ISAES 2019

XIII International Symposium on Antarctic Earth Sciences

22 July (Mon) – 26 July (Fri) , 2019
Songdo Convensia, Incheon, Republic of Korea

Abstract List – Poster (Mon/Tue)

Poster Presentation

No.	Day	Time	Presenter	E-mail	Institution/Organization	Abstract no.	Session no.	Title
1	MON/TUE	13:45-15:00	Seongchan Hong	tyr0327@gmail.com	Korea University, Korea	A088	01	OSL dating of raised beach in Terra Nova Bay, Antarctica with tectonic implications
2	MON/TUE	13:45-15:00	Jeremy Lee	jeremykmlee@gmail.com	University of Melbourne, Australia	A183	01	Revisiting the Admiralty Suite and its link to southeastern Australia
3	MON/TUE	13:45-15:00	Yingchun Cui	cuiyingchun@fio.org.cn	First Institute of Oceanography, MNR, China	A194	01	The early Paleozoic magmatism in northern Victoria Land, Antarctica
4	MON/TUE	13:45-15:00	Taeyoon Park	typark@kopri.re.kr	Korea Polar Research Institute, Korea	A235	01	Jurassic phreatoicid isopods from Victoria Land, Antarctica
5	MON/TUE	13:45-15:00	Changhwan Oh	bluemirine@gmail.com	Chungbuk National University, Korea	A236	01	New occurrence of Triassic gymnosperm wood at the Ricker Hills, southern Victoria Land, Antarctica
6	MON/TUE	13:45-15:00	Sangbong Yi	handjive@kopri.re.kr	Korea Polar Research Institute, Korea	A251	01	Paleozoic metamorphism identified in the Mountaineer Range of northern Victoria Land, Antarctica
7	MON/TUE	13:45-15:00	Simon Cox	s.cox@gns.cri.nz	GNS Science, New Zealand	A254	01	The Convoy Range mapping project, Victoria Land, Antarctica
8	MON/TUE	13:45-15:00	Andreas Laeufer	andreas.laeufer@bgr.de	Federal institute for geosciences and natural resources (BGR), Germany	A263	01	Dating the Granite Harbour Intrusives of northern Victoria Land (Antarctica) - Magmatic ages, inheritance and alteration
9	MON/TUE	13:45-15:00	Hyeoncheol Kim	hckim@kigam.re.kr	Korea Institute of Geoscience and Mineral Resources, Korea	A298	01	Geological mapping around the Jang Bogo Station, Northern Victoria Land, and preliminary study on U-Pb zircon age and geochemical features of igneous and metamorphic rocks
10	MON/TUE	13:45-15:00	Yeongmin Kim	galgari1@snu.ac.kr	Seoul National University, Korea	A304	01	Geochemical interpretation of the tectonic evolution in northern Victoria Land, Antarctica
11	MON/TUE	13:45-15:00	Laura Crispini	laura.crispini@unige.it	University of Genova, Italy	A344	01	Meso-Cenozoic reactivation of the Rennick Geodynamic Belt (northern Victoria Land, Antarctica): new evidence from paleostress analysis
12	MON/TUE	13:45-15:00	Frank Lisker	flisker@uni-bremen.de	University of Bremen, Germany	A378	01	Cenozoic exhumation of the Mountaineer Range, Transantarctic Mountains, in northern Victoria Land: new constraints from apatite (U-Th-Sm)/He data
13	MON/TUE	13:45-15:00	Andreas Laeufer	andreas.laeufer@bgr.de	Federal institute for geosciences and natural resources (BGR), Germany	A387	01	Study of a polymict conglomerate from Reilly Ridge (northern Victoria Land, Antarctica): indirect evidence for the evolution of the Ross Orogen
14	MON/TUE	13:45-15:00	Giovanni Pio Liberato	giovannipio.liber@student.unisi.it	University of Siena, Italy	A396	01	Permian-Triassic fluvial deposits: a preliminary lithostratigraphic comparison between Southern Victoria Land (Antarctica) and Tasman (Australia) basins
15	MON/TUE	13:45-15:00	Luca Zurli	luca.zurli@student.unisi.it	University of Siena, Italy	A397	01	Petrography and geochronology of Permian glaciogenic sequences in Victoria Land (Antarctica)
16	MON/TUE	13:45-15:00	Gianluca Cornamusini	gianluca.cornamusini@unisi.it	University of Siena, Italy	A398	01	Stratigraphy of Late Palaeozoic Ice Age sequences in Victoria Land (Antarctica) and Tasmania (Australia): a comparison across southern Gondwana
17	MON/TUE	13:45-15:00	Giovanni Pio Liberato	giovannipio.liber@student.unisi.it	University of Siena, Italy	A399	01	Paleoenvironmental implications from facies analysis of Permian-Triassic nonmarine deposits of Allan Hills (Southern Victoria Land, Antarctica)
18	MON/TUE	13:45-15:00	Laura Crispini	laura.crispini@unige.it	University of Genova, Italy	A406	01	Early Paleozoic geodynamics of northern Victoria Land: state of art, new investigations and implications for Gondwana reconstruction
19	MON/TUE	13:45-15:00	Franco Maria Talarico	franco.talarico@unisi.it	University of Siena, Italy	A408	01	Provenance study of Permian-Triassic sandstones (Allan Hills, Antarctica): quantitative compositional, minero-chemical and geochronological analyses
20	MON/TUE	13:45-15:00	Andreas Laeufer	andreas.laeufer@bgr.de	Federal Institute for Geosciences and Natural Resources (BGR), Germany	A430	01	GANOVEX: 40 years of Earth System research in Victoria Land - in remembrance of Franz Tessensohn
21	MON/TUE	13:45-15:00	Valentina Corti	valecorti7@gmail.com	University of Siena, Italy	A443	01	Polycyclic aromatic hydrocarbons as marker of fossil charcoal in transported Triassic wood of Allan Hills (Southern Victoria Land, Antarctica)
22	MON/TUE	13:45-15:00	Daria Agapitova	shunya2004@bk.ru	Gramberg All-Russian Research Institute of Geology and Mineral Resources of the World Ocean, Russia	A079	04	Age and Geochemistry of the Cape Burks Gabbroids (Russkaya Station Area, West Antarctica)
23	MON/TUE	13:45-15:00	Adelina Geyer	ageyer@ictja.csic.es	Instituto de Ciencias de la Tierra Jaume Almera ICTJA-CSIC, Spain	A084	04	Deciphering Deception Island's magma plumbing system: An interdisciplinary approach
24	MON/TUE	13:45-15:00	Santiago Giralt	sgiralt@ictja.csic.es	Instituto de Ciencias de la Tierra Jaume Almera ICTJA-CSIC, Spain	A090	04	Antarctic volcanoes: A remote but significant hazard
25	MON/TUE	13:45-15:00	Alessio Di Roberto	alessio.diroberto@ingv.it	Istituto Nazionale di Geofisica e Vulcanologia, Italy	A108	04	The 1254 C.E. tephra layer and its potential for correlations and synchronization of Antarctic ice cores and marine sediments
26	MON/TUE	13:45-15:00	Eun Young Lee	eun.y.lee@chonnam.ac.kr	Chonnam National University, Korea	A158	04	Early Cretaceous volcaniclastics on the Naturaliste Plateau, offshore SE Australia (IODP Site U1513): Implications for the East Gondwana breakup
27	MON/TUE	13:45-15:00	Adam Martin	a.martin@gns.cri.nz	GNS Science, New Zealand	A248	04	Petrogenetic models for the evolution of alkalic magmas in the Erebus volcanic province, Antarctica
28	MON/TUE	13:45-15:00	Mi Jung Lee	mjlee@kopri.re.kr	Korea Polar Research Institute, Korea	A273	04	Geochemical characterization and correlation of the 1252 C.E. Rittmann tephra in Antarctic ice
29	MON/TUE	13:45-15:00	Philip Kyle	philipkyle1@gmail.com	New Mexico Institute of Mining and Technology, USA	A402	04	Tephra from blue ice areas in Victoria Land, insight into eruptive history of the McMurdo Volcanic Group, Antarctica
30	MON/TUE	13:45-15:00	Erica Maletic	maletic.2@osu.edu	The Ohio State University, USA	A417	04	Noble gases and trace element geochemistry of xenoliths in the Ford Ranges of Marie Byrd Land, Antarctica
31	MON/TUE	13:45-15:00	Ilnur Abdrakhmanov	ilnur_01_95@mail.ru	Saint-Petersburg Mining University, Russia	A145	05	P-T Evolution of Metapelitic Granulites from the Bunger Hills, East Antarctica: Constraints from Mineral Thermobarometry and Isochemical Phase Diagram Modeling
32	MON/TUE	13:45-15:00	Evgenii Mikhalskii	emikhalsky@mail.ru	VNIIOkeangeologia, Russia	A152	05	Thermobarometry of metavolcanic rocks of the Ruker Group, southern Prince Charles Mountains, East Antarctica: Implications on the Prydz Orogeny
33	MON/TUE	13:45-15:00	Geoffrey Grantham	ghgrantham@uj.ac.za	University of Johannesburg, South Africa	A223	05	The structural evolution of the Straumsnutane and western Sverdrupfjella areas, western Dronning Maud Land, Antarctica – implications for the amalgamation of Gondwana.
34	MON/TUE	13:45-15:00	Forrest Horton	horton@whoi.edu	Woods Hole Oceanographic Institution, USA	A245	05	Island arc–continental arc collision caused protracted eclogite-facies metamorphism in northern Victoria Land (Antarctica)
35	MON/TUE	13:45-15:00	Geoffrey Grantham	ghgrantham@uj.ac.za	University of Johannesburg, South Africa	A439	05	Sri Lanka - Correlation with N. Mozambique and Antarctica at the heart of Gondwana: North and South.
36	MON/TUE	13:45-15:00	Mayuri Pandey	mayuri1414@gmail.com	Department of Geology, India	A440	05	Nature of subglacial geological terrains in and around Gamburtsev Mountains, Antarctica: New insights from heavy mineral studies of site 739, ODP 119
37	MON/TUE	13:45-15:00	Kazuyuki Shiraishi	kshiraishi@nipr.ac.jp	National Institute of Polar Research, Japan	A449	05	Geology of the eastern Dronning Maud Land, East Antarctica: Missing link to Sri Lanka
38	MON/TUE	13:45-15:00	Adolfo Maestro	a.maestro@igme.es	Instituto Geológico y Minero De España (Igme), Spain	A033	07	MESOZOIC-CENOZOIC STRESS FIELD EVOLUTION IN TASMANIA FROM FAULT POPULATION ANALYSIS IN RELATION TO AUSTRALIA-ANTARCTICA PLATE SEPARATION
39	MON/TUE	13:45-15:00	Marga Garcia	m.garcia@csic.es	Andalusian Institute of Earth Sciences (CSIC-UGR), Spain	A179	07	Contourite features distribution and water masses circulation in the Eastern Bransfield Basin (Antarctic Peninsula)
40	MON/TUE	13:45-15:00	Molly Patterson	patterso@binghamton.edu	Binghamton University, USA	A200	07	Understanding the sensitivity of WAIS to 2 degree Celsius warming: A Science Plan for Crary Ice Rise
41	MON/TUE	13:45-15:00	Taichi Sato	taichi-sato@aist.go.jp	Geological Survey of Japan, AIST, Japan	A256	07	The origins of southern part of Madagascar Plateau and Del Cano Rise, based on re-estimated seafloor spreading history of Southwest Indian ridge 35°E to 55°E
42	MON/TUE	13:45-15:00	Adrian Lopez-Quiros	alquiros@iact.ugr-csic.es	Spanish National Research Council (CSIC), Spain	A268	07	The nature, timing and implication of green-clay authigenesis: A reliable paleoenvironmental indicator for the Antarctic Cenozoic climate history

