanced biogenic sedimentation in the deep sea. The increased productivity and carbon sequestration potentially impacted the reduction of atmospheric CO2-levels, tipping the climatic scales towards colder conditions.

1628

The roles of turbidity current and glacial dynamics in shaping continental margin, off Prydz Bay, East Antarctica

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The Early Pliocene saw major changes in geomorphology and sedimentation in the Prydz Bay region that produced Prydz Channel and Amery Depression on the shelf and the trough- mouth fan on the upper slope. However, evidence for the state of the EAIS during the Pliocene is sparse and difficult to interpret unequivocally. Marine geological-geophysical data collected from the continental shelf in Prydz Bay, Antarctica, including seismic-reflection data, bathymetry, core records from ODP drilling and gravity coring sites, reveal a complex paleo-subglacial drainage system linked to an offshore depositional regime. Sediment delivery mechanisms at the Prydz Bay are influenced by a number of interplayed factors including canyons-channels, turbidity currents, bottom current, sea level changes, paleo-ice streams, meltwater, and mass-wasting processes because the sedimentary sequences comprise turbidites, contourites and blocky mass transport deposits. The canyons and channels along the Prydz Bay margin act as main conduits for turbidity currents and debris flows that bring sand-sized sediments from the glaciated margins to the deep sea, facilitating slope bypass. Coriolis force is a key factor, which controls the deposition architectures of the intra-channel sedimentation and owing to its effects, turbidity currents build higher levees on the left-hand side in the Southern Hemisphere. However, we noticed that higher levee deposits developed at the right-hand side and erosional features and slumps are occurred on the left-hand side on the Wilkins canyon. To explain this, we propose that a high energetic, strong erosive traction-dominated flow, which is associated with dominantly bypassing channel systems controlled such depositional architectures.

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Reconstructing past ice-ocean changes using beryllium isotopes: assessment in the Ross Sea

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Beryllium isotopes measured in glacio-marine sediment have the potential to record past changes in ice-shelf geometry, ocean circulation and/or meltwater discharge, on a range of timescales. However, reliable application of the approach firstly requires assessment of beryllium isotope concentrations in sediments of known environmental settings. We measured isotopes in a range of modern sediments from across the Ross Sea, and combined these with previous data from the region.

We found that both meteoric 10Be and the 10Be/9Be ratio are able to robustly distinguish between depositional settings. Statistically different concentrations occur between sub-glacial (low 10Be and 10Be/9Be), sub-ice shelf (intermediate 10Be and 10Be/9Be) and open marine (high 10Be and 10Be/9Be) settings. This result differs from that found in Prydz Bay (East Antarctica), where the 10Be was shown to reflect sub-ice shelf circulation patterns rather than depositional environment. We therefore suggest that down-core measurements of beryllium isotopes from the Ross Sea should provide a clear reconstruction of past changes in ice-shelf geometry. Lower magnitude variability in isotope concentrations could reflect changes in ocean circulation or meltwater discharge.

Further work is required to test: 1) Are beryllium isotopes measured in sediment from beneath the Ross Ice Shelf an indicator of sub-shelf circulation or the distance from the grounding-line/calving-front?; and 2) Does variability in beryllium isotopes reflect changes in meltwater discharge?

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Ocean-driven non-linear glacier retreat during the Holocene: southwestern Ross Sea, Antarctica.

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Recent grounding-line retreat, dynamic thinning and mass loss in Antarctica has been attributed to oceanic warming. Episodic grounding-line retreat and rapid thinning also occurred in the southwestern Ross Sea during the Holocene, despite relatively cold ocean temperatures. The exact driver of ice loss at this time remains uncertain, with large-scale ice sheet models unable to simulate the timing and rate of thinning indicated by geological data in southwestern Ross Sea.

Here we apply the 2D finite-element ice-flow model Úa to investigate the role of ocean temperature and bed geometry in the deglaciation of the southwestern Ross Sea. Model runs were constrained by onshore records of ice sheet thinning at Mawson and Mackay Glaciers, as well as offshore ages of grounding-line retreat and inferences from seafloor geomorphology.

Our experiments demonstrate that the bed geometry controlled the spatial pattern of grounding-line retreat. Topographic pinning points limited the rate of ice loss until retreat progressed beyond a bathymetric threshold. Additionally, ocean thermal forcing determined the timing of this ice loss. Enhanced ocean-driven melt is required during the Early-to-Mid Holocene in order to replicate the records of deglaciation. Such oceanic changes are possibly linked to the production of High Salinity Shelf Water, and could explain similar episodes of ice loss that are recorded elsewhere in Antarctica at this time.

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Laminated sediments in core RS15-LC42 in the central basin of the Northwestern Ross Sea: Preliminary microscopic results

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An 11.75 m-long core RS15-LC42 was collected at the water depth of 2084 m in the Central Basin (71°49.40'S, 178°34.76'E) of the northwestern Ross Sea. Core LC42 consists of three major sediment facies: IRD-poor bioturbated mud, IRD-rich massive mud, and laminated mud. These facies are intercalated throughout the core and, particularly, 8 laminated mud facies were distinct, despite the different thickness from about ten cm to more than 2 m. In this study, we focus on the uppermost laminated mud (LM1). LM1 occurs between 150 cm and 175 cm downcore with the upper and lower boundaries to IRD-poor bioturbated mud. The lower boundary seems clear whereas the upper boundary is fairly bioturbated. A series of a few mm to a few cm-thick light and dark laminae were interlayered to form LM1. At 165-167 cm downcore, thin section was made for the microscopic observation and polished section was prepared for SEM examination. Based on microscopic observation, the thin light layer seems coarser than the thick dark layer. The SEM examination reveals that the coarse-grained light layer consists of angular to subangular silt particles including silt-sized aggregates of fragmented diatoms. In contrast, the fine-grained dark layer is composed of mostly clay-sized clastic particles enriched with the very tiny diatom pieces. Thus, the formation process and related depositional condition of these laminated sediments will shed light on understanding the advance and retreat of glacier and its role to the depositional process in the slope basin of the northwestern Ross Sea.

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Pre-site surveys and plans for deep geological drilling in Antarctica: Observations beneath the Ekström Ice Shelf (Sub-EIS-Obs), Dronning Maud Land, East Antarctica

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During previous seasons, pre-site seismic surveys have taken place on the Ekström Ice Shelf (EIS), with the primary goals of establishing a chronostratigraphic framework for the sub-ice-shelf sedimentary record and gaining a better understanding of the cryosphere/ocean/sediment interactions, thresholds, magnitudes, and rates of previous ice-sheet changes in this area. The sediments cover the Explora Wedge, a syn-rift volcanic deposit. Supposed ages for the sedimentary sequences range from Late Mesozoic to Quaternary. From vibroseismic profiles, we selected sites for seafloor sampling through up to 332m ice melted by Hot Water Drilling (HWD) and 722m depth below the ice shelf surface. First preliminary results for stratigraphic age (diatoms and absence of pollen) from core catcher samples indicate ages between 2.5 and 10 Ma. Last deglacial sediments below the EIS display high carbonate contents from prevailing sessile benthic organisms, mainly bryozoans. One ^{14}C age constraint from a surface bivalve shell provided a minimum age for the grounding line retreat at Site EIS-2 of 7098±98 ^{14}C years BP (uncorrected). Petrographic and geochemical analyses of clasts offer information about the geology of the outcropping strata and the ice-covered hinterland.

We plan to establish an international consortium to deploy deep drillings through the sediments overlying the Explora Wedge and the wedge itself. We expect these sediment sequences to reveal the history of polar amplification and climate changes in this part of Antarctica, as well as the build-up of the East Antarctic Ice Sheet during past climates. We further aim at deciphering its Cenozoic and future variability.

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Late Pliocene to recent variations in ocean heat flux to the Ross Sea continental shelf interpreted from XRF sediment geochemistry, IODP Site U1523

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International Ocean Discovery Program (IODP) Site U1523 was cored on the outer continental shelf of the eastern Ross Sea. Sedimentation at this site is dominantly controlled by currents, recording variations in alongslope (Antarctic Slope Current [ASC]) and downslope (Ross Sea Bottom Water) current flow from the late Miocene to present. In the Ross Sea, the ASC acts as a barrier to the transfer of warmer modified Circumpolar Deep Water onto the continental shelf and therefore changes in ASC strength play a role in penetration of warm water in this region. Here we target the upper Pliocene to recent record to examine changes in current strength as a proxy for oceanic forcing (heat flux) using sediment geochemical records. We collected X-ray fluorescence (XRF) core scanning data and calibrated it with major and trace element analyses. We also measured total carbon, organic carbon, and carbonate content on select samples. These data allow us to construct high-resolution records of major and trace element sediment composition. Initial results show cyclical variations in some records. Silica and barium are anticorrelated over some intervals, whereas zirconium and titanium typically show distinct peaks interspersed with intervals of little variation. Carbonate content is generally low (0.5–5 wt%), although a few samples record higher carbonate content (up to ~12 wt%). We use multivariate statistical analysis to identify distinct geochemical signatures that may represent different water-mass sources. Our data will be combined with other records to elucidate changes in ocean heat flux and its influence on Antarctic ice-sheet stability.

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Evaluating and applying the sea-ice biomarker lipid IPSO25 on sediments from western Antarctic continental shelves

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Over the past decade, an organic geochemical biomarker lipid, i.e. a highly branched isoprenoid (HBI) diene called $IPSO_{25}$ (Ice Proxy of the Southern Ocean with 25 carbon atoms; Belt et al., 2016), has gained pronounced attention as a proxy for sea-ice reconstructions in Antarctica. To further evaluate the reliability of this proxy, we investigated several seafloor surface sediments from the Amundsen Sea, the Antarctic Peninsula and the Weddell Sea and compared the proxy-based sea-ice reconstructions to satellite data and modelling outputs.