Poster Presentation

No.	Day	Time	Presenter	E-mail	Institution/Organization	Abstract no.	Session no.	Title
43	MON/TUE	13:45-15:00	Jude Castelino	judste@bas.ac.uk	British Antarctic Survey, United Kingdom	A352	07	Drift sediments on the eastern Falkland Plateau: Insight on Antarctic Circumpolar Current (ACC) history in the Southwest Atlantic
44	MON/TUE	13:45-15:00	Dimitris Evangelinos	dimevangelinos@correo.ugr.es	Instituto Andaluz de Ciencias de la Tierra (IACT), Spain	A409	07	The evolution of the Antarctic Circumpolar Current across the Tasman Gateway during the last 30 million years
45	MON/TUE	13:45-15:00	Expósito Ceballos	carlosexposito.geology@gmail.com	University of Granada, Spain	A441	07	Late Eocene foraminifera assemblages in the southeastern margin of the South Orkney Microcontinent, Drake Passage, Antarctica: preliminary results
46	MON/TUE	13:45-15:00	Alex Burton-Johnson	alerto@bas.ac.uk	British Antarctic Survey, United Kingdom	A446	07	Geochronology and geochemistry of the northern Scotia Sea: a revised interpretation of the North and West Scotia ridge junction
47	MON/TUE	13:45-15:00	Dan Morgan	dan.morgan@vanderbilt.edu	Vanderbilt University, USA	A162	09	Bedrock erosion rates and the development of weathering features in Antarctica
48	MON/TUE	13:45-15:00	Mauro Guglielmin	mauro.guglielmin@uninsubria.it	University of Insubria, Italy	A225	09	Geophysical and Geomorphological investigations of Polygonal Patterned Ground in continuous Antarctic permafrost as a Mars analog.
49	MON/TUE	13:45-15:00	Stefano Ponti	s.ponti@uninsubria.it	University of Insubria, Italy	A242	09	Active layer modeling at Signy Island (maritime Antarctica) and the role of the surface type
50	MON/TUE	13:45-15:00	Mayara Daher	mayara.daher@gmail.com	Universidade Federal de Viçosa, Brazil	A316	09	Statistical analysis of soils properties from Antarctica based on a large database
51	MON/TUE	13:45-15:00	Maria Papale	maria.papale@irbim.cnr.it	Institute of Polar Science, National Research Council (ISP, CNR), Italy	A335	09	Microbial life in the brine of cryo-environments in the Northern Victoria Land (Antarctica)
52	MON/TUE	13:45-15:00	Heejung Kim	re503@snu.ac.kr	Seoul National University, Korea	A346	09	Thermal diffusivity of Antarctic soil estimated using Carslaw-Jaeger and finite element methods
53	MON/TUE	13:45-15:00	Antonio Correia	correia@uevora.pt	University of Evora, Portugal	A422	09	ELECTRICAL RESISTIVITY IMAGING TO STUDY PERMAFROST DISTRIBUTION IN A MARINE TERRACE IN BYERS PENINSULA, LIVINGSTON ISLAND, MARITIME ANTARCTICA
54	MON/TUE	13:45-15:00	Francesca Battaglia	fbattaglia@inogs.it	Cá Foscari University of Venice, Italy	A104	12	High resolution seismo-stratigraphic evidence from the Edisto Inlet fjord, western Ross Sea (Antarctica)
55	MON/TUE	13:45-15:00	Ester Colizza	colizzae@units.it	Univesity of Trieste, Italy	A130	12	The STREAM project: Late Quaternary evolution of the ocean-ice sheet interactions - the record from the Ross Sea continental margin (Antarctica)
56	MON/TUE	13:45-15:00	Julia Lindow	jlindow@whoi.edu	Woods Hole Oceanographic Institution, USA	A131	12	New Chronologies on East Antarctic Ice Sheet Stability – Surface Exposure Ages from Bennett Platform, Transantarctic Mountains
57	MON/TUE	13:45-15:00	Zhongyan Shen	shenzhongyan@gmail.com	The Second Institute of Oceanography, China	A157	12	Multiple Glaciation in the Middle Segment of the Western Ross Sea: Revealed by Intermediate-Resolution Seismic Data
58	MON/TUE	13:45-15:00	Molly Patterson	patterso@binghamton.edu	Binghamton University, USA	A199	12	Assessing the orbital response of the WAIS from a Ross Sea deep ocean perspective since the Late Pliocene
59	MON/TUE	13:45-15:00	Sunghan Kim	delongksh@kopri.re.kr	Korea Polar Research Institute, Korea	A214	12	Preliminary results of geochemical proxies (biogenic opal, TOC, and CaCO3) at IODP Site U1523 on the Ross Sea Continental Shelf
60	MON/TUE	13:45-15:00	Benji Griffin	benjigriffin1@gmail.com	Victoria University of Wellington, New Zealand	A288	12	Plio-Pleistocene Antarctic Slope Current in the outer Ross Sea, and linkages to West Antarctic Ice Sheet variability.
61	MON/TUE	13:45-15:00	Min Kyung Lee	mklee@kopri.re.kr	Korea Polar Research Institute, Korea	A297	12	Paleoceanographic changes during the past one million years in the Central Basin, northwestern Ross Sea
62	MON/TUE	13:45-15:00	Christina Riesselman	christina.riesselman@otago.ac.nz	University of Otago, New Zealand	A337	12	Antarctic Holocene deglaciation and environmental evolution of the eastern Ross Embayment
63	MON/TUE	13:45-15:00	Denise Kulhanek	kulhanek@iodp.tamu.edu	Texas A&M University, USA	A348	12	Using sedimentology and geochemistry to elucidate Antarctic Ice Sheet extent in the late Miocene to Pliocene: Results from IODP Site U1522 on the Ross Sea Continental Shelf
64	MON/TUE	13:45-15:00	Denise Kulhanek	kulhanek@iodp.tamu.edu	Texas A&M University, USA	A349	12	XRF sediment geochemistry from IODP Site U1523, outer Ross Sea continental shelf, and its utility to distinguish sediment input from various water masses
65	MON/TUE	13:45-15:00	Younho Noh	ss112@kopri.re.kr	Korea Polar Research Institute, Korea	A388	12	A preliminary study of the relationship of chemical data with the diatoms assemblage in the coastal core sediment of the Antarctic Ross Sea.
66	MON/TUE	13:45-15:00	Luca Zurli	luca.zurli@student.unisi.it	University of Siena, Italy	A392	12	Petrography of gravel size clasts from IODP_exp374 drillcores (Ross Sea - Antarctica): implications for Miocene ice flows
67	MON/TUE	13:45-15:00	Fiorenza Torricella	torricellafiorenza@gmail.com	Università di Pisa, Italy	A431	12	LATE QUATERNARY PALEOENVIRONMENT AND PALEOCLIMATE OF THE NORTHERN DRYGALSKI BASIN (ROSS SEA, ANTARCTICA) USING MICRORGANISM ASSEMBLAGES AND SEDIMENT CHARACTERISTICS: PRELIMINARY RESULTS
68	MON/TUE	13:45-15:00	Benoit Faucher	bfauc073@uottawa.ca	University of Ottawa, Canada	A021	16	Hydrochemistry, mass balance and ice-cover dynamics of Lake Untersee (Queen Maud Land).
69	MON/TUE	13:45-15:00	Christopher Gardner	gardner.177@osu.edu	The Ohio State University, USA	A221	16	Change at 85 Degrees South: Heekin Valley Proglacial Lakes from 1960 to 2018
70	MON/TUE	13:45-15:00	Maddie Myers	memyers23@gmail.com	Louisiana State University, USA	A410	16	Spatiotemporal Heterogeneity of Climatic Controls on Snow Persistence on the Lakes of Taylor Valley, east Antarctica and Implications for Primary Productivity
71	MON/TUE	13:45-15:00	Antonio Correia	correia@uevora.pt	University of Evora, Portugal	A425	16	GEOELECTRIC SURVEY TO STUDY THE AQUIFER FORMATIONS NEAR THE PERUVIAN ANTARCTIC STATION OF MACHU PICCHU, KING GEORGE ISLAND, MARITIME ANTARCTICA
72	MON/TUE	13:45-15:00	Jhon Fredy Mojica Moncada	jfm11@nyu.edu	New York University Abu Dhabi, UAE	A034	18	Characterization of ocean mixing during the 2017 Weddell Polynya event
73	MON/TUE	13:45-15:00	Bookeun Khim	bkkhim@pusan.ac.kr	Pusan National University, Korea	A054	18	Particulate matter in the polynya of Terra Nova Bay in the western Ross Sea: record of 2014 to 2016
74	MON/TUE	13:45-15:00	Hyangsun Han	hyangsun@kopri.re.kr	Korea Polar Research Institute, Korea	A275	18	Operational iceberg A68 monitoring with remote sensing and information services
75	MON/TUE	13:45-15:00	Matthew Jeromson	matt.jeromson@canberra.edu.au	University of Canberra, Australia	A336	18	Beryllium-10 concentration of West Antarctic marine sediments and its relationship to ice shelf ocean circulation and depositional environments
76	MON/TUE	13:45-15:00	Mengmeng Li	1007589079@qq.com	Nanjing University, China	A338	18	Arctic sea ice thickness retrievals from CryoSat-2: seasonal and interannual comparisons of three different products
77	MON/TUE	13:45-15:00	Yi Chen	201821051033@mail.bnu.edu.cn	Beijing Normal University, China	A133	19	Anomalous heat fluxes over Indian Ocean in association with the Arctic Oscillation during boreal winter
78	MON/TUE	13:45-15:00	Yiwen Shi	201831051010@mail.bnu.edu.cn	Beijing Normal University, China	A151	19	Unstable Interannual relationship between Arctic Oscillation and Indian Ocean During Boreal Winter: Different Regimes of Air–Sea Interaction
79	MON/TUE	13:45-15:00	Rui Mao	mr@bnu.edu.cn	Beijing Normal University, China	A198	19	Increasing difference of surface air temperature between Eastern Antarctica and Antarctic Peninsula in future climate : A multimodel ensemble analysis
80	MON/TUE	13:45-15:00	Seongjoong Kim	seongjkim@kopri.re.kr	Korea Polar Research Institute, Korea	A203	19	A numerical simulation of a strong wind event in January 2013 at King Sejong station, Antarctica
81	MON/TUE	13:45-15:00	Sicheng He	sichenghe@mail.bnu.edu.cn	Beijing Normal University, China	A240	19	Performance of Amundsen Sea Low Variation in CAS FGOALS-f2 Model
82	MON/TUE	13:45-15:00	Sangyoon Jun	syjun@kopri.re.kr	Korea Polar Research Institute, Korea	A280	19	Dynamical mechanisms of the poleward intensification of the southern hemispheric westerlies during the Last Glacial Maximum
83	MON/TUE	13:45-15:00	Changkyu Lim	cklim@kopri.re.kr	Korea Polar Research Institute, Korea	A451	19	A reconstruction of the ASL intensity using multiple linear regression model during 20th century

A088

Session01: Geological History of Victoria Land: Reviews and New Findings

OSL dating of raised beach in Terra Nova Bay, Antarctica with tectonic implications

Seongchan Hong[1], Min Kyung Lee[2], Yeong Bae Seong[1†], Lewis Owen[3], Hyun Hee Rhee[1], Jae Il Lee[2], Kyu-Cheul Yoo[2]

[1]Department of Geography Education, Korea University, Seoul 02841, Korea, [2]Korea Polar Research Institute, Incheon 21990, Korea, [3]Department of Geology, University of Cincinnati, Cincinnati, OH 45221, USA

Optically stimulated luminescence (OSL) dating of cobble surfaces on two sets of raised beaches in Terra Nova Bay in Victoria Land of Antarctica determines relative sea-level change since the Mid-Holocene. The study includes dating of five raised beaches on Inexpressible Island (II-1 to II-5) and five raised beaches at Jangbogo Station (JS-1 to JS-5). The raised beaches at Jangbogo Station began to form before 6.1±0.9 ka and constantly emerged at a rate of 0.9 m/ka, while the raised beaches on Inexpressible Island started to emerge around 4.9±0.5 ka at an average rate of 3.5 m/ka. However, the rate of emergence on Inexpressible Island was 1.8±0.2 m/ka from 4.9±0.5 to 1.1±0.1 ka, since when the rate has been 14.9±1.4 m/ka. The spatio-temporal difference in the emergence rate of the raised beaches is likely the result of local tectonics. This view is consistent with recent GPS geodetic analyses showing differential uplift across the region. Moreover, the rapid uplift since 1.1 ka on Inexpressible Island is likely due to vertical movement associated with active faults. This study illustrates the successful use of OSL dating for raised beach sediment to helping define rates of emergence and determining controls on raised beach formation.

Session01: Geological History of Victoria Land: Reviews and New Findings

Revisiting the Admiralty Suite and its link to southeastern Australia

Jeremy Lee[1 †], Steven Boger2, Roland Maas1, Friedhelm Henjes-Kunst3, C. Mark Fanning4, Anna Maria Fioretti5, Andreas Läufer3

[1]*The University of Melbourne, Australia*
[2]*Johannes Gutenberg University Mainz, Germany*
[3]*Federal Institute for Geosciences and Natural Resources (BGR), Germany,*
[4]*Australian National University, Australia*
[5]*Istituto di Geoscienze e Georisore, Italy*

The post-Ross Devonian granites of the Admiralty Suite are found throughout Northern Victoria Land, predominantly in the low-grade turbidite sequence of the Robertson Bay Terrane. Across the Southern Ocean in southeastern Australia, contemporaneous Devonian granites are also widespread. The geochemical and geochronological fingerprints of these Australian granites allude to deeper crustal heterogeneity, possibly reflecting the inclusion of an exotic microcontinent (modern day western Tasmania) into the Pacific margin of eastern Gondwana during the Palaeozoic.
This study presents new geochemical and geochronological data for the Admiralty Suite and related Australian granites in order to determine if there are comparable crustal heterogeneities in Northern Victoria Land that reflect an exotic basement derived from this microcontinent, known as VanDieland. Major element whole rock data indicate mostly metaluminous to weakly peraluminous, I-type, granitic to granodioritic compositions. Trace element compositions suggest some of the granites are highly differentiated, with very low Nb/Ta ratios (e.g. 4.6) correlating with low Y/Ho (e.g. 29.3), as well as high Rb/Sr ratios. Sr-Nd isotopic compositions display strong similarities between the granites in both Antarctica and Australia, however, due to the highly fractionated nature of some samples, precise geochoronological data are required to perform appropriate age corrections to the isotopic compositions, thus allowing for more robust interpretations.

Session01: Geological History of Victoria Land: Reviews and New Findings

The early Paleozoic magmatism in northern Victoria Land, Antarctica

Yingchun Cui [†] , Chenguang Liu , Andreas Läufer

[1]First Institute of Oceanography, MNR, China, [2]Federal Institute for Geosciences and Natural Resources (BGR) , Germany

Victoria Land is located at the Pacific end of the Transantarctic Mountains bordering the western coastline of the Ross Sea in Antarctica. The David Glacier with the Drygalski Ice Tongue separates the region into northern and southern Victoria Land (nVL and sVL, respectively).
The basement of Victoria Land comprise up to granulite-facies metamorphic rocks intruded by plutons and dykes of the Granite Harbour Intrusives, which constitute the Wilson Terrane (WT) in nVL. The WT is separated by major fault zones from the Bowers and Robertson Bay terranes further to the east. Metamorphism and deformation are attributed to the late early Paleozoic Ross Orogeny.
Post-Ross sequences in nVL include the mid-Palaeozoic Admiralty and Gallipoli igneous suites and the cover rocks of the Beacon and Ferrar supergroups. Youngest (non-glacial) rocks belong to the rift-related magmatism of the Cenozoic West Antarctic Rift System.
During the recent GANOVEX XIII campaign of the BGR in the 2018-19 season, we sampled Granite Harbour Intrusives in the area along the Ross Sea coast between Harbord Glacier in the southern Prince Albert Mountains and Fitzgerald Glacier in the Mountaineer Range, in order to get a better understanding of the temporal distribution and the evolution of magmatism related with the Ross orogeny using the methods of petrology, geochemistry and U-Pb zircon geochronology, and so on.

Session01: Geological History of Victoria Land: Reviews and New Findings

Jurassic phreatoicid isopods from Victoria Land, Antarctica

Tae-Yoon Park[1†], Thomas Hegna[2], Benjamin Bomfleur[3], George Wilson[4]

[1]Division of Earth-System Sciendes, Korea Polar Research Insititute, Korea, [2]Department of Geology, Western Illinois University, USA, [3]Institute of Geology and Palaeontology, University of Munster, Germany, [4]Saugatunk Natural History Laboratory, Michigan, USA

The isopod suborder Phreatoicidea has the earliest known fossils in the Isopoda. Extant phreatoicideans live in epigean or hypogean fresh waters of Australia, New Zealand, South Africa, and India, indicating that their biogeographical distribution originated from ancient Gondwana. Fossil records of phreatoicidean isopods include two palaeophreatoicids, Hesslerella from the Carboniferous of the U.S. and Palaeophreatoicus from the Permian of Russia, and two amphisopid species of the genus Protamphisopus from the Middle Triassic of China and Australia. In Triassic-Jurassic palaeogeography, today's phreatoicidean-harboring regions were surrounding Antarctica, implying an overlooked presence of this isopod group in Antarctica. In the course of a joint United States and British Antarctic expedition 1971/1972, multiple specimens of phreatoicidean isopod fossils were collected from lacustrine deposits intercalated in the late Early Jurassic Kirkpatrick basalt at Carapace Nunatak of southern Victoria Land, Antarctica. An additional specimen—collected during the German GANOVEX IX expedition during 2005/2006 from a similar sedimentary interbed within Kirkpatrick basalt at Gair Mesa, northern Victoria Land—may indicate a wider distribution of this Jurassic phreatoicid in Antarctica. Detailed morphological features of the phreatoicidean fossils from Antarctica are being assessed, which will be used for phylogenetic analysis. Preliminary observations show that the Jurassic phreatoicideans from Antarctica have head and pereiopod features readily distinct from those of the Triassic Protamphisopus. The Jurassic specimens from Antarctica may thus provide more information about the morphology of Mesozoic phreatoicideans, and possibly cast light on the obscure biogeographic evolution of the group.

Session01: Geological History of Victoria Land: Reviews and New Findings

New occurrence of Triassic gymnosperm wood at the Ricker Hills, southern Victoria Land, Antarctica

Changhwan Oh[1,2†], Jae-Hyuk Lee[3], Jusun Woo[2,4], Jong-Ik Lee[2]

[1]Chungbuk National University, Korea, [2]Korea Polar Research Institute, Korea, [3]Gyeongsang National University, Korea, [4]Seoul National University, Korea

During the 2016 Antarctic summer season, the fourth Korea Antarctic Geological Expedition (KAGEX IV) investigated the Ricker Hills in southern Victoria Land, Antarctica and collected 33 specimens of fossil wood from an outcrop of Triassic Beacon sandstone in a small basin, Ricker Hills area. Based on anatomical features, four specimens can be identified as belonging to the seed-fern wood Kykloxylon sp. (Corystospermales). A specimen is identified as Agathoxylon sp. and it is the first report of the genus from the Triassic deposits in Victoria Land, Antarctica. We are able to reconfirm that corystosperm trees were a dominant component of the Triassic forest vegetation in Antarctica, with minor occurrences of Agathoxylon trees of yet uncertain affinities from those results. In addition, the new occurrence of Agathoxylon at the Ricker Hills also shows us that there is still a shortage of fossil wood studies in Victoria Land.