We then applied the $IPSO_{25}$ proxy to a marine sediment core recovered from inner Pine Island Bay on the Amundsen Sea Embayment (ASE) continental shelf. Pine Island Glacier, which drains the West Antarctic Ice Sheet (WAIS) into the eastern ASE, is regarded as a hotspot for rapid mass loss of the WAIS and may contribute 3.5 – 10 mm to sea level rise over the next 20 years (Favier et al., 2014). Thinning of the glacier is attributed to the basal melting of its floating ice shelf by warm Circumpolar Deep Water upwelling onto the continental shelf. We conducted organic geochemical biomarker analyses, which provide valuable insights into the sea-ice conditions in the ASE and the evolution of Pine Island Glacier over the Holocene. Therefore, we considered $IPSO_{25}$ alongside a phytoplankton biomarker, subsurface temperatures derived from GDGT analysis and sedimentological parameters for reconstructing palaeo sea-ice coverage. In order to provide semi-quantitative palaeo sea-ice estimations, we further applied and evaluated the recently proposed $PIPSO_{25}$ index (Vorrath et al., 2019).

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Reconstructing past Totten Glacier expansion and retreat using diatom and radiolarian based temperature reconstructions.

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The Totten Glacier drains more ice than any East Antarctic glacier, contains the equivalent of 3.5m sea level rise, and rests on bedrock below sea level. Recent observations have shown that basal melting of the glacier is due to warm water masses entering the cavity beneath the glacier via a deep submarine channel. Changes in ocean heat flux likely explain observed Totten Glacier melt rates, so reconstructing past ocean temperature may provide insight into how the glacier has changed in the past.
The Totten Glacier drains at the Sabrina Coast. Marine sediment cores from the continental shelf and slope are valuable when estimating past ocean temperatures and ice-ocean interactions. Well-preserved siliceous microplankton skeletons (namely diatom frustules and radiolarian tests) in Sabrina Coast sediments are useful when reconstructing past ocean conditions, particularly considering carbonate microfossils are virtually absent.
This poster will present Holocene temperature reconstructions of surface water using diatom-based transfer functions, and at depth using radiolarian-based transfer functions, to help identify possible warm water incursions during the Holocene. Other proxy evidence will be relied upon to investigate the presence/absence of sea-ice and timing of past melt water pulses and to link SST estimates and periods of retreat and expansion.

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Contourite drifts and paleoceanography in the Powell and Jane Basins, north-western Weddell Sea

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This research is based on the seismic data (more than 30000 km) collected in the Northern Weddell Sea by many countries/organizations and available from the Seismic Data Library System as well as on the new data acquired in 2018 by the Russian Antarctic Expedition. Seven major seismic horisons were identified in the sedimentary cover of the north-western Weddell Sea. Ages of the horizons (c. 27, 20, 18, 14, 12, 6 and 3 Ma) were suggested on the basis of ODP drilling and our knowledge about the past environmental conditions in the West Antarctica (seismic stratigraphy generally follows the previously created models with minor changes). Different types of contourite drifts were identified in the Powell and Jane Basins. Drift distribution and current-controlled moats/channels allow us to reconstruct the bottom water circulation in the Late Cenozoic. In the Powell Basin, bottom currents originated soon after the basin opening (between 25 and 20 Ma). Major depositional changes in the studied region are marked by the horizon '5' (c. 12 Ma) which correlates with the start of full West Antarctic glaciation and arisen connection between the Weddell Sea and the Scotia Sea. Current-controlled (buried and recent) moats, channels and marginal valleys are well identified and continuously mapped along the slopes of continental margins and basement highs (sea mounts and the Jane Volcanic Arc) showing the position of bottom current cores. This study was supported by the Russian Foundation for Basic Research, Project 19-05-00858.

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The SWAIS 2C Project - Sensitivity of the West Antarctic Ice Sheet in a Warmer World

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Antarctic ice sheet dynamics remain the largest uncertainty in projections of future sea level rise. The SWAIS 2C Project is a new international effort that aims to understand past and current drivers and thresholds of WAIS dynamics to improve projections of the rate and size of ice sheet changes under a range of elevated greenhouse gas levels in the atmosphere and associated average global temperature scenarios to and beyond the 2°C target of the Paris Climate Agreement. A primary goal of SWAIS 2C is to acquire geological records of WAIS extent from past intervals of warmth including Quaternary super-interglacials. Previous drilling by the Deep-Sea Drilling Project (DSDP), Ocean Drilling Program (ODP), and recent International Ocean Discovery Program (IODP), MeBO, and ANDRILL recovered stratigraphic records of past ice sheet behaviour across the mid to outer continental shelf. Similarly, the response of WAIS to past warmer-than-present climates has been inferred from far-field globally-integrated records of sea level and ocean δ18O. We will utilize new drilling technology to obtain a sedimentary history of past ice sheet dynamics at two locations (Kamb Ice Stream and Crary Ice Rise) along the Siple Coast in the West Antarctic interior. Geological records from this location have proven difficult to obtain but are critical to better constrain marine ice sheet sensitivity to past and future increases in global mean temperature up to 2°C.

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Late Miocene to late Pleistocene paleo ice flow to the central Ross Sea from detrital zircon U/Pb geochronology

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In 2018, International Ocean Discovery Program Expedition (IODP) 374 retrieved sediments from a ~695.74 m succession of upper Miocene to recent strata at Site U1522 located in the Glomar Challenger Basin, Ross Sea. With the goal to unravel till input from East (EA) and West Antarctica (WA), 10 till samples were selected to collect U/Pb ages by LA-ICPMS on the 250-63 µm size fraction (200-300 grains per sample to maximize detection of small age populations).

Four samples from ~700 to 540 m CSF-A (core depth below sea floor) with late Miocene depositional ages have distinct age peaks at 600-500 Ma, 350-320 Ma, 240-160 Ma, 100 Ma, and 30-40 Ma, similar to ages reported in the Swanson Formation, Ford Granodiorite, WA ice streams and Byrd Coast Granite. Ages 30-40 Ma are not well documented elsewhere and could be associated with felsic phases of early McMurdo Volcanics or with younger WA volcanism. Three late Miocene-Pliocene samples (~480-340 m CSF-A) have a Triassic-Permian signal similar to the upper Beacon Supergroup. However, 600-500 Ma ages similar to the Swanson Formation or Lower Beacon remain strong. Three samples (~220-3 m CSF-A) of Plio-Pleistocene age have similar zircon age populations to one another and predominantly resemble ages from EA Nunataks, with a small 100 Ma (i.e. WA) peak present.

Our analyses on till deposited on the central Ross Sea continental shelf provide evidence for a change from predominantly WA sediment input to a more significant EA contribution over time.

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Rapid Denudation of West Antarctica during the Early-Middle Miocene

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Most of the West Antarctic Ice Sheet is grounded well below sea level; this geometry strongly influences the response of the ice sheet when ocean warmth is supplied to its margin. Topographic reconstructions suggest that West Antarctica largely fell below sea level during the early-middle Miocene, but the timing of this transition remains poorly constrained despite its considerable impact on the ice sheet's susceptibility to changing ocean conditions.

In 2018, International Ocean Discovery Program Expedition 374 recovered 411.5m of predominantly lower-middle Miocene sediment at Site U1521 on the middle-outer continental shelf of the Ross Sea. To unravel ice sheet behaviour during this period, we consider the provenance of sediments from the lower part of Site U1521, which were deposited ~18-16.7 Ma, using various geochemical methods (zircon U-Pb dating, hornblende/biotite Ar-Ar dating, fine-grained Sr and Nd isotopes). These data have been augmented by clay mineralogy and petrographic characterisation of gravel-sized clasts, and integrated with palynology, lithofacies and seismic facies interpretations.

Whilst some units have a distinct geochemical and petrographic fingerprint characteristic of a central Transantarctic Mountain source region, 180m of sediment contains abundant reworked dinoflagellates and was primarily derived from West Antarctica. This West Antarctic sediment was deposited from ~17.8-17.4 Ma, coinciding with a period of increased obliquity sensitivity. This well-defined shift in provenance implies a significant change to ice sheet flow. We suggest this is linked to the lowering of the West Antarctic topography below sea level, heralding the transition to the more sensitive marine-based ice sheet observed today.

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Mid-Miocene and Pliocene Antarctic ice sheet characteristics and stability deduced from lava—ice interactions at Mason Spur and Helms Bluff, McMurdo Sound, Antarctica

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Assessing variations in Antarctic ice sheets is fundamental in quantifying future climate and sea level change and is largely reliant upon numerical modeling. Critically, some fundamental but unknown aspects of past ice sheet conditions, such as ice thickness and thermal regime (ice sheet stability), are best answered by looking at lava—ice interactions in a field of study termed glaciovolcanology. Such parameters are necessary for accurate ice sheet and sea level modeling. To that end, glaciovolcanology studies have been undertaken in the southwest Ross Sea of southern Victoria Land, at Mason Spur and Helms Bluff. These studies compliment glaciovolcanology studies undertaken nearby at Minna Bluff and in northern Victoria Land, and offshore drilling studies by ANDRILL and the Cape Roberts Project. Mason Spur exposes part of a Cenozoic eruptive centre in McMurdo Sound, c. 100 km southwest of Ross Island. It was active c. 12 to 11 Ma during warming immediately post the Mid-Miocene Climatic Optimum and records evidence of eruption in the presence of either free water, snow or alpine glaciers. Nearby Helms Bluff exposes another volcanic feature erupted at c. 4.5 Ma. It includes ‘a‘a lava-fed delta formations with morphologies typical of emplacement beneath ice. The outcrop allows an estimation of the minimum thickness of the past overlying ice sheet and records wet- versus dry-based glaciation conditions. In conjunction with nearby onshore and offshore records, these studies inform time-slice reconstructions of Neogene ice sheet conditions, including during periods of volcanic eruption not well represented in marine drillcore records.

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Summer sea-ice variability in the eastern Weddell Sea during the last glacial stage as recorded in snow petrel stomach oils ('mumiyo')

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Antarctic sea ice is a critical component of the climate system, affecting a range of physical and biogeochemical feedbacks, and supporting unique ecosystems. During the last glacial stage, Antarctic sea ice was more extensive than today. However, uncertainties in both empirical data sets and climate models over the seasonal distribution and character of the sea-ice pack limit our understanding of sea-ice drivers, ecosystem response, and climate impacts. Here, we exploit a unique biological archive of conditions in the sea-ice pack: the preserved remains of regurgitated snow petrel stomach oils (sometimes referred to as 'Antarctic mumiyo'), deposited on nunataks above the ice sheet. We present results from a sequence recovered from the Lake Untersee Oasis, central Dronning Maud Land (71°20.2'S, 13°23.6'E), which records snow petrel foraging in the eastern Weddell Sea. By linking dietary signals in the stomach oils to modern feeding habits, we demonstrate centennial-scale variability to the summer sea-ice pack close to the Antarctic continent early in the last glacial stage (ca. 24.5-30.7 cal. ka. BP). By identifying the presence and evolution of open waters ('polynyas') within the sea-ice pack, the results challenge existing hypotheses which emphasise the development of an extensive, thick, multi-year 'sea-ice cap' as the key for positive sea ice / climate feedbacks during glacial stages.

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Variations in Antarctic Ice Sheet extent in the late Miocene to Pliocene: Results from IODP

Site U1522 on the Ross Sea Continental Shelf

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The marine-based West Antarctic Ice Sheet is particularly vulnerable to increasing ocean temperatures; however, lack of ice-proximal records limits the ability of modelers to use paleoclimate data to better constrain future ice-sheet retreat and sea-level rise. International Ocean Discovery Program (IODP) Expedition 374 cored 702 m of Neogene sequences at Site U1522 on the Ross Sea continental shelf, recovering ~280 m of core (40%). The site targeted a seismic sequence of massive and laminated acoustic facies interpreted as interbedded glacial, glaciomarine, and open-marine deposits to provide insight into past ice-sheet behavior. Our study targets the consolidated sediments below 200 mbsf, which consist of upper Miocene to Pliocene diatom-bearing to rich sandy to muddy diamictite, mudstone, and diatomite. We present X-ray fluorescence (XRF) core scanning results, calibrated with major and trace element analyses that provide a high-resolution record of sedimentary geochemical variations. XRF bromide counts correlate strongly with total organic carbon content and we use these data as a proxy for paleoproductivity. We combine all of these data, together with sedimentary facies analyses, to evaluate late Miocene to Pliocene changes in relative ice sheet proximity, sediment provenance, and paleoproductivity. Initial results reveal cyclical geochemical variations that may reflect changes in provenance. We also use downhole logging data to assess lithological changes across core gaps, including an unrecovered interval between 230 and 250 mbsf that likely corresponds to the mid-Pliocene Warm Period. This integrated approach allows us to develop a better understanding of Antarctic ice sheet sensitivity in a warming world.

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Cryptotephra in marine sequences of the Ross Sea, Antarctica: implications and potential applications

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Marine sediments of Antarctica contain tephra, fragmented material produced by explosive eruptions of Antarctic volcanoes and widely dispersed by wind. Tephra are preserved specially when sequences suffer small disturbance and sedimentation rate are high. If fingerprinted, dated and linked to a volcanic source, tephra become time-synchronous markers for independent correlations between geological archives. Tephra are also significant for volcanological reconstructions to derive the type, magnitude, age and recurrence of eruptions. Tephra record can be significantly extended by examining successions for the presence of cryptotephra (non-visible tephra). These are essential to increase the number of eruptions recognizable of any magnitude and in distal occurrences. Recently, for the first time in Antarctica, a cryptotephra record was found in a core from the Joides Basin (Ross Sea; Di Roberto et al. 2019).
This discovery widens the tephra research possibilities, allowing far-reaching objectives to be tackled. On these bases, an innovative and multi-disciplinary project called CHIMERA - CryptotepHra In Marine sEquences of the Ross Sea, Antarctica: implications and potential applications - granted by PNRA proposes to: 1) re-examine marine sediment cores located in the continental shelf basins of the western Ross Sea; 2) identify, date and fingerprint cryptotephra intercalated in these marine sequences; 3) make marine cryptotephra easily identifiable as a stratigraphic markers; 4) synchronize and correlate these levels with Antarctic tephra archives extrapolating information into regional/continental framework and 5) use these stratigraphic markers for the paleoenvironmental reconstructions, mainly addressed to the ice shelf oscillations during the different glacial/interglacial conditions of the Late Quaternary.

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Deglacial dynamics in the Ross Sea (Antarctica) revealed by the occurrence of the planktic foraminifer Neogloboquadrina pachyderma

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Ice shelves are very sensitive to climate variability as their dynamic change is related to atmospheric and oceanic warming/cooling. The dynamics of the Ross Ice Shelf, the largest in Antarctica, have been investigated by several researchers, however, the timing of its retreat from the Last Glacial Maximum (LGM) is still under debate, mainly due to a lack of robust marine chronostratigraphy. Since calcareous organisms are rarely preserved in the Antarctic sediments, possible ages are often based on acid-insoluble organic matter, leading to several problems mainly concerning the incorporation of reworked organic matter. For this reason, the recovery of sediments containing continuous occurrence of calcareous foraminifers can help reconstruct past glacial dynamics in the Ross Sea with a robust age model. Neogloboquadrina pachyderma is the only calcareous planktic foraminifer able to live in polar oceans, surviving in brine channels within sea-ice under hyper-saline and low temperature conditions. The distribution of N. pachyderma in the Antarctic continental margin enables to test models of ice shelf dynamics and water mass variations. We document intervals with an abundant occurrence of well-preserved N. pachyderma (juveniles and adult forms) from the deglacial sedimentary sequences in the northern Drygalski Basin and Hallett Ridge (Western Ross Sea). We discuss N. pachyderma habitat, also considering data of benthic foraminifers, diatoms, and stable isotopes. We suggest that co-occurrence of large N. pachyderma tests and abundant juvenile forms in the deglacial sediments reflect open water conditions and/or variation in the duration and coverage of seasonal sea ice.

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Initial Geologic Results from Thwaites Glacier Offshore Research (THOR) 2019 and 2020 Field Seasons

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Uncertainty in sea-level projections arises from a lack of understanding of how the West Antarctica Ice Sheet will behave in coming decades. Thwaites Glacier, which currently contributes ~4% to sea-level rise, is thinning and accelerating in a deep setting that allows relatively warm Circumpolar Deep Water to melt the glacier base. Significant retreat of Thwaites Glacier will trigger ice loss across the region. Thwaites Glacier mass balance has become increasingly negative, suggesting that unstable retreat may have already begun. These observations motivated a large international collaboration, led by US and UK teams, aimed at understanding the factors that control the stability of Thwaites Glacier.

The Thwaites Offshore Research team conducted three field deployments to study recent glacier retreat. Two cruises of the RVIB N.B.Palmer in 2019 and 2020, combined with sub-ice-shelf sediment coring of 4 sites (2019-2020 season), provide a diverse suite of data along the Thwaites and Pine Island glacier margins. Thwaites Glacier retreat allowed surveying of previously unmapped seafloor in 2019. Major calving of Pine Island Glacier in 2020 allowed surveying in areas that were only accessible by ice-shelf coring previously. Extensive multibeam surveys, 3.5 kHz subbottom and high-resolution seismic profiles, and ~100 sediment cores were collected to investigate properties of the bed from which the glaciers retreated.

The bathymetry reveals troughs that route Circumpolar Deep Water to Thwaites Glacier and bedforms that record past ice-flow. Sediments record glacier retreat and ocean interaction, extending the instrumental record several thousand years through analysis of sediment properties, microfossils, and porewater.

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Sea ice variability across glacial-interglacial cycles in the Weddell Sea

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Multi-proxy investigations of gravity cores recovered from the Antarctic continental margin in the Weddell Sea sector provide for an assessment of sea ice conditions, water temperature and primary productivity variability 1) during the last deglacial at the continental slope off Atka Bay in the northeastern part of the Weddell Sea and 2) across the last glacial-interglacial cycles in the Powell Basin (western Weddell Sea) and proximal to the Riiser Larsen Ice Shelf in the eastern Weddell Sea. Highly branched isoprenoids (HBIs), glycerol dialkyl glycerol tetraether (GDGT) proxies and the recently proposed PIPSO25 index (Vorrath et al., 2019) are used to track past sea ice and ocean temperature fluctuations. These biomarker records are further complemented by XRF and physical property data which support the identification of linkages between ocean and ice-shelf dynamics. Radiocarbon dating and consideration of ice core data finally support the development of core chronologies. Distinct variations in the abundance of the sea ice proxy IPSO25 (Belt et al., 2016) at all three sites point to rapid changes in sea ice cover with potential implications for primary productivity, dense shelf water formation and ice-albedo feedback mechanisms during crucial time intervals of climate warming.

References

Belt et al., 2016. Nature Communications, v. 7, p. 12655.
Vorrath et al., 2019. Biogeosciences, v. 16, no. 15, p. 2961-2981.