Session01: Geological History of Victoria Land: Reviews and New Findings

Paleozoic metamorphism identified in the Mountaineer Range of northern Victoria Land, Antarctica

Sang-Bong Yi[1†], Mi Jung Lee[1], Seunghee Han[1]

[1]*Korea Polar Research Institute, Korea*

Antarctica is classified into the East and West Antarctica, and the East Antarctica of which consists mainly of Archean to Proterozoic old massifs. The northern Victoria Land of the East Antarctica is composed of the Neoproterozoic to early Paleozoic Wilson Terrane and the early Paleozoic Bowers and Robertson Bay terranes accreted to the Wilson Terrane. In the Mountaineer Range, various rock units related to the early Paleozoic Ross orogeny, such as the Murchison migmatitic gneiss (Wilson Terrane), the Dessent Ridge amphibolite, the Bowers Terrane metasedimentary rocks and mafic/ultramafic rocks in the Tiger Gabbro Complex crop out, and several studies on these units have been published.

This study investigates the early Paleozoic metamorphism (Ross orogeny) of the northern Victoria Land in terms of formation and evolution of the Dessent Ridge amphibolite in the Mountaineer Range, and the results are as follows. (1) The protolith of Dessent Ridge amphibolite formed at 514.6 ± 2.0 Myr ago. Although its metamorphic time is unclear, the distinctive c. 500 Ma igneous and metamorphic ages reported in the Mountaineer Range makes it possible to assume that the metamorphic age of the Dessent Ridge amphibolite could also be c. 500 Ma. (2) The Dessent Ridge amphibolite underwent an intermediate-P/T type metamorphism characterized by the peak pressure of c. 10 kbar (c. 600 ˚C) and the peak temperature of c. 700 ˚C (c. 7 kbar). (3) This is interpreted as a result that a mafic crust (i.e., Dessent Ridge unit) accreting to continental Wilson Terrane margin experienced the high temperature metamorphism at the middle deep arc environment (c. 7 kbar, c. 25 km) after the subduction (c. 10 kbar, c. 35 km).

A254

Session01: Geological History of Victoria Land: Reviews and New Findings

The Convoy Range mapping project, Victoria Land, Antarctica

Capponi Gianni[1], Simon Cox[2]
[†], Chiara Montomoli[3], Stefano Casale[4], Matteo Simonetti[3], Andreas Läufer[5], Giovanni Musumeci[4], Maria Christina Salvatore[4]

[1]University of Genoa, Italy, [2]GNS Science, Dunedin, New Zealand, [3]University of Torino, Italy, [4]University of Pisa, Italy, [5]BGR Hannover, Germany

The Convoy Range mapping project has two principal aims: 1) to complete 1/250000 geological mapping for the area between 76° and 76°30' S, filling the gap between the GIGAMAP maps (Pertusati et al., 2016) to the north and the geological maps by GNS - New Zealand to the south (Pocknall et al., 1994; Cox et al., 2012); and 2) to integrate such new mapping in the digital database GeoMAP (see Cox et al. this conference). New mapping was performed by a three-person team in the 2017/18 and 2018/19 austral summers (33rd and 34th ItaliAntartide expeditions); this activity was heli-supported, starting from both the Italian Base Mario Zucchelli (2017/18) and from a remote camp at Starr Nunatak (2018/19). Geological observations, collated on the Convoy Range and Franklin Island quadrangles of the USGS 1/250000 topographic base maps, are displayed on this poster.

Field activity included geological and geological-glacial field mapping, photogeological analyses, structural observations and rock sampling. Dolerite sills of the Ferrar Group are prevalent in this area, with limited outcrops of the extrusive correlative - the Mawson - Exposure Hill Formation. Sandstones of the Beacon Supergroup are limited to small outcrops and to 100 m-long rafts enclosed in the dolerite. Granites and granodiorites of the Granite Harbour Intrusive Complex constitute the crystalline basement underlying the Gondwana Sequence, only outcropping out along the lower-lying sector close to the Ross Sea coast. Minor enclaves of Wilson Terrane gneiss are hosted in the Granite Harbour granitoid. Structural data of bedding, fault and fracture attitudes were measured at outcrops. More than 250 rock samples were collected for subsequent laboratory analyses, including samples of glacial deposits to perform surface exposure dating by cosmogenic isotope analysis. Subsequent office-based activity has included: digitization of the new cartographic data and integration in the GeoMAP dataset; elaboration of structural data; microstructural analyses; mineralo-petrographic analyses of rocks and glacial deposits.

References:

Cox S. C., Turnbull I.M., Isaac M.J., Townsend D.B., Smith Lyttle B. (2012) Geology of southern Victoria Land. Institute of Geological & Nuclear Sciences 1:250 000 Geological Map 22, 135 p. + 1 folded map.

Pertusati P.C., Ricci C.A., Tessensohn F. (2016) German - Italian Geologic Antarctic Map Programme: Introductory Notes to the Map Case. Terra Antartica Reports, 15, 1 - 15.

Pocknall D.T., Chinn T.J., Skyes R., Skinner D.N.B. (1994) Geology of the Convoy Range, southern Victoria Land, Antarctica. Institute of Geological & Nuclear Sciences Geological Map 11, 1:50,000. 36 p. + 1 folded map.

Session01: Geological History of Victoria Land: Reviews and New Findings

Dating the Granite Harbour Intrusives of northern Victoria Land (Antarctica) - Magmatic ages, inheritance and alteration

Martina Menneken[1], Andreas Läufer[2†], Tim John[3], Jasper Berndt[4], Friedhelm Henjes-Kunst[2], Jörg Giese[5]

[1]Institut fuer Geowissenschaften, Rheinische Friedrich-Wilhelms Universitaet Bonn, Bonn, Germany, [2]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany, [3]Freie Universitaet Berlin, Berlin, Germany, [4]Universitaet Muenster, Muenster, Germany, [5]Geological Survey of Norway, Tronheim, Norway

The Granite Harbour Intrusives (GHI) are a suite of calc-alcaline granitoids distributed throughout the Transantarctic Mountains, including the Wilson Terrane in northern Victoria Land (NVL). They are understood as a typical magmatic arc system associated with west-dipping subduction beneath the active continental margin of East Gondwana in the late Ediacaran to early Paleozoic. Based on zircon Pb-Pb and Rb-Sr whole rock ages, three main phases of emplacement were suggested for the GHI: Around 560 Ma, 510 Ma, and 480 Ma. The earliest phase with ages up to c. 560 Ma has been best documented in granites from southern Victoria Land (e.g. Encarnacion and Grunow, 1996). In NVL, however, the scarce products of this first phase seem to have been limited to the southern part of the Terra Nova Intrusive Complex and the north-western part of the Deep Freeze Range with Pb-Pb zircon ages between 517 and 531 Ma (Rocchi et al. 2004). However, arc-derived detrital zircon ages indicated that subduction might have started as early as c. 580 Ma (Goodge 2007). This is supported by U-Pb zircon ages up to c. 590 Ma from the central Transantarctic Mountains (Goodge et al. 2012) and detrital zircon data indicating the presence of previously unrecognized distinct pulses and extended duration of granitoid activity (Paulsen et al., 2016). So far, however, granitoids with magmatic ages >560 Ma seem to remain undiscovered in NVL.

Here, we present a combination of Pb-Pb-ages, δ18O, trace element and inclusion data of zircons from granitoids of the GHI, sampled during BGR expeditions GANOVEX VII (1992/93), GANOVEX VIII (1999/2000) and GANOVEX XI (2015/16), covering a region of about 400 km along strike of the former Palaeo-Pacific active continental margin, as well as about 350 km carton-wards. We obtained three distinct age groups for NVL granitoids: (i) 580-560 Ma, (ii) 530-510 Ma, and (iii) 490-480 Ma. Our study shows that not only alteration might be a key factor to consider when evaluating zircon characteristics with respect to their host rock, but also the timing and preservation of primordial features. By carefully comparing Pb-Pb- age data with related isotopic, chemical, and mineralogical features, a complex history of magma emplacement starting as early as c. 580 Ma and involving late-stage fluid alteration events is being revealed. Our data support the existence of a long-lived accretionary magmatic arc in the Wilson Terrane, which lasted over a period of at least c. 100 Ma after the transformation of the post-Rodinia rifted margin into the active continental margin of East Gondwana in the late Neoproterozoic.

Encarnacion, J. and Grunow, A. (1996): Changing magmatic and tectonic styles along the paleo-Pacific margin of Gondwana and the onset of early Paleozoic magmatism in Antarctica.- Tectonics, 15, 1325-1341.
Goodge, J.W. (2007) Metamorphism in the Ross orogen and its bearing on Gondwana margin tectonics, Geological Society of America, Special Paper, 419, 185–203.
Goodge, J.W., Fanning, C.M., Norman, M.D. and Bennett, V.C. (2012): Temporal, isotopic and spatial relations of early Paleozoic Gondwana-margin arc magmatism, central Transantarctic

Mountains, Antarctica.- J. Petrology, 53, 2027-2065.
Paulsen, T.S., Deering, C., Sliwinski, J., Bachmann, O. and Guillong, M. (2016): Detrital zircon ages from the Ross Supergroup, north Victoria Land, Antarctica: Implications for the tectonostratigraphic evolution of the Pacific-Gondwana margin.- Gondwana Research, 35, 79-96.
Rocchi, S., Di Vincenzo, G. and Ghezzo, C. (2004): The Terra Nova Intrusive Complex: Victoria Land, Antarctica.- Terra Antartica Reports, 10, 1-49

Session01: Geological History of Victoria Land: Reviews and New Findings

Geological mapping around the Jang Bogo Station, Northern Victoria Land, and preliminary study on U-Pb zircon age and geochemical features of igneous and metamorphic rocks

Hyeoncheol Kim[1†], Taehoon Kim[1], Daeyoung Kim[2], Jong Ik Lee[2], Jusun Woo[3]

[1]Korea Institute of Geoscience and Mineral Resources, Korea, [2]Korea Polar Research Institute, Korea, [3]Seoul National University, Korea

Jang Bogo Station, one of Korean Antarctic year-round stations, is located on the coast of Terra Nova Bay in Northern Victoria Land. Metamorphic and igneous rocks around the Jang Bogo Station mainly consist of early Paleozoic greenschist to amphibolite facies schists and gneisses of the Wilson Metamorphic Complex (WMC), and granites of Granite Harbour Igneous Complex (GHIC). Meta-sedimentary rocks of WMC mainly consist of biotite schist, migmatitic garnet-biotite gneiss, foliated feldspar phenocryst biotite granite and leucocratic granite, whereas igneous rocks of GHIC consist of diorite and biotite granite.