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Towards better definition of the age frames and palaeogeography of the oldest Cenozoic glaciations in West Antarctica: isotopic ages of selected volcanogenic series and erratics from King George Island.

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Isotopic studies were carried out in the central part of King George Island. Selected mafic to intermediate igneous rocks were sampled for this purpose. Single-grain U-Pb dating of zircon from andesitic basalts and andesites was controlled by a whole rock 40Ar-39Ar data. The U-Pb isotope dating was also performed on zircons from nine erratic pebbles of different rocks that were found in the tillite of the Polonez Cove Formation. The new age determinations allow to more precise and credible stratigraphic correlation of glaciogenic rocks that intercalate in some places the magmatic succession of King George Island. For example, some volcanogenic formations, considered previously as Cretaceous in age, were emplaced or deposited in fact during the Eocene when volcanic processes were the most intense there. The U-Pb isotope age spectrum obtained from the erratics allowed to define the areas of their derivation and consequently the way of migration of the Polonez ice sheet in West Antarctica. Our studies indicate that most of K-Ar age estimations in West Antarctica cannot define a real age of magmatic rocks and they should be verified by much more credible Ar-Ar or (in the rocks with zircon) integrated U-Pb and Ar-Ar data.

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SDLS as a tool for collaborative data sharing and discovery for understanding the tectonic, geology and paleo-environments of Antarctica

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Acquiring marine multichannel seismic data is an expensive and difficult task, especially in polar environments. In 1991, Antarctic Seismic Data Library System (SDLS) was created under the mandates of the Antarctic Treaty System (ATS) and the auspices of the Scientific Committee on Antarctic Research (SCAR) to provide open access to Antarctic multichannel seismic reflection data (MCS). The goal of the SDLS is to preserve access to the valuable multi-channel seismic data, share information about existing data, and promote collaboration between researchers from different countries and institutions. By doing so, the SDLS maximizes the use of existing data and avoids duplication of survey efforts. The SDLS provides access to the data through library branches worldwide and through a web portal (https://sdls.ogs.trieste.it/), which provides access to unrestricted MCS data in the library. We will present recent updates of the SDLS and provide examples of its use. Today, SDLS holds over 330,000-line km from 129 seismic surveys. The data and resulting cooperation have been a critical basis for scientific progress of the Antarctic marine geoscience community including preparation for numerous ODP and IODP drilling campaigns, tectonic studies, circum-Antarctic sediment distribution, and paleobathymetry analysis.

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Obliquity paced oscillations of the Ross Ic Shelf during the Quaternary

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The frequency of Antarctic glaciations during the Quaternary are not well understood. Benthic oxygen isotope records provide evidence for eccentricity paced global ice volume changes since c. 800 000 years and the ice core records (such as EPICA) also appear to have 100 000 year cycles over the last 800 000 years.

Here we present results from the 6.21 m long, NBP03-01A-20PCA sedimentary record from the Ross Embayment. Sediments comprise mud with numerous clasts and paleomagnetic analyses revealed magnetic reversals C1n-C1r.1r-C1r.1n-C1r.2r which have corresponding ages of 773 ka, 990 ka, and 1070 ka.

Time series analysis of a Anhysteretic Remanent Magnetisation (ARM) data, which are controlled primarily by the concentration of magnetic minerals, revealed strong obliquity paced cycles between c. 800 ka and 350 ka. The presence of obliquity cycles prompted us to carry out core scanning XRF and grain size analyses. We identified obliquity paced cycles in the titanium elemental data over the same period which we suggest represent variations in the terrigenous material in the core. Weaker obliquity cycles are also present in the >2mm IBRD fraction which we suggest is controlled by the proximity of the ice shelf front.

Our data indicate that Ross Ice Shelf calving line advance and retreat cycles were paced with obliquity until at least 350 ka and that the mid-Pleistocene transition occurred later in the Southern Hemisphere than in the North.

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Stratigraphic architecture of Ross Sea sequences reveals nature of ice sheet dynamics during the early to middle Miocene

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Ice sheet oscillations during early-middle Miocene, are intermittently preserved in the sedimentary record on Antarctica's continental shelf, with widespread erosion resulting from the ice sheet advance. Seismic reflection data and deep drilling sites from DSDP leg 28 and IODP Expedition 374 located along the present-day middle continental shelf of the central Ross Sea, indicate the presence of expanded sections of the early-middle Miocene period. These expanded sections hold key evidence for the reconstruction of the Antarctic Ice Sheet oscillation during this period, including the Miocene Climate Optimum (MCO ~17-14.5 Ma), as well as large erosive surfaces associated with ice sheet advance both prior to, and following the MCO. Through correlating core, wireline log and reflection seismic data we reveal marked local variability in the sedimentary record of the Ross Sea continental shelf, which we interpret as evidence of a highly dynamic ice sheet. Here, we look at the seismic architecture of sediment packages associated with ice sheet advance and retreat, and provide preliminary drill core constraints for seismic isopach mapping on how changing ice masses through time influenced sediment deposition. Periods of major ice flow over the basins are revealed by the formation of prograding wedges. Ice sheet retreat is typically marked by high velocity seismic units associated with chert layers and diatom-rich muds documented in the drill core sections. Overall, our research shows several periods of diachronous ice sheet expansions in the Ross Sea prior to, and following the MCO.

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Diatom assemblage variability over the last two glacial cycles in Adelie Land, East Antarctica

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Relative diatom abundance is used together with sedimentological and geochemical data to reconstruct sea-ice cover and surface water productivity over the last two glacial cycles, in a sediment core from the WEGA channel, on the Adelie Land continental slope. The core site is 3,000 m below sea level, approximately 150 km north off the shelf edge, over 250 km from the present-day ice sheet grounding line and is affected by Adelie Antarctic Bottom Water down slope flow. Today, sea-ice cover occurs for part of the year and high productivity occurs in polynyas to the north of the site. The core contains six meters of alternating layers of interglacial and glacial deposits dating to the MIS 7 interglacial (~240 ka), each interval consisting of varying amounts of both hemipelagic and transported shelf sediment. The interglacials are characterised by high productivity (biogenic silica 8-22%) and dominance of Thalassiosira antarctica resting spores (60-70%) suggesting open marine environment. However, the glacials, MIS 2-4 and MIS 6, differ, with MIS 4-2 showing higher (biogenic silica 3-18%) and MIS 6 lower productivity (biogenic silica 3-6%). MIS 2 is characterised by relatively high levels of Thalassiosira antarctica (20-30%) and an increase in Eucampia antarctica (18-62%), including an increase in the sea-ice proxy terminal/intercalary valve ratio (0.2-0.8). Open water diatom species persist during all climatic stages, from MIS 5e to Holocene, suggesting polynya continuity within the Adelie region during the last glacial cycle.

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Influence of topography, substrates and meltwater outbursts on active icesheet retreat during the Late Holocene, offshore Windmill Islands, Antarctica

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The post-glacial history of the East Antarctic ice sheet is not well-known or understood. High resolution multibeam bathymetry from the nearshore region of the Windmill Islands, East Antarctica, reveals a suite of seafloor features recording two major readvances of the Law Dome ice margin during the Late Holocene. Readvance of this ice margin is likely activated by meltwater sourced from episodic jokhulaup outbursts, as observed recently in the region. A complex landform record of moraines, crevasse squeeze ridges and flutes reveal strong topographic and substrate control on the pattern of ice sheet advance and retreat. Cross-cutting relationships between moraine ridges within sediment-floored troughs and embayments provide evidence of active ice sheet retreat, with recession punctuated by phases of readvance, consistent with forcing from episodic meltwater outbursts. The complex pattern of retreat likely reflects the presence of a soft, deformable bed beneath the ice within the troughs and embayments, which promoted greater forward movement of the ice during readvance. In contrast, hard beds of highly fractured crystalline bedrock lack streamlined bedforms, indicating that the retreating ice mass was slow moving or static over these features and less responsive to external drivers forcing periodic readvance during overall deglaciation. This research provides a new understanding of the dynamic retreat of the Law Dome ice sheet; a style of retreat previously not recognised for the seemingly stable East Antarctic ice sheet.

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Chronostratigraphic integration of Neogene sequences from the subantarctic Pacific Ocean: Initial results from IODP Exp. 383, Dynamics of the Pacific Antarctic Circumpolar Current

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Excellent chronostratigraphy is essential for the development and comparison of paleoceanographic reconstructions across Neogene climate transitions. However, the calibration of Miocene and Pliocene biostratigraphic datums in the Southern Ocean has historically been hampered by the presence of hiatuses, compounded by the limited distribution of sediment cores with suitable lithologies to support the development of high-fidelity magnetostratigraphies.

From May-July, 2019, IODP Exp. 383 collected sediment cores from multiple holes at four pelagic and hemipelagic sites comprising a zonal transect along the northern flank of the Pacific Antarctic Circumpolar Current, from 76°41’ W to 125°26’ W. Diatoms, radiolarians, calcareous nannofossils, and planktonic foraminifers provide excellent primary biostratigraphic control for sites U1539, U1540, U1541, and U1543, all of which record apparently continuous accumulation. Central South Pacific Site U1541 (54°13’ S, ~3600 m water depth) spans >8.2 Myr, constrained by 74 biostratigraphic events and anchored by 27 well-defined polarity reversals. Eastern South Pacific Site U1543, on an elevated ridge west of the Chile Trench (54°35’ S, ~3860 m water depth) spans >7.2 Myr, is constrained by 54 biostratigraphic events and 29 well-defined polarity reversals. While Pleistocene shipboard biostratigraphic age assignments from all sites are generally in good agreement with the paleomagnetic reversal stratigraphy, systematic offsets and increasing age uncertainties were identified in the Pliocene and Miocene. Here, we use the exceptional shipboard paleomagnetic records from U1541 and U1543 to evaluate the calibration of select biostratigraphic datums, a first step towards providing a new Southern Ocean reference section for key intervals of the geologic timescale.