Biotite schist is gray-colored and fine- to medium-grained garnet-biotite schist intercalated with minor calc-silicate and amphibolite. Migmatitic gneiss consists of medium- to coarse-grained, and is primarily composed of migmatitic garnet-biotite gneiss, together with minor mafic schist and feldspar porphyroclastic biotite gneiss. Migmatitic gneiss contains local domains consisting of biotite schist and mafic schist, and showing gradational contact relationship with the host. Migmatitic gneiss and biotite schist were intruded by poly-phase intrusives of leucocratic granite, yielding their complicated appearances. Some veins of leucocratic granite are continuous to in-situ granitic neosomes of the migmatitic gneiss. Feldspar porphyroclastic biotite gneiss is foliated and medium- to coarse-grained biotite gneiss typically containing feldspar porphyroclasts. Feldspar porphyroclastic biotite gneiss is easily distinguished from migmatitic gneiss by the occurrence of feldspar porphyroclasts and by the lack of differentiated compositional layers. Foliated feldspar phenocryst biotite granite is weakly to moderately foliated and medium- to coarse-grained. This rock unit locally shows heterogeneous distribution of constituent minerals. This lithologic unit is distinguished from the migmatitic gneiss by the lack of metamorphic differentiation forming leucocratic and melanocratic layers, as well as the leucocratic granite intrusives. Leucocratic granite is massive to weakly foliated and medium- to coarse-grained quartz-feldspar granite, and massive K-feldspar megacryst leucocratic granite, characteristically contain cordierite and garnet phenocrysts. This lithologic unit intruded biotite schist and migmatitic gneiss of the WMC as dikes or veins of several cm to several m in width. Diorite is dark greenish gray, massive and fine- to medium-grained dioritic to gabbroic rock, whereas biotite granite is massive to weakly foliated and medium- to coarse-grained. Biotite granite commonly contains xenoliths of diorite and migmatitic gneiss.

Granites show wide compositional range from gabbro to granite. Most of granites belong to metaluminous to peraluminous I-type granite except for leucocratic granite predating the intrusion of granites, belonging to peraluminous S-type granite. Granites commonly shows negative anomaly for Ba, Nb, P and Ti and flat HREE pattern, whereas leucocratic granite shows discernible negative anomaly for Sr and variable HREE pattern in spider diagram. Most of granites and leucocratic granite are plotted in VAG+syn-COLG. The youngest detrital zircon age of meta-sedimentary schists and gneisses is dated at < ca. 700 Ma and < ca. 590 Ma, respectively, with metamorphic age at ca. 510 Ma on the overgrowth rim of zircon. Emplacement age of leucocratic granite intruding the schists and gneisses along the foliation is dated at ca. 482-480 Ma with slightly old age of ca. 524 Ma at the core. Emplacement age of granites is dated ca. 480-460 Ma. Peak metamorphic event occurs before

the intrusion of granites at ca. 480 Ma, and major magmatic event at ca. 480-460 Ma.

A304

Session01: Geological History of Victoria Land: Reviews and New Findings

Geochemical interpretation of the tectonic evolution in northern Victoria Land, Antarctica

CHUNGWAN LIM[1†], INSUNG LEE[2], YEONGMIN KIM[2], JONG IK LEE[3], JUSUN WOO[2]

[1]Department of Earth Science Education, Kongju National University, Korea, [2]School of Earth and Environmental Sciences, Seoul National University, Korea, [3]Korea Polar Research Institute, Korea

The studies of Magnetic activity have revealed the Antarctica peninsula has been dominant of a calc-alkaline nature for the last 580 Ma. This research focuses on exposing the typical tectonic setting in Antarctica as a continental margin magmatic arc relative with the igneous activity using geochemical data corrected rocks from northern Victoria Land, Antarctica. Within the study area, igneous, metamorphic and sedimentary rocks are compositionally distinguishable, and all magmatic rocks, especially in igneous rocks, show increasing SiO2, and increasing K/Si, Rb/Si, Th/Si and to a lesser extent Ce/Si and La/Si ratios away from the proposed trench axis. The pegmatitic granite from by the cooling and crystallization of hot, molten rock (magma and lava) and indicate the genesis of calc-alkaline magma, which have high large ion lithophile elements (LILE; e.g. K, Rb, Th)/high field strength elements (HFSE; e.g. Zr, Nb, Ti) ratios relative to non-orogenic counterparts, and increasing LILE/HFSE ratios with increasing fractionation. It is proposed that the high LILE/HFSE ratios in igneous melts are primary features due to dehydration processes with the subducted slab and to fractionation of minor mineral phases from the melt. The increasing LILE/HFSE ratios in more acid rocks are probably due to the removal of minor mineral phases from the melt. We have proposed that an enriched subcontinental mantle provides a viable alternative source for the increased LIL-element contents found in continental margin calc-alkaline magmas below northern Victoria Land, Antarctica.

A344

Session01: Geological History of Victoria Land: Reviews and New Findings

Meso-Cenozoic reactivation of the Rennick Geodynamic Belt (northern Victoria Land, Antarctica): new evidence from paleostress analysis

PAOLA CIANFARRA[1], LAURA FEDERICO[2], LAURA CRISPINI[2]
[†], COSTANZA ROSSI[1], GIOVANNI CAPPONI[2], FRANCESCO SALVINI[1]

[1]Dipartimento di Scienze, Universita' degli Studi Roma Tre , Italy, [2]DISTAV, University of Genova, Italy

The tectonic setting of northern Victoria Land is characterized by the Paleozoic tectonic juxtaposition of three main lithotectonic units known as Wilson, Bowers and Robertson Bay terranes. The regional fault corridors bounding these units have been (intermittently) active since Paleozoic times. The Wilson-Bowers boundary is a first-rank tectonic lineament, running from the coast of the Ross Sea to the Southern Ocean, with a roughly NW to NNW direction and an along strike length exceeding 400 km.
In this work we explore the structural architecture of the northernmost part of the Wilson-Bowers boundary, represented by the Rennick Geodynamic Belt (RGB), a deformation zones formed by the envelop of a fault network, NNW oriented, lying on the southward on-land prosecution of the Tasman Fracture Zone (TFZ).
To unravel and characterize the last tectonic activity of the RGB we performed a paleostress analysis on fault slip data and a field based study of the intensity of brittle deformation across the fault zone. Specifically we applied two inversion methodologies using over 800 fault slip data collected by the Authors in the last decade during the Italian Antarctic Expeditions in north Victoria Land (PNRA – Italian National Antarctic Research Program). The multiple Monte Carlo convergent method, implemented in the Daisy software (http://host.uniroma3.it/progetti/fralab/Downloads/Programs/) provides the best orientation of the principal paleostresses with an estimate of the error quantified by the MAD (Mean Angular Deviation) factor, that is the average angular deviation between the measured pitch of the kinematic vector on the fault plane and the predicted one by applying to the fault the computed paleostress. At each step, faults are uniquely associated to the stress tensor that provides the lowest MAD. The Fsa software (Célérier, 1999: http://www.isteem.univ-mont2.fr/PERSO/celerier/software/fsa.html) combines a random grid search of the stress tensors following a Monte Carlo approach, with a subsequent check of satisfaction of the frictional constraint (i.e. the fault plane must form with an orientation that fulfils the Mohr-Coulomb yield criterion, the ratio between the shear (t) and the normal stress (sn) equals tan φ, where φ is the angle of internal friction). The software actually allows a direct inspection of the reduced Mohr circle of the calculated stress tensors, so that we can select the one with the largest number of faults showing a high t/sn ratio.
The two different inversion algorithms, used in this study, provided very similar results and confirmed the prevalent strike-slip behavior of the RGB characterized by a double reactivation with right-lateral over left-lateral kinematics.
The intensity of brittle deformation was quantified in the field through the adimensional, scale invariant H/S parameter that is the ratio between the joint dimension (H) and its spacing (S) with the adjacent joint belonging to the same azimuthal family. A total of 539 joints were measured in the field. The analysis of the spatial variation of the H/S showed that the eastern sector of the RGB (Bowers Mts in the Bowers Terrane) is characterized by higher intensity of brittle deformation (mean H/S>5) with respect to the western sector (USARP Mts, i.e Wilson terrane with mean H/S < 2). Moreover the northern parts of both the Bowers Mts and USARP provinces show the highest intensity of brittle deformation (H/S value of 7.9 in the northern Bowers Mts province and 4.8 in the

northern USARP province). This feature may be related to the southward, on-land prosecution of the TFZ, thus strengthening the hypothesis that the fracture zones off-shore between Australia and Antarctica continue as Cenozoic strike-slip faults onshore in Victoria Land. This strike-slip activity occurs along inherited Paleozoic fault zones, that possibly acted as seed for the initial nucleation of the TFZ during the Australia-Antarctica rifting.

Session01: Geological History of Victoria Land: Reviews and New Findings

Cenozoic exhumation of the Mountaineer Range, Transantarctic Mountains, in northern Victoria Land: new constraints from apatite (U-Th-Sm)/He data

Evandro Balbi[1], Frank Lisker[2]
†, Laura Crispini[1], Andreas Läufer[3], Maria Balestrieri[4], Sofia Locchi[1]

[1]DISTAV, University of Genova, Italy, [2]FB Geowissenschaften, University of Bremen, Germany, [3]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany, [4]Dipartimento Scienze della Terra, University of Florence, Italy

The Mountaineer Range (MR) is a mountain range of the Transantarctic Mountains (TAM) located in the southern part of northern Victoria Land. It consists of Paleozoic basement rocks, mostly Cambro-Ordovician granitoids of the Wilson Terrane, and lavas of the Neogene McMurdo volcanic suite. The MR links a highland plateau landscape that is typical for almost the whole TAM with a high Alpine topography restricted to northern Victoria Land.
Uplift and exhumation of the TAM, including the MR, cannot be reconstructed by means of traditional geological methods due to the lack of any preserved rock between 180 Ma and Eocene times and for the inaccessibility of the adjacent offshore Ross Sea basin. This challenge has made the TAM a key region and a test field for the application of thermochronological methods. The large regional set of thermochronological data, mainly apatite fission track ages and proxies, was originally interpreted in terms of monotonous cooling and exhumation in three stages since at least Early Cretaceous time (e.g. Fitzgerald, 2002). However, the recent interpretation of combined thermochronological data, geological field evidences and geomorphological constraints implies a more complex thermal history that requires the existence of an extensive intra-Gondwana sedimentary basin between at least Permian and Paleogene (e.g. Lisker and Läufer, 2013; Prenzel et al., 2018). This basin, the Mesozoic Victoria Basin (MVB), was inverted since the Oligocene when rapid exhumation, probably linked to the opening of the West Antarctic Rift System, triggered the development of the present topography.
A new thermochronological study from the MR provides new apatite (U-Th-Sm)/He (AHe) data to further reconstruct the geometry of the MVB, to refine burial depth and basin topography, to determinate timing and course of exhumation and to conclude on accompanying and subsequent uplift. Ninety-eight single apatite grains from 23 basement samples were analyzed. Single grain AHe ages range from 41 to 21 Ma and mean sample AHe ages spread between 37 and 21 Ma. Most samples derive from a vertical profile at Mount Monteagle and show a good correlation between age and elevation. Their ages are 1 – 10 Ma younger than fission track ages of the same samples dated by Balestrieri et al. (1997), and 5 – 100 Ma younger than AHe ages from the neighboring Eisenhower and Deep Freeze Ranges (Prenzel et al., 2014, 2018).
The thermal history models of the new thermochronological data are very similar to the models presented by Prenzel et al. (2014, 2018) indicating common burial and exhumation of the MVB. All models refer to heating of a paleo-surface exposed at ~180 Ma due to the development of the MVB, followed by increased temperatures between Late Cretaceous and Eocene. The lack of any Mesozoic deposits does not allow to determinate the burial depth of the MR within the MVB. It suggests, however, that the MR was buried deeper than areas located further south, where more than 500 m of Permo-Triassic strata and Jurassic volcanics are still preserved, and a sedimentary overburden of 2 – 3 km was calculated. The thermal history models of the MR and throughout northern Victoria Land further reveal a stage of rapid Oligocene cooling that marks the inversion of the MVB.

References:
Balestrieri et al., 1994 – Terra Antartica, 1, 82-87;
Fitzgerald, 2002 – Royal Society of New Zealand Bulletin, 35, 453-469;
Lisker and Läufer, 2013 – Geology, 41, 1043-1046;
Prenzel et al., 2014 – Tectonophysics, 630, 113-130;
Prenzel et al., 2018 – Gondwana Research, 53, 110-128.

A387

Session01: Geological History of Victoria Land: Reviews and New Findings

Study of a polymict conglomerate from Reilly Ridge (northern Victoria Land, Antarctica): indirect evidence for the evolution of the Ross Orogen

Sofia Locchi[1], Laura Crispini[1†], Andreas Läufer[2†], Frank Lisker[3], Dieter Rammlmair[2], Evandro Balbi[1]

[1]DISTAV, University of Genova, Genova, Italy, [2]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany, [3]FB Geowissenschaften, University of Bremen, Bremen, Germany

During the GANOVEX XI campaign in the 2015-16 Antarctic season, a conglomerate sequence was sampled at Reilly Ridge in the north-eastern Lanterman Range in northern Victoria Land (NVL). This conglomerate represents one of several conglomeratic units within the Bowers Supergroup (e.g. Carryer Conglomerate, Reilly Conglomerate, etc.), which are poorly studied and still not fully understood. The Bowers Supergroup is part of the Bowers Terrane, which represents the central of three lithotectonic units that formed during the late Ediacaran to early Palaeozoic Ross Orogeny in the Transantarctic Mountains (e.g., Kleinschmidt and Tessensohn, 1987). The internal Wilson Terrane in the west and the external Robertson Bay Terrane in the east adjoin it tectonically.
The study of the Bowers Terrane is fundamental for understanding the evolution of the Paleo-Pacific active continental margin of former East Gondwana at that time, which experienced a long period of subduction from the latest Ediacaran into early Paleozoic (e.g., Goodge et al., 2012).
However, there are still uncertainties about the geodynamics related to this subduction system, e.g. the migration of the slab to a continuously more outboard position with time. Thus, the geodynamics related to the Ross Orogeny may be the starting point for any interpretation of the more recent history of NVL.

Here, we provide new constraints on the conglomerates from Reilly Ridge with regard to provenance of pebbles and detrital minerals and its possible source regions within the general frame of the Ross Orogen. We supply field observations and lab-based structural-petrographic and geochemical analyses of clasts and matrix (optical microscopy, point-counting, non-destructive μ-EDXRF/M4 Tornado). The analysed rocks represent a polymict conglomerate composed of clasts comprising different igneous and metamorphic lithologies (granitoid, volcanics, orthogneiss, low grade-metamorphic sandstone and limestone) fitting the neighbouring units of the Wilson and the Bowers terranes. More specifically, the erosional products derived from two potential sources, namely from a continental arc and an island arc located at a relatively close position to the depositional basin.The conglomerate and the associated finer-grained rocks most likely indicate a shallow marine environment with high-energy transport and relief, which was located within an area affected by active tectonics in an active continental margin setting. Based on our own and literature data, we assigned the studied rocks to the so-called Southend Conglomerate of the likely late Cambrian Spur Formation (Mariner Group - Bowers Supergroup; see Bradshaw et al., 1985; Cooper et al., 1990).

Bradshaw et al. (1985): Conference for Energy and Mineral Resources, Earth Science Series, 467–479
Cooper et al. (1990): New Zealand Journal of Geology and Geophysics, 33, 1, 55-66
Goodge et al. (2012): J. Petrology 53-10, 2027-2065
Kleinschmidt and Tessensohn (1987): In: McKenzie (Ed.), Gondwana Six: Structure, Tectonics and Geophysics, Geophys. Monogr., 40, 89–105

A396

Session01: Geological History of Victoria Land: Reviews and New Findings

Permian-Triassic fluvial deposits: a preliminary lithostratigraphic comparison between Southern Victoria Land (Antarctica) and Tasman (Australia) basins

Giovanni Liberato[1] †, Gianluca Cornamusini[1], Luca Zurli[1], Paolo Conti[1], Clive Calver[2], Sebastien Meffre[2], Franco Talarico[1]

[1]*University of Siena, Italy,* [2]*University of Tasmania, Australia*

During the Permian-Triassic Transition (PTT), the southern margin of the Gondwana was characterized by numerous retroarc foreland and intracratonic basins that evolved through different paleotectonic and paleoclimatic phases. The corresponding sedimentary successions record the aforementioned changes. This work, through a multidisciplinary study including logging and facies analysis, wants to face a preliminary stratigraphic comparison between the Southern Victoria Basin (SVL, Allan Hills, Victoria Land, Antarctica) and the Tasman Basin (Tasmania, Australia), at that time contiguous.
From north to south Tasmania, a detailed sedimentological study of approximately 1000 m of Permian-Triassic freshwater sections (Upper Parmeener Supergroup) were measured both in outcrop as well as in core at Mineral Resources Tasmania in Hobart (Australia). Based on sedimentological and stratigraphic features including lithofacies, sand/mud ratio and stacking patterns, the preliminary results on fluvial deposits comparison are summarized below:

i) Permian-Triassic Tasman fluvial deposits, even if similar in facies and sedimentary structures, are formed by sandstones granulometrically lower on average and have a different sand/mud ratio than Victoria Group. Lithofacies types of the Tasman sedimentary successions mainly comprise fluvial medium-fine-grained sandstones, reddish-brownish-greenish sandy siltstones and mudstones, coal seams and carbonaceous materials, measured in P/T Boundary and in middle Triassic. The coal seams appear to be less developed than in Victoria Land.

ii) In both basins the paleoenvironments and fluvial styles along the Permian-Triassic transition changed. An average granulometric increase and a fluvial style like sandy-braided are recorded in Early Triassic, whereas it was meandering during Late Permian. The PTT seems to be less erosive in SVL than in Tasmania, giving rise to a stratigraphic boundary variable from conformable to disconformable. This is also confirmed by the high variability in the Upper Permian strata thickness from North to South of Tasmania.

iii) A rise and fall of the base level is clearly evident in Tasmania, in particular also affecting the Lower Parmeener Supergroup (Early Permian), as recorded by these deposits that pass from glacio-marine to shallow marine and freshwater facies at least 2 times during Permian-Triassic. In Antarctica instead, findings of sedimentary structures associated with fluvial tidally influenced zone in Allan Hills (SVL), could be related to these cyclical rise and fall sea level events that interested this portion of the Gondwana.

iv) The stacking pattern frequency of the fluvial systems between Victoria Land and Tasman basins shows a good potential correlation. Respectively, from the Permian to the early and middle Triassic are low-high-low frequency similarly to the SVL fluvial system. It remains to be clarified whether this resulted from cyclic events or due to contractional tectonics or both together.

From this preliminary study we can understand how useful is the comparison of contiguous retroarc foreland/ intracratonic basins along the Southern Gondwana margin. The SVL and Tasman basins show good stratigraphic-sedimentological correspondences. New palynologic and provenance studies including sedimentary petrography and detrital zircon U/Pb geochronology on Permian-Triassic sandstones and mudstones, and overall a high-resolution facies and stacking pattern analysis will be essential dispensers for to have a better global evolutionary view of the southern Gondwana.

A397

Session01: Geological History of Victoria Land: Reviews and New Findings

Petrography and geochronology of Permian glaciogenic sequences in Victoria Land (Antarctica)

Luca Zurli[1†], Gianluca Cornamusini[1,2], Giovanni Liberato[1], Franco Talarico[1,3], Jusun Woo[4], Valentina Corti[1]

[1]University of Siena - Department of Physics, Earth and Environmental Sciences , Italy, [2]Centre of Geotechnologies - University of Siena, Italy, [3]National Museum of Antarctica - University of Siena, Italy, [4]Seoul National University, Korea

The Carboniferous-Permian glacial age, known as the Late-Palaeozoic Ice Age (LPIA), is one of the longest and most extensive cold episodes in the Earth history, which led to the deposition of glaciogenic sequences across the entire Gondwana. In the past, it was believed that during the LPIA a single ice sheet covered the Gondwana, but recent studies demonstrate that small ice caps occupied, diachronically, different portions of Gondwana following the position of the paleo-South Pole; in this scenario, provenance studies can validate the hypothesis of a local source of sediments, rather than the long-distance one. In Antarctica there are discontinuous outcrops of the glaciogenic sequences along the Transantarctic Mountains related to the Stage III of the LPIA; those sequences are known as Metschel Tillite in Southern Victoria Land (SVL) and Lanterman Formation, and its equivalents, in Northern Victoria Land (NVL). Recent studies yielded U/Pb ages from the Central Transantarctic Mountains (CTM) and the Ellsworth Mountains; this work provides new data from Victoria Land, a region of the Transantarctic Mountains where geochronological data from glaciogenic succession are not available. In this study, we present the result of the quantitative petrographic analysis of 42 samples from glacial intervals and pre- and post-glacial formations, the petrographic characterization of the diamictite cobbles to pebbles and the geochronological analysis of 600 zircon detrital grains from four diamictite samples. Samples were collected during XXVIII, XXX and XXXI PNRA expeditions, from the glacial Metschel Tillite in SVL and the Lanterman Formation, and its equivalents, in NVL. Quantitative petrographic data were obtained applying the Gazzi-Dickinson point-counting method; geochronological data were obtained with LA-ICP-MS at the KOPRI laboratory (Incheon – Republic of Korea). U/Pb age populations show wide differences between Southern and Northern Victoria Land samples; while SVL samples are almost similar, with the major population related to the Ross - Pan-African Orogeny (480-600 Ma) and with secondary population related to the Grenville Orogeny (900-1300 Ma), NVL samples show wide differences in the zircon age populations. The petrographic analysis of SVL diamictites show a composition dominated by quartz fragments, both with well-rounded and sub-angular shape, indicating a partial reworking of older deposits; feldspars and/or cordierite are not abundant and strongly weathered. Lithic clasts are made by felsic granitoids, sedimentary and meta-sedimentary rocks and rare volcanic products. NVL diamictites are characterized by the absence of well-rounded quartz grains and the common presence of feldspars, both K-feldspars and plagioclase; lithic clasts are felsic granitoids, meta-sedimentary and metamorphic rocks. The variability in the petrographic composition and in the zircon age populations across Victoria Land indicates the influence of the local basement lithology in the tillite composition and the inference of local paleo-ice flows. Those data are coherent with the forming view of a LPIA characterized by small ice centres across Gondwana, rather than a single ice sheet spreading from Antarctica to Gondwana margins.

A398

Session01: Geological History of Victoria Land: Reviews and New Findings

Stratigraphy of Late Palaeozoic Ice Age sequences in Victoria Land (Antarctica) and Tasmania (Australia): a comparison across southern Gondwana

Luca Zurli[1], Gianluca Cornamusini[1, 2†], Giovanni LIberato[1], Franco Talarico[1, 3], Jusun Woo[4], Paolo Conti[1, 2], Valentina Corti[1]

[1]Department of Physics, Earth and Environmental Sciences, University of Siena, Via Laterina, 8, 53100 Siena, Italy, Italy, [2]Centre for Geotechnologies, University of Siena, Via Vetri Vecchi, 34, 52027 San Giovanni Valdarno (AR), Italy, Italy, [3]National Museum of Antarctica, University of Siena, Via Laterina, 8, 53100 Siena, Italy, Italy, [4]School of Earth and Environmental Sciences, Seoul National University, Gwanak-gu, Seoul 08826 South Korea , Korea

During Carboniferous and Permian, the Earth experienced a cold episode known as the Late Palaeozoic Ice Age (LPIA) that left tillite succession across Gondwana. The LPIA view is changing from a single ice sheet covering the entire Gondwana to a series of small and diachronous ice caps widespread through the supercontinent. Stratigraphic studies and facies analysis are key tools for the evaluation of the paleo-environmental depositional setting and, consequently, of the style of glaciation. In this study, 9 detailed stratigraphic logs, from outcrops and drill holes, have been measured: four from Southern Victoria Land (SVL) (Antarctica), three from Northern Victoria Land (NVL) (Antarctica) and two from Tasmania (Australia). For any log, bed-by-bed facies analysis has been done and 19 sedimentary facies have been recognized and grouped in 8 facies associations (FA), indicative of the depositional environment. In SVL, the facies analysis, with the evaluation of the glacio-tectonic structures, indicate that the Metschel Tillite has been deposited in an ice-proximal to sub-glacial subaqueous environment and the deposition recorded at least two phases of ice front advance and related retreat. The glacial interval is delimitated at the bottom by an erosive surface delimiting the Devonian Taylor Group and at the top by another erosive surface, above which lay conglomerates grading upward into cross-bedded sandstones of the Weller Coal Measures. In the NVL, the Eisenhower Range diamictites, laying directly the crystalline basement, are thin and they present sub-glacial and ice-proximal facies, with a quite different petrographic composition; no glacial features (e.g. clasts with striae) have been recognized and the glacial origin of both these deposits is not certain. Differently, the more northern glacial sequences of the Rennick Glacier and Neall Massif are thicker and show a wide facies variety, coherent with a floating ice front in a subaqueous environment; the near glacial sequence in the Lanterman Range shows a glacio-lacustrine origin. Two drill cores in the Tasman Basin have been analysed and compared with outcrops of the Wynyard Tillite. Preliminary studies show wide changes in the tillite thickness between the Truro Tillite and the Stockers Tillite; both show an ice-proximal subaqueous depositional environment, with at least two ice front advances. The large-scale view of the LPIA deposits across Victoria Land shows two thick sequences in the SVL and in the northern part of NVL, deposited in a subaqueous environment, separated by thin and scattered deposits related to small ice centres in a basement high in the southern part of NVL.

A399

Session01: Geological History of Victoria Land: Reviews and New Findings

Paleoenvironmental implications from facies analysis of Permian-Triassic nonmarine deposits of Allan Hills (Southern Victoria Land, Antarctica)

Giovanni Liberato[1†], Gianluca Cornamusini[1]

[1]*University of Siena, Italy*

The sedimentary rock sequences that outcrop in the north-eastern belt of Allan Hills, in Southern Victoria Land, Antarctica, show a spectacular terrestrial succession, about 350 meters thick, which contains the Permian-Triassic boundary (PTB). Our preliminary results show sedimentary structures and facies interpretation done through a high-resolution sedimentological study. The outcropping succession starts from the Lower to ?Upper Permian Weller Coal Measures Fm., upwards through the Lower Triassic Feather Conglomerate Fm., to the Lashly Fm. with its members A, B and C, Middle Triassic in age. Regional studies showed that the succession of Victoria Land was deposited in a continental intracratonic basin extending northwards, linked to a foreland system to south. About ten stratigraphic columns were measured at high resolution (centimeter scale) to try to make a first lateral correlation across about four kilometers of northeastern Allan Hills and to determine the facies stacking pattern. For example, sedimentary facies of the Permian Weller Coal Measures Fm., include some structures recorded for the first time for such deposits, as cross-bedded sandstones with mud drapes, interference ripples, tidal bundles (reflecting neap-spring tidal cycles interrupted by flood events), tangential cross-bedding, reactivation surfaces, wavy, flaser and lenticular bedding, seasonal rhythmites with carbonaceous clay, suggesting a fluvial dominated system with tidal influence. These results highlight that layers of sheet like fluvial channel belt were interested by strongly fluctuations in discharge. Throughout the whole Permian-Triassic succession, the lateral facies variations that have been correlated across the Allan Hills northeastern belt will be discussed. Several lithofacies and facies associations have been identified and include mainly conglomerates, pebbly sandstones, greywackes, siltstones, mudstones and coal representing fluvial and floodplain depositional systems.

The Lower Triassic Feather Sandstone highlights an architecture that it would appears to be largely progradational from fold-thrust belt margin toward mainly North for the craton area. We also show how in the middle Triassic Lashly Fm., there are still sedimentary structures implying tidal influence. It is clear that, from the Permian to the Triassic, the river system undergoes changes in a cyclic order. To this regard, the results record the occurrence of a wide spectrum of terrestrial environments through the time, as: i) sandy braided-river tidally influenced, ii) lacustrine, iii) sandy meandering-river highly tidally influenced iv) gravelly sandy braided-river, v) sandy braided to meandering-river tidally influenced.

Characteristics such as abundant mud drapes, cyclic mudstone intervals in sandstones and current reversals indicate that the Permian and Middle Triassic palaeoenvironments were affected by regional geologic changes due to climate, tectonics, sea level rise and fall.

Finally, in this sense, this work could be the first evidence of fluvial dominated-tidally influenced associations environment for such deposits, which would imply an estuary-like or tide-dominated deltas system in the present western cratonic area of East Antarctica, covered by the ice caps, not very far from the Southern Victoria Land.

A406

Session01: Geological History of Victoria Land: Reviews and New Findings

Early Paleozoic geodynamics of northern Victoria Land: state of art, new investigations and implications for Gondwana reconstruction

Gianfranco Di Vincenzo[1], Laura Crispini[2] †, Andreas Läufer[3], Bradley Hacker[4], Rosaria Palmeri[5], Riccardo Tribuzio[6], Samuele Agostini[1], Claudio Ghezzo[7], Giovanna Giorgetti[7], Cristina Malatesta[2], Sonia Sandroni[5], Simone Vezzoni[1]

[1]Istituto di Geoscienze e Georisorse - CNR, Pisa, Italy, [2]DISTAV-Dipartimento di Scienze della Terra dell'Ambiente e della Vita, University of Genova, Italy, [3]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany, [4]Department of Earth Science, University of California, Santa Barbara CA, USA, [5]MNA-Museo Nazionale dell'Antartide, University of Siena, Siena, Italy, [6]Dipartimento di Scienze della Terra e dell'Ambiente, University of Pavia, Italy, [7]DSFTA-Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente, University of Siena, Italy

Much of the Earth history has been marked by episodic assembly and breakup of supercontinents. Our knowledge of the supercontinent cycle is important as it influenced the Earth's geologic, climatic and biological evolution. Paleozoic sequences exposed along the Transantarctic Mountains (TAM) in Antarctica, southeastern Australia and in south New Zealand are segments of a formerly contiguous continental margin active since the early Paleozoic along the eastern margin of the supercontinent Gondwana. Northern Victoria Land (NVL), located at the Pacific side of the TAM, plays a key role in any geodynamic reconstructions of Gondwana because it represents the along-strike continuation of Australia in Antarctica, and it hosts the only Paleozoic eclogite-facies rocks known along the Transantarctic Mountains. NVL consists of Neoproterozoic to early Paleozoic basement rocks, whose structural architecture is ascribed to the Ross-Delamerian orogenic cycle. Although the Ross Orogen in NVL is mostly interpreted as the result of a subduction-related arc/back-arc/trench system, its architecture and geodynamic evolution during the early Paleozoic remain controversial, and formulating an accurate geodynamic model has been hindered by a dearth of constraints, concerning onset and duration of magmatism and metamorphism. Following a multidisciplinary approach, which integrates field data with petrological, geochemical and geochronological investigations, our research group aims to fill the gap left by previous investigation of NVL, with the aim of clarifying the geodynamics in the area during the early Cambrian and improve our knowledge about correlation of NVL and southeastern Australia. Starting from available data and geodynamics models proposed so far in literature for NVL, here we report about our work in progress and recent fieldwork in Antarctica.