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Do turbidite deposits in the Hillary Canyon levee record dense shelf water outflow? Investigating the physical record of Antarctic Bottom Water (AABW) production in the Ross Sea from the late Pliocene (3.3 Ma) through present

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Oceanographic processes on the Antarctic shelf, such as sea ice and polynya formation, result in the formation of dense shelf water (DSW), which contributes to Antarctic Bottom Water (AABW) production. The seaward propagation of DSW to the continental slope can, in turn, trigger turbidity currents that entrain and transport sediment to the deep sea. The resultant turbidite deposits therefore represent a record of AABW outflow history. Our study is focused on IODP Exp 374 Site U1524, located 120 km seaward of the Ross Sea shelf edge on Hillary Canyon levee, one of the largest conduits for AABW outflow. The 280 m thick sedimentary section spans the late Pliocene (3.3 Ma) to recent and contains >3,300 thin (1.5 mm) turbidite beds whose frequency systematically declines up section. We subsampled 100 turbidites and their directly overlying mud and performed grain-size analysis using laser diffraction and x-ray particle sizing, respectively. Median grain size of the turbidites ranges from fine to medium silt (5-30 μm) with an upper end (D90) of medium silt to very fine sand (19- >100 μm). Mud deposits overlying the turbidites have an average silt:clay ratio of 23% and show no systematic variability up section. Sediment composition from XRF data suggests that the turbidites contain a mixture of biogenic (diatom fragments) and terrigenous material. Smear slide analysis of a representative subset confirms an up-section trend of decreasing biogenic content. Our sedimentological record is integrated with other proxy data to investigate AABW history in context of West Antarctic Ice Sheet dynamics.

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The MIS 3 deglaciation of sub-Antarctic Marion Island with cosmogenic 36Cl exposure dating

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Glacial oscillations of the Quaternary provide valuable insights into past and present climate linkages. For the Southern Ocean, the sub-Antarctic Islands provide a valuable terrestrial record of glacial chronologies, since they are unique, not only in size and topography, but also in oceanic situation when compared to other continental landmasses (e.g. Antarctica or Patagonia). Here we present a constrained glacial chronology for Marion Island, southern Indian Ocean, from cosmogenic 36Cl exposure dating. Exposure ages of glacial erosional and depositional features show that island deglaciation was underway before ~50 ka ago and was near completion by the peak of the global last glacial maximum (~20 ka ago). No evidence is found to suggest ice re-advances within this time frame, but minor stand stills are possible. Any Holocene re-advances, e.g. during the Antarctic cooling period, would have been restricted to the island's interior above 900 m a.s.l. This glacial chronology is similar to those of other sub-Antarctic islands (e.g. Kerguelen, Auckland & Campbell, and possibly South Georgia) and a number of mountain valleys elsewhere in the Southern Hemisphere (e.g. in Patagonia and New Zealand). We suggest a combination of declining temperatures, the expansion of the Antarctic ice sheet, the northward migration of the southern westerly wind belt and ocean frontal systems and Marion Island's physiography, created optimal conditions for glacier growth in MIS3 (or earlier) instead of MIS2. Our findings add to evidence that suggest the Southern Hemisphere was in a glacial maxima prior to the global LGM.

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Ostracod record from Pleistocene biogenic carbonate sediments off Cape Adare and IODP 374 U1523 site, a comparison

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Increasing attention has been paid to environmental and climatic change in the scientific literature with a focus on organisms which provide a proxy record of these changes. Ostracods have an excellent fossil record and are among the few groups that can be palaeo-environmentally informative in the marine realm. The NW Ross Sea area off Cape Adare shows carbonate-rich lithofacies, consisting of poorly sorted sandy and gravelly skeletal remains, with a good presence of biological remains. The high ostracods abundance is linked to the water mass circulation with related changes of nutrient content, salinity, sea ice cover and $CaCO_3$ saturation. In addition, the fossil assemblages, as well as textural and geochemical characteristics of marine limestone, contain invaluable proxies that render it possible to reconstruct the evolution of marine ecosystems. Analyses of ostracod fauna from six gravity cores, collected during two PNRA cruises, in 1998 and 2002 respectively, allowed for the determination of the more or less favorable periods when carbonate factories operated in order to produce carbonate sediment and to reconstruct the ice shelf-front oscillation phases and the connected paleoenvironmental / climatic changes. The first results regarding the ostracods recovered from the IODP 374 U1523 site show an equivalent ostracod association to the aforementioned cores, with high quanti/qualitative values in seven units, thus making it possible to compare the environmental and climatic events of the late Quaternary with possible analogous changes which occurred in the last 3.0 Ma.

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Distribution, systematics and biostratigraphy of Pleistocene Radiolaria from core ABP-06, Station-I (Sections 4 and 5) Central Indian Ocean

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Diversified assemblages of radiolaria were recovered from the core ABP-06 of Station-I (Sections 4 and 5). The study area lies between Latitude 110 44.004'S and Longitude 760 3.311'E. The samples were collected at a water depth of 5,236 m. Lithologically, the studied sections are composed of silty clay and siliceous ooze of dark brown colour and containing rich radiolaria. Thirty samples at an interval of 4 cm were used to carry out the detail study. Forty taxa are identified in which 25 Spumellaria and 15 Nassellaria. The distribution of each radiolaria in the sections along with their systematics of stratigraphically important taxa are given. Based on the identified taxa, one radiolarian zone i.e. Collosphaera tuberosa is established. C.tuberosa is made on the appearance and disappearance and the presence of stratigraphically important taxa of this zone. It is observed that both the sections lie between 0.18-0.42 Ma of Pleistocene age.

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Characterization of detrital and diagenetic minerals in a terrigenous sand layer, Resolution Drift, northern Amundsen Sea (Site U1533, IODP379)

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Sediment cores recovered from 4180m water depth on the western flank of Resolution Drift, northern Amundsen Sea, are dominated by hemi¬pelagic muds, but also contain discrete beds of sand or gravel transported downslope from the continental shelf. A deep-sea channel near Site U1533 likely provided the pathway for downslope transport of sediment by turbidity currents, with occasional overspill distributing sediment to the site.

We investigated coarse sand that forms an isolated, sharply bounded layer in Hole U1533D at 39.11m CSF-A depth within thick monotonous mud. The sand horizon is ~2.5cm thick and exhibits normal grading. The detrital mineral assemblage is highly varied, containing quartz, K- feldspar, plagioclase, biotite, hornblende, zircon, rutile, monazite, xenotime, apatite, Fe-Ti oxides, titanite, spinels, and polycrystalline grains. This assemblage is strongly continental in character, reflecting a prevalent source in felsic granitoids. Hornblende and titanite indicate metaluminous plutonic sources; monazite and xenotime suggest more evolved granitoids or metamorphic rocks. U-Pb zircon age dating is in progress and initial results bearing on provenance will be reported.

Also abundant in the sand horizon are light-colored, dumbbell-shaped grains of Mn-oxide, 90 to 150 µm in dimension. Electron backscatter diffraction, used for microstructural-crystallographic characterization, reveals that Mn-oxides are highly crystalline, surrounding micro-grains that provided a nucleation point. The discovery of these forms is significant in light of new recognition of the abundance of particulate Mn in seafloor sediment, to be factored in to global manganese budget, and Mn as a paleoenvironmental indicator (Uramoto et al. 2019; Wu et al. 2019).

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Geochemical characterization and geochronology of distinctive rhyolite tephra and other sparse volcanogenic material in IODP379 deep-sea cores, Resolution Drift, northern Amundsen Sea

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One discrete layer of volcanic ash (tephra) was recovered by IODP379 from ~30m depth within uniform brown marine mud of early Pleistocene age. The coarse ash layer has a sharp base and upper boundary that is gradational over 5 cm into overlying mud. Using spectral and density characteristics, a diffuse cryptotephra was located at comparable depth in a second drill hole approximately 1000 m away. From thin section and electron microprobe analysis, the tephra are coarse (50-300µm) cuspate glass shards with elongated vesicles. The composition determined by EMPA-WDS is rhyolite, with SiO2 > 75 wt.%. 40Ar/39Ar sanidine dating is underway. Preliminary dates are between 2.5 (±0.1) and 2.9 (±0.02) Ma. Based on the discrete tephra horizon, coarse shard morphology, and continuity between two drill holes located 1 km apart, the rhyolite tephra is interpreted as having formed as airfall settled to depth in the deep ocean, at the site >550 km from the Amundsen Sea coastline.
Rhyolite is a rare occurrence in the Marie Byrd Land volcanic province. One notable locality is at Chang Peak-Mt. Waesche in the Executive Committee Range (~1000 km from the drill site). Our comparison of the IODP tephra to rhyolite glass from Chang Peak (sample MB-7.3, J. Smellie) does suggest an affinity to that volcanic center, however the IODP379 tephra differs in respect to the major oxides compositions and age (MB-7.3, 1.308± 0.008 Ma). We conclude that IODP379 tephra record an eruptive event from the Mt. Waesche center that is unknown from surface exposures.

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Origin of detrital and diagenetic minerals in a terrigenous sand layer, Resolution Drift, northern Amundsen Sea (Site U1533, IODP Expedition 379)

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Sediment cores recovered from 4180m water depth on the western flank of Resolution Drift, northern Amundsen Sea, are dominated by hemi¬pelagic muds, with sparse discrete beds of sharply bounded sand or gravel. We investigated an isolated, normally graded layer of coarse sand, ~2.5cm thick in Hole U1533D at depth 39.11m CSF-A. The highly varied detrital mineral assemblage includes quartz, K- feldspar, plagioclase, biotite, hornblende, zircon, rutile, monazite, xenotime, apatite, Fe-Ti oxides, titanite, spinels, and polymineralic grains.

Also abundant in the sand horizon are light-colored spherical- and dumbbell-shaped grains of Mn-oxide, 90 to 150 µm in dimension. Scanning electron microscopy analysis reveals that the Mn-oxides are crystalline and grew radially, rather than concentrically. Enclosed mineral fragments are common, indicating growth in the sand layer, however, it is not clear what material(s) served as nucleation sites. Discovery of a potentially new Mn-oxide form is important, in light of recent descriptions of the presence and extent of Mn particles in seafloor sediment, and their significance for the global manganese budget (Wu et al. 2019; Uramoto et al. 2019).

The mineral assemblage is strongly continental in character and indicative of prevalent granitoid source rocks, some metaluminous, and some metamorphosed. The sand horizon may represent material transported from the continental shelf. A deep-sea channel near Site U1533 likely provided the pathway for downslope transport of sediment by turbidity currents, with occasional overspill distributing sediment to the site. No evidence has been found to indicate other catastrophic processes, such as tsunami or meteorite impact.

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How sensitive are Antarctic Holocene relative sea-level records to late-Holocene glacial fluctuations?

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Traditional models of glacial-isostatic adjustment through the Holocene across much of Antarctica suggest a record of exponentially decreasing rates of relative sea-level (RSL) fall. Such models propose little to no effect of late Holocene ice-mass changes on RSL. However, increasing evidence of glacial oscillations across many parts of Antarctica, including the Antarctic Peninsula, are beginning to mount. What impact, if any, have these oscillations had on Antarctic sea-level records? In this study we review new and existing relative-sea level records from Joinville Island along the eastern tip of the Antarctic Peninsula, the Western Antarctic Peninsula, and the South Shetland Islands that suggest abrupt increases in the rate of sea-level fall through the late Holocene. We propose that these abrupt increases in the rate of RSL fall mark the solid earth response to periods of accelerated glacial retreat during the Holocene. In addition, we examine ground-penetrating radar profiles through raised beaches across the Antarctic Peninsula that also point to periods of relative sea-level rise during the Late Holocene, possibly in response to local glacial advances. These RSL reconstructions point to a dynamic Earth beneath the Antarctic Peninsula supporting recent assertions of a weak rheology underlying this part of Western Antarctica.

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Integrating marine and terrestrial geomorphic records to examine coastal landscape evolution in an Antarctic oasis

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The integration of onshore and offshore mapping reveals relationships between geomorphic features on land and their submarine continuity. This information is critical to understanding landscape evolution, particularly in areas that have experienced alternating glacial, subaerial and marine conditions such as Antarctica. We have used high-resolution imagery and digital terrain models of the marine and terrestrial environments of the Vestfold Hills, an ice-free coastal oasis in East Antarctica, to better understand geomorphic processes including past ice-sheet behaviour. Previous studies of ice dynamics in the Vestfold Hills have been based solely on terrestrial records. Data sources include aerial photography, satellite imagery, and swath bathymetry, as well as ground-based observations.

Mapping the adjacent marine and terrestrial environment highlights the occurrence of similar erosional and depositional landforms, both on land and on the seafloor. Characteristic landforms include knock and lochan topography, boulder fields, moraines, paleoshorelines, and shell-rich marine sediments that were shaped during periods of variable climate and sea level change. Most of the landforms characterising the seafloor developed in glacial or subaerial environments and were subsequently drowned by post-glacial sea-level rise. Significant geomorphological features, such as lakes (lochan), boulder fields, moraines, and paleoshorelines, are now submerged. Similarly, the occurrence of paleoshorelines (marine terraces) and shell-rich marine deposits on land is of particular interest because these landforms can preserve Holocene marine records. Integrating adjacent terrestrial and marine mapping information is crucial for understanding the geomorphological evolution of this rare ice-free coastal area.

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Assessing changes in the detrital sediment record during the Pliocene at the Ross Sea

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The Pliocene is the most recent time in Earth's history when global warmth was sustained longer than any Quaternary interglacial. Understanding ice sheet - climate interactions during the Pliocene provides insights into ice sheet response to ongoing warming. International Ocean Discovery Program (IODP) expedition 374 drilled and recovered 200 meters of Pliocene sedimentary sequences at the Ross Sea. The mid- to late Pliocene interval at Site U1524 is composed of massive to laminated olive gray muddy diatom ooze interbedded with greenish gray muddy/sandy diatom ooze. The insterval shows a cyclicity of the natural gamma radiation measurements within a 200 ky continuous record. For this reason, it was targeted to assess changes in provenance of detrital sediments, in an attempt to verify if changes in mineralogy and isotope composition is paced by orbital parameters. Preliminary XRD results show that the bulk mineralogy of the targeted interval is largely homogeneous and major constituents are quartz, illlite, chlorite and feldspar. Changes in color throughout the sedimentary record are caused by changes in the abundance of these minerals possibly due to variable continental erosion rate and ocean current strength during the time of deposition. Next steps will be to address how Nd varies in the detrital mud fraction to pair this information with mineralogical data.

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An invitation to the international Antarctic research community from Oregon State University's Marine & Geology Repository: Discover new records from the US Antarctic Program's Southern Ocean sediment core collection

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Sediment cores are physical records of past conditions that can be reused to address a wide variety of new research questions, often far beyond the initial purpose for collection. The National Science Foundation's Antarctic Core Collection (ACC) is the world's largest collection of seafloor sediment samples. With over one-hundred and twenty research cruises and expeditions around Antarctica, the collection has grown over the last fifty years to represent the most comprehensive physical archive of Antarctic ice sheet and ocean behavior. In 2018, Oregon State University's Marine and Geology Repository (OSU-MGR) relocated this historic collection of over eighteen kilometers of core samples from the Antarctic Research Facility at Florida State University to the OSU-MGR in Corvallis, Oregon. The relocation project included the construction of a state-of-the-art facility large enough to house the original marine geology research collections, and the ACC, including temperature-controlled space large enough to house the next fifty years of coring expeditions. In addition to long-term storage and archiving services, the new facility includes a core lab large enough to run major sampling parties, five track systems in a designated instrumentation lab, a wet lab with a fume hood for sediment processing, digital description platforms, and a thirty-person classroom. OSU-MGR staff are working to improve the ACC's metadata records in order to build an effective modern inventory using new digital collection management techniques. Current and future curation projects will comply with FAIR data principles, with the goal of making all OSU-MGR collections and associated datasets more easily discoverable online.

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Onshore to offshore glacial reconstruction of Terra Nova Bay, Western Ross Sea: a community work in progress

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With over 100 years of scientific exploration, the Terra Nova Bay area boasts a dense array of data to aid understanding of modern and past glacial behaviour. New terrestrial chronologies from cosmogenic surface exposure dating provide a history of ice-surface lowering for major outlet glaciers, while newly acquired marine geophysical observations and sediment cores constrain the past extent, timing and behaviour of marine-based ice. Using a group GIS, we have initiated new analyses on previously collected samples (Cryptotephra, ramped pyrolosis and meteoric 10Be). Ongoing sedimentary analysis and identification of material for new age constraints combined with recent high-resolution bathymetric data provide new life to cores held in national repositories.

Initial results reveal a mid-Holocene thinning signal along the David Glacier and a series of grounding zone wedges (GZW) consistent with a short-term stagnation of grounded ice which fits with previous studies along the Northern Foothills. X-ray analysis of archived sediment cores near GZWs provide linkages between episodes of onshore glacier thinning and offshore grounding line retreat. Ultimately, these geometric relationships and age constraints inform glacier modelling studies aimed at understanding processes that control glacial behaviour. For example, mapped glacial lineations provide geometric constraints for confluent ice while chronologies from GZWs and terrestrial surface exposure age studies are used to assess the model fit with reconstructed behaviour. This PAIS supported, ‘grass roots’ collaboration compliments ongoing, larger-scale efforts around the Antarctic and provides a forum which allows for open communication timely sharing of data acquisition plans and initial results.

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Rapid thinning of David Glacier in the recent geological past: chronology and controls

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Quantitative satellite observations of ice sheet mass loss span the last four decades, providing limited insights into long-term drivers. Geological records serve to extend the observational record and aid our understanding of ice sheet – climate interactions. Here we present the first millennial-scale reconstruction of changes in David Glacier, the largest East Antarctic outlet glacier in Victoria Land. Thinning profiles derived from 50 10Be and 3He surface exposure samples show that David Glacier experienced rapid thinning up to 2m/yr during the mid-Holocene (~6.5 kyr). Thinning ceased at 6 kyr, suggesting initial formation of the Drygalski Ice Tongue. Our work when combined with new records from adjacent glaciers shows that simultaneous glacier thinning in this sector of the Transantarctic Mountains occurred ~3 kyr after the retreat of grounded ice in the Ross Embayment. The timing and rapidity of the reconstructed thinning at David Glacier is similar to that reconstructed in West Antarctica and Antarctic Peninsula.

We use a glacier model constrained by our geological data to identify the causes of these rapid changes in David Glacier. We show that glacier thinning and marine-based grounding line retreat is initiated by interactions between enhanced sub-ice shelf melting and reduced lateral buttressing, leading to Marine Ice Sheet Instability. Such rapid glacier thinning events are not captured in continental or regional-scale numerical modelling reconstructions for this period. Together, our chronology and modelling suggest a paleo-dynamic thinning event enduring for ~2,000 years, offering insights into the nature and drivers of future ice sheet thinning in Antarctica.