A430

Session01Geological History of Victoria Land: Reviews and New Findings

GANOVEX: 40 years of Earth System research in Victoria Land - in remembrance of Franz Tessensohn

Andreas Läufer[1 †]

[1]*Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany*

Since 1979, scientists of the Federal Institute for Geosciences and Natural Resources (BGR) in collaboration with national and international institutions have studied the lithosphere and processes related to the geological evolution of Antarctica through time. The main target have been the Transantarctic Mountains (TAM) in Victoria Land and the Ross Sea region within the frame of the research program GANOVEX (German Antarctic North Victoria Land Expedition). This long-term program was initiated by Franz Tessensohn with GANOVEX I in the 1979-80 Antarctic season. The completion of GANOVEX XIII in 2018-19 has led the program into its 40th year. Based on the task sharing agreement with the Alfred Wegener Institute Helmholtz Centre of Polar and Marine Research (AWI), BGR is responsible for the terrestrial ("hard-rock") part of German geoscientific research in Antarctica. BGR logistics has supported numerous projects based at German universities, which receive financial support through the Antarctic Priority Program of the German Research Foundation (DFG). BGR owns Gondwana Station at Terra Nova Bay and Lillie-Marleen-Hut in the Everett Range of the TAM, since 2005 recognized as Historic Site & Monument within the Antarctic Treaty System. In the early years of BGR's Antarctic activities, large areas of northern Victoria Land (nVL) were "white spots" on Earth's geological map. Modern plate tectonic models of the crustal structure of the Paleo-Pacific margin of Antarctica did not exist. Only numerous observations combined with comprehensive geological mapping revealed the ancient plate tectonic configuration, and several new geographical names referring to BGR's Antarctic research in nVL appeared on international map sheets (e.g., BGR Nevé, GANOVEX Range). BGR also organized or co-organized expeditions to the Shackleton Range, the central TAM, and East Antarctica (Dronning Maud Land, Lambert Glacier, Gamburtsev Subglacial Mountains) and participated in the Cape Roberts Project and ANDRILL in the Ross Sea. BGR makes a major contribution to the main scientific goals of German Antarctic research and assists the government in the pursuit of its political goals, such as maintaining Germany's consultative status within the Antarctic Treaty System. Through planning, organization and implementation of geoscientific expeditions conducted on a broad scientific basis and in cooperation with national and international partners, BGR makes an important contribution to the primarily basic geoscientific polar research to which Germany is committed in line with its co-responsibility for the global environment.

While GANOVEX celebrates its 40th anniversary in 2019, BGR had the sad duty to inform the community that Franz Tessensohn passed away on 09th April 2019, only a few months before his 80th birthday. Franz was the initiator of BGR's polar research program and long-time head of the polar research group. After participation in US-American Antarctic expeditions in 1976/77, Franz was expedition leader of five successive GANOVEX campaigns as well as the international EUROSHACK expedition (with Mike Thomson, BAS) to the Shackleton Range. He was member of the International Steering Committee of the Cape Roberts Project. When the Arctic became a second focus of BGR's polar research in the late 1980s, Franz initiated BGR's Arctic terrestrial geoscientific research program CASE (Circum-Arctic Structural Events). Within the German geoscientific polar research community, Franz played a leading role in establishing and defining Germany's geoscientific research in the both polar land areas. As father of BGR's flagships GANOVEX and CASE and as initiator and organizer of numerous expeditions and conferences, he established the cooperation network between BGR and national and international geological surveys, polar research institutions,

universities and museums, which has become the foundation of today's Antarctic and Arctic international research of the BGR.

Session01Geological History of Victoria Land: Reviews and New Findings

Polycyclic aromatic hydrocarbons as marker of fossil charcoal in transported Triassic wood of Allan Hills (Southern Victoria Land, Antarctica)

valentina corti , luigi d'acqui , gianluca cornamusini , luca calamai , giovanni liberato , dalila pas quini , franco talarico

[1]Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente, Universit?di Siena, Siena, Italy, [2]Istituto di Ricerca sugli Ecosistemi Terrestri, Consiglio Nazionale delle Ricerche, Sesto Fiorentino, Italy, [3]Centro di Geotecnologie, Universit?di Siena, San Giovanni Valdarno, Italy, [4]Dipartimento di Scienze e Tecnologie Agrarie, Alimentari, Ambientali e Forestali, Universit?di Firenze, Firenze, Italy

Fossil charcoal represents an important tool to determine the occurrence of wildfire scenarios involving woods of terrestrial paleoenvironments.
This proxy has been applied extensively for several reconstructions, ranging from the Paleozoic to Quaternary of some typical alluvial setting, particularly regarding the fluvial one, where charcoal has been preserved within the deposits. The fossil charcoal contained within deposits, subdivided in micro- and macrocharcoal, is usually determined through morphological analyses involving microscopical and SEM observations, keeping in consideration also some macroscopical properties of the coal. Unsubstituted polycyclic aromatic hydrocarbons (PAHs) are used extensively as wildfire indicators in environmental and sedimentary rocks samples due to their pyrolytic origin. Ratios between PAHs of pyrolytic and petrogenic origin are used as biomarker to indicate the pyrogenic source. In this work, we have used a pyrogenic index using several PAHs attributed to the two different origins. We have tried to apply this PAHs analysis to silicified fossil woods recognized during past Italian Antarctica Expeditions within sandstone deposits relative to a sandy-braided stream of Middle Triassic age, magnificently outcropping in Allan Hills (Southern Victoria Land, Antarctica). The charcoal in Allan Hills, as well as for the whole Paleozoic-Mesozoic terrestrial deposits of Victoria Land, has been rarely revealed on leaves only of Middle-Late Triassic age, through micromorphological analysis, whereas analyses on woods has been disregarded so far in the literature.
The fossil woods are particularly concentrated (more than 250 log samples have been recorded) in three stratigraphic levels, forming a fossilferous horizon some meters thick, built mainly of trough cross-stratified middle-coarse sandstones of downstream accretion forms and sandy bedforms.The logs, some of them some meters long, are almost totally transported by fluvial current flows, probably due to significant floods, as peat-remnant rafts demonstrate, forming fossil logjams. Most of the log samples, all silicified, appear to be totally or more often partially black in colour due to the effect of carbonization.
The PAHs analysis by GC –MS on methanol-dichlorometane extracts of log specimens revealed the presence of a larger amount of PAHs of pyrogenic origin in the log black portion with respect to the PAHs from petrogenetic source indicating that the log carbonized portions were of wildfire origin. However, a similar trend, albeit to a lesser extent, occurred also in the grey portions. This would indicate a migration of pyrogenic PAHs from the black zone probably occurring during the permineralization process. In fact, the amorphous silica that initially permeated wood (through fluid flow), thanks to a strong affinity with PAHs, would have been easily transported during the silicification process.The occurrence of fossil charcoal within some of the logs implies a paleoenvironmental scenario during the Middle Triassic, when possibly dramatic wildfires affected riparial forests or part of them. Then the burned trees, together with unburned ones would have been transported by floods and accumulated within the fluvial bars.

A079

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Age and Geochemistry of the Cape Burks Gabbroids (Russkaya Station Area, West Antarctica)

Daria Agapitova[1†], Eugene Mikhalsky[1], Nadezda Sushchevskaya[2], Eugene Kunakkuzin[3], Sergey Skublov[4,5], Sergey Sergeev[6,7]

[1]Gramberg All-Russia Research Institute of Geology and Mineral Resources of the World Ocean, Russia, [2]Vernadsky Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences , Russia, [3]Geological Institute, Kola Science Centre, Russian Academy of Sciences , Russia, [4]Institute of Precambrian Geology and Geochronology, Russian Academy of Sciences , Russia, [5]St. Petersburg Mining University , Russia, [6]St. Petersburg State University, Earth Science Institute , Russia, [7]Karpinskii All-Russia Research Institute of Geology, Russia

Intrusive magmatic complex consisting of differentiated gabbroids, and vein bodies of felsic, intermediate, and mafic composition was formed in the Cape Burks area (The Hobbs coast, West Antarctica). The gabbroids are represented by olivine and olivinefree gabbros and gabbronorites, with sharply subordinate troctolites, gabbro-anorthosites, and anorthosites. The U-Pb SHRIMP-II zircon age of the gabbroids and vein rocks was estimated at 100+/- 1 Ma. The developed rocks of mafic and intermediate-felsic composition do not represent a bimodal magmatism but rather reflect specifics of magma differentiation.

The gabbroids were supposedly formed in the upper lithosphere of West Antarctica in the tectonically active conditions. Their composition was mainly determined by accumulation and fractional crystallization. The thickness of the pluton is no less than 2,5-3 km. The complex was likely formed in a rift-related within-plate setting.

The primary melts were derived from lithospheric mantle weakly enriched in lithophile elements. Felsic and intermediate vein rocks were presumably crystallized from separating residual liquid. The genetic link between the gabbroids and vein rocks, including felsic rocks,follows from similar Sr-Nd isotope signatures, complementary trace-element patterns, and similar trace-element composition of zircons.

A084

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Deciphering Deception Island's magma plumbing system: An interdisciplinary approach

Adelina Geyer[1], Antonio M. Álvarez-Valero[2], Guillem Gisbert[3], Meritxell Aulinas[4], Daniel Hernández-Barreña[2], Agustín Lobo[1], Joan Martí[1], Santiago Giralt[1†]

[1]Institute of Earth Sciences Jaume Almera, ICTJA, CSIC, Lluis Sole i Sabaris s/n, 08028 Barcelona, Spain , Spain, [2]Departamento de Geologia, Universidad de Salamanca, 37008 Salamanca, Spain , Spain, [3]Instituto de Geociencias, CSIC-UCM, Severo Ochoa 7, 28040 Madrid, Spain, Spain, [4]Departament de Mineralogia, Petrologia i Geologia Aplicada. Universitat de Barcelona, Marti Franques s/n, 08028 Barcelona, Spain , Spain

Deception Island (South Shetland Islands) is one of the most active volcanoes in Antarctica, with more than 20 explosive eruptive events registered over the past two centuries. Recent eruptions (1967, 1969, and 1970) and the volcanic unrest episodes that happened in 1992, 1999, and 2014–2015 demonstrate that the occurrence of future volcanic activity is a valid and pressing concern for scientists, technical and logistic personnel, and tourists, that are visiting or working on or near the island. Understanding the current state of the island's magmatic system, and its potential evolution in the future, is fundamental to increase the effectiveness of interpreting monitoring data during volcanic unrest periods and hence