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Preliminary Results of JARE61 Geomorphological Survey at Langhovde and West Ongul Island in Lützow Holm Bay, East Antarctica

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The geomorphological survey in the 61st Japanese Antarctic Research Expedition (JARE61) was carried out at Langhovde and West Ongul Island in Lützow Holm Bay, East Antarctica. The objective of this research is to establish the East Antarctic Ice Sheet history from the Last Interglacial to the Present, especially during the deglaciation.

The mass loss of Antarctic Ice Sheet (AIS) due to the global climate changes will contribute to global sea-level rise, and also the information of present ice-sheet mass balance is required to achieve an accurate projection of AIS behavior against global climate and oceanic changes. The timing and amplitude of AIS change during the deglaciation is essential to assess a glacial isostatic adjustments effect on the present ice-sheet mass balance. However, the difficulty of access in Antarctica make it challenging to obtain field-based evidence of ice-sheet and sea-level change during the deglaciation. In this presentation, we document the preliminary results of geomorphological survey at Langhovde and West Ongul Islands in Lützow Holm Bay. We surveyed the bathymetry of Lake Nurume and coastal area (<150 m water depth) in Langhovde to determine potential sites for collecting samples. In addition, we conducted on-water coring in Lake Nurume and successfully took ~3 m long core and also collect surface sediments and terrestrial cosmogenic nuclides samples. The collected samples contain past sea-level and ice-sheet records of targeted period. This research plan will continue to the next few years, so the collected samples and data will be the first step.

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Deglaciation history of the East Antarctic Ice sheet revealed by exposure ages and marine-lake sedimentary records in Lützow-Holm Bay, Dronning Maud Land

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The East Antarctic Ice Sheet (EAIS) is one of the most significant potential contributors to future sea-level changes. The inflow of modified Circumpolar Deep Water (mCDW) has been focused as one of the major causes of the thinning and mass loss of the Antarctic Ice Sheet. However, the role of the mCDW for the large-scale deglaciation of the EAIS, such as the deglaciation since the Last Glacial Maximum (LGM), remains unclear due to the lack of the geological data. Therefore, highly-resolved reconstruction of the deglaciation history of the EAIS since the LGM is essential to understand the role of the mCDW, which will be a useful analog for calibrate the climate and ice sheet models and refine the future ice sheet retreat projection. In this presentation, we show an overview of our recent activities in the Lützow-Holm Bay, Dronning Maud Land, East Antarctica. Newly obtained surface exposure ages and sedimentary Be-10 records coupled with the previously reported benthic foraminiferal assemblage from Syowa Oasis and Lützow-Holm Bay show a rapid thinning of the EAIS during the early-mid Holocene potentially due to an inflow of mCDW. We, therefore, suggest that it will be a key to obtain both terrestrial and marine-based geological data in the Antarctic margin to understand the potential impact of ocean warming to the rapid and large scale ice sheet melting of the EAIS.

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Oceanic versus bottom water dynamics in the Central Basin, Western Ross Sea (Antarctica), since the Last Glacial Maximum

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The aim of this work is to investigate the dynamics between oceanic and bottom waters recorded in marine sediments collected in the Central Basin (Ross Sea), since the Last Glacial Maximum. In this area, located in the slope area in front of the JOIDES Basin (Western Ross Sea, Antarctica), the dense and cold High Salinity Shelf Water (HSSW) outflows from the shelf margin and mix with the Antarctic Bottom Water (AABW) and the relatively warm Circumpolar Deep Water (CDW) intrudes locally into the continental shelf mixing with dense shelf water (ISW) and HSSW. This study has been conducted in the framework of the STREAM Project (Late Quaternary evolution of the ocean-ice sheet interactions: the record from the Ross Sea continental margin, Antarctica), funded by the twelfth executive program for scientific and technological cooperation between Italy and Republic of Korea (period 2019-2021). Several analyses have been performed on three box cores (X-ray image, magnetic susceptibility, grain-size, TOC, δ13C, biogenic silica, CaCO3 contents, diatom and foraminifer assemblages, tephra identification, 14C dating). Here we revealed that diatom assemblages and grain-size results are important parameters to understand the ocean-bottom water dynamics. In particular, these parameters recorded the entrance of warm oceanic water underlined by the presence of open ocean warm diatoms mainly characterized by Fragilariopsis kerguelensis. On the other hand, levels with high sand content and reworked diatoms represented by Paralia sulcata, a fossil coastal taxon, suggest a strengthening of bottom current transport during the post-LGM deglaciation.

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Early Last Interglacial ocean warming drove substantial ice mass loss from Antarctica

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The future response of the Antarctic ice sheet to rising temperatures remains highly uncertain. A useful period for assessing the sensitivity of Antarctica to warming is the Last Interglacial (LIG) (129 to 116 ky), which experienced warmer polar temperatures and higher global mean sea level (GMSL) (+6 to 11 m) relative to present day. LIG sea level cannot be fully explained by Greenland Ice Sheet melt (~2 m), ocean thermal expansion, and melting mountain glaciers (~1 m), suggesting substantial Antarctic mass loss was initiated by warming of Southern Ocean waters, resulting from a weakening Atlantic me- ridional overturning circulation in response to North Atlantic surface freshening. Here, we report a blue-ice record of ice sheet and environmental change from the Weddell Sea Embayment at the periphery of the marine-based West Antarctic Ice Sheet (WAIS), which is under- lain by major methane hydrate reserves. Constrained by a widespread volcanic horizon and supported by ancient microbial DNA analyses, we provide evidence for substantial mass loss across the Weddell Sea Embayment during the LIG, most likely driven by ocean warming and associated with destabilization of subglacial hydrates. Ice sheet modeling supports this interpretation and suggests that millennial-scale warming of the Southern Ocean could have triggered a multimeter rise in global sea levels. Our data indicate that Antarctica is highly vulnerable to projected increases in ocean temperatures and may drive ice–climate feedbacks that further amplify warming.

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Tracing West Antarctic ice stability in the Amundsen Sea during Late Pleistocene Warm Times

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Marine-based portions of the West Antarctic Ice Sheet (WAIS) hold more than three meters worth of global sea level equivalent ice and are contributing to global sea level rise at an accelerating rate. Yet the fate of Antarctic Ice Sheet remains the largest uncertainty in projections of future sea level rise.

Back in 1978, Mercer suggested a WAIS collapse (i.e. disintegration) as the likely source of ~5m sea level rise during the Eemian, the last interglacial (LIG; ~125,000 years ago), during which peak global temperatures were ~1°C warmer than preindustrial. However, more than 40 years after Mercer's influential paper, we still have not found clear physical evidence for a WAIS collapse during the LIG, or indeed any of the other late Pleistocene interglacials when temperatures were 1-2°C warmer than today.

We here present two new downcore records from the Amundsen Sea off West Antarctica. Geochronological and mineralogical provenance mapping of seafloor surface sediments from the West Antarctic shelf in and around the Amundsen Sea identifies a unique fingerprint of Pine Island (and Thwaites) Glacier. This knowledge is subsequently used to interpret Late Pleistocene down-core records from the continental slope and rise. The most pronounced signal over the past 450,000 years is observed during the LIG and may be taken as indication for detachment of Pine Island Glacier from the bed it rests on today. Our new data are consistent with at least partial WAIS collapse, highlighting the importance of the WAIS in assessing past and future sea level rise.

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Sedimentology and physical properties of marine sediments cores from Port Foster, Deception Island, Maritime Antarctica

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The South Shetland Islands present rapid environmental changes due to regional warming and new climate conditions. Deception Island is situated at the southern end of the South Shetland Islands and is the largest active volcano in Maritime Antarctica. The last subglacial eruptions that occurred in 1969 and 1970 were entirely explosive and affected the mass balance of the local glaciers. Glaciers cover about 57% of the island with a part by pyroclastic materials, and permafrost is present at lower elevations on the island. Over the last century, glaciers have been retreating quickly and the active layer thickness of permafrost is increasing. This study outlines the glacial and climatic processes on the island by sedimentological analysis and physical properties measurements of the superficial marine sediment with an average length of 30 cm. We collected nine samples using a Box-Corer sampler in Port Foster in two expeditions (2014 and 2018). Continuous and non-destructive high-resolution measurements were obtained with the Multi-Sensor Core Logger (MSCL). The physical parameters measured include wet bulk density, magnetic susceptibility, and electrical resistivity. Cores were visually logged and described by sediment colour, grain size, and sedimentary structures. The particle size distribution of sand fractions was obtained by CAMSIZE analyzer, and the silt samples were analyzed by the Malvern laser light scattering granulometer at 1-cm intervals and processed with the Gradistat program . In this work, we will present results from these analyses, with a focus on the reconstruction of sedimentation processes in Deception Island.

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Petrophysical parameters of Central Bransfield Basin marine sediments and their responses to climatic fluctuation

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The work analyzes eight marine sediment cores from the Bransfield Central Basin based on petrophysical parameters in order to investigate lithological, sedimentological and paleoclimatic issues. The water depth varies 304 to 1463 meters of water depth, and core length ranges from 1.5 to 5.2 meters. The cores were submitted to Multisensor Core Logger (MSCL-S), geotechnical tests gamma-spectrometric, granulometric and statistical analyses. Values of density, magnetic susceptibility, electrical resistivity, p-wave velocity, acoustic impedance, porosity, shear strength, total and spectral (U, Th and K) gamma radiation, and grain size were considered. Three distinct lithologies were identified in the Bransfield Central Basin: (a) subglacial deformation till, black colored, gravel content, average density values of 1.902 g/cm3, electrical resistivity of 0.600 Ohm.m, magnetic susceptibility of 497.412 SIx10-5, total gamma radiation of 209.3 nGy/h, and p-wave velocity of 1653,270 m/s; (b) massive diamictons with distinct shades of gray, cobble content, density of 1.475 g/cm3, electrical resistivity of 0.368 Ohm.m, magnetic susceptibility of 237.431 SIx10-5, total gamma radiation of 192.11 nGy/h, and p-wave speed of 1540,061 m/s; (c) siliceous ooze with, olive to brown colored, gravel content, density of 1.146 g/cm3, electrical resistivity of 0.374 Ohm.m, magnetic susceptibility of 4.296 SIx10-5, total gamma radiation 156.3 nGy/h, and p-wave speed 1515.379 m/s. Despite the low accuracy of the estimated date of the sediments, the results can infer climatic oscillations occurring approximately every 500 years. The response of petrophysical parameters is an important tool for separating natural climatic variability from anthropogenic events in cases of potential global warming.

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Climate and sea ice reconstructions in the industrial era at the Western Antarctic Peninsula – a multiproxy study based on IPSO25

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Recent changes and variability in climate conditions impact the distribution and properties of sea ice, as it is sensitive to environmental variations. We study the rapidly transforming region of the Western Antarctic Peninsula (WAP) focusing on the conditions and development of sea ice in the pre-satellite era. For this we apply the novel proxy $IPSO_{25}$ (Belt et al., 2016). Three short cores (multicores) from different oceanographic regimes resolve the last 200 years (based on ^{210}Pbex dating) and we analyzed geochemical bulk parameters, biomarkers (highly branched isoprenoids, GDGTs) and diatoms. These results are compared to multiple satellite observations, climate archives and modelled data. This multiproxy-based approach provides insights on changes in spring sea ice cover, primary production regimes, ocean temperature (based on $TEXL_{86}$ and RI-OH) and atmospheric circulation patterns. Despite a good agreement between satellite sea ice cover and the production of the sea ice biomarker $IPSO_{25}$, long-term trends of sea ice decrease at the WAP are not linearly linked to biomarker records. We suggest that masking effects from the complex oceanography and primary production dynamics must be considered in biomarker interpretations for sea ice reconstructions at the WAP. In-phase patterns of the positive Southern Annular Mode and the negative El Niño Southern Oscillation are closely linked to temperature, sea ice distribution, and $IPSO_{25}$ production and could be a key for sea ice reconstructions and projections as well.

Belt et al., 2016. Nature Communications, v. 7, p. 12655.

1479

How quickly can the East Antarctic ice margin complete an advance and retreat cycle?

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The duration of ice advance during Last Glacial Maximum in Antarctica provides insight into its overall sensitivity to environmental thresholds, the response time of the ice sheet to climate and sea level perturbations, and is an essential component in understanding Glacio-Isostatic adjustments and crustal uplift in the present day. While measuring the timing of ice retreat has become relatively routine through the advent of Be -10 exposure dating, determining the onset of glaciation remains difficult due to the challenges of obtaining pre-glacial sediments.

Here, we present a combination approaches to dating the duration of ice extent from Vestfold Hills and Rauer Group in Prydz Bay, including in-situ C-14 in bedrock surfaces, biogenic sediments and subglacial carbonates. These disparate techniques provide a unique insight into the history of ice sheet margin fluctuations in this region. Taken together, they suggest a highly dynamic ice sheet behaviour that is not reflected in existing ice sheet hindcasts, or clearly observed in other parts of the ice sheet margin. We discuss the potential drivers of these short-term fluctuations, and the topographic characteristics of the continental shelf that makes this sector especially prone to these dynamic ice sheet changes.

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Regional-scale abrupt Mid-Holocene ice sheet thinning in the western Ross Sea, Antarctica

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Records of ice sheet change from the recent geological past provide insight to the rates, magnitudes, drivers and mechanisms of ice sheet thinning in a future, warming climate. Deglaciation of the western Ross Sea since the last glacial maximum provides a useful analogue for future marine-based ice sheet retreat, but existing empirical and model data do not provide a coherent history of ice loss over this time. We present a cosmogenic surface-exposure chronology from Mawson Glacier. Our data record at least 220 m of abrupt ice thinning at 7.5–4.5 kya (occurring at a rate of 10–397 cm yr-1, 2 σ), followed by more gradual thinning until the modern glacier geometry was reached within the last thousand years or so. The timing, rates and magnitudes of thinning at Mawson Glacier are remarkably similar to that documented 100 km to the south at Mackay Glacier. Together, both outlet glaciers demonstrate that abrupt regional-scale deglaciation occurred in the western Ross Sea in the Mid-Holocene. Once initiated, ice sheet thinning occurred in this region at rates similar to some rapidly changing parts of Antarctica today and persisted for approximately 570–720 years. Ocean thermal forcing likely drove grounding-line retreat and ice drawdown, which then accelerated as a result of marine ice sheet instability as these glaciers retreated into overdeepened basins in the western Ross Sea.

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Greenhouse to Icehouse Antarctic paleoclimate and ice history from George V Land and Adélie Land shelf sediments: IODP mission-specific-platform Expedition 373

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The George V and Adélie Land continental shelf of East Antarctica contains a record of Antarctica's climate and ice history from the warm and vegetated landscapes of Eocene greenhouse climates through latest Eocene glacial inception to today's ice-covered continent. Because Paleogene to Pleistocene seaward-dipping strata are accessible at shallow depths under the sea bed, we can access them with robotic seafloor drills such as MeBo. IODP Expedition 373 plans to carry out this drilling, but is currently postponed until 2023 or later.

The history of this Antarctic margin includes warm-world high-CO_2 environments, which will help understand Antarctic climate and the limits of ice-sheet stability under conditions expected from global warming. In particular, we plan to investigate:

- Antarctica's climate during Early/Middle Eocene greenhouse warmth, including cyclicity, temperatures, and vegetation. We would provide high latitude temperatures address the pole-equator gradient and we will look for evidence for DeConto's permafrost hypothesis for hyperthermals;
- Climate cooling over the late Eocene in advance of main glacial inception. Were there precursor glaciations? What conditions led to Antarctica becoming the ice-covered continent we see today? Up to now there are extremely few well-recovered late Eocene sediment sequences from Antarctica, and we can fill this knowledge gap;
- The timing, environmental conditions, and extent of major ice advance at the Eocene/Oligocene boundary (~34 Ma), and the role of glacial isostatic adjustment (GIA) – e.g., relative sea level rise adjacent to expanding ice sheets;
- Oligocene ice and climate conditions, which are only poorly known.

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IODP Expedition 382 (Iceberg Alley) – Preliminary Results

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International Ocean Discovery Program (IODP) Expedition 382, Iceberg Alley and Subantarctic Ice and Ocean Dynamics, sailed in early 2019 to: 1. investigate the long-term history of the Antarctic Ice Sheet (AIS) and how ice retreat responded and contributed to global sea-level; 2. decipher how past changes in ocean bioproductivity, sea ice extent, and dust deposition in the Southern Ocean might have influenced atmospheric CO_2 variability.

Located in the southern Scotia Sea, Iceberg Alley is the path where many Antarctic icebergs drift north into the warmer waters of the Antarctic Circumpolar Current (ACC). We drilled biosilica-rich sediments at three sites (U1536, U1537, U1538) continuously back to 3.5 Ma. The patterns in the magnetic susceptibility record correlate closely to the 800 kyr dust record in the EDC ice core, which provides both millennial-resolution dating and a record of Southern Ocean westerly winds. Magneto-, bio-, and cyclo-stratigraphy extends the dating to the older part of the record, covering key time periods in AIS evolution such as the mid-Pliocene warm period, the mid-Pleistocene transition, and interglacials and glacial terminations of the last 800 kyr. High concentrations of iceberg-rafted debris (IBRD) signal ice margin retreat, and geochemically-determined provenance of the IBRD will fingerprint sources of icebergs and regional ice retreat. The resolution of the dating will allow us to evaluate leads and lags between dust deposition, sea ice extent, and sea surface temperature, and interpret them in terms of global climate and atmospheric CO_2.

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Glacier retreat history of the Crystal Sound in the Antarctic Peninsula

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The three gravitational cores (BS17-GC16, -GC17 and -GC18) were obtained from the deep basin of the Crystal Sound of the Antarctic Peninsula in 2017. Paleoenvironmental interpretations are based upon TOC, opal, TN, chloride/sulfate ions, diatom assemblage, particle size, sedimentary structures, and physical properties. Chronology is constrained by 25 AIO 14C dates including ramped PyrOx 14C dating in the lower section of the longer core BS17-GC18 (8.9 m). The calibrated bottom age is ~11.4 cal. kyr BP that corresponds to the timing of early Holocene climatic optimum (HCO) in the AP. We recognize two climatic events: the middle HCO (~9.0 to ~3.0 cal. kyr BP) and the Neoglacial (~3.0 cal. kyr BP to modern). The 2.2-m-thick turbidite layer in the lower section of the core is the result of a high energy transport system to the deep basin within the crystal sound. During the period from the early HCO to ~9.0 cal. kyr BP, the slight increase of marine diatoms and opal contents indicates the continued seawater intrusion from open ocean under a retreating ice shelf. The low chloride/sulfate pore water concentrations prior to the middle HCO suggest deposition in brackish environments associated with grounding zone proximal lithofacies. During the middle HCO, the elevated contents of TN, TOC and opal is accompanied by high diatom valve abundance in response to enhanced phytoplankton production facilitated by open ocean environment. The decline of TN, TOC, opal and diatom valves around ~3.0 cal. kyr BP corresponds to the Neoglacial climatic event.

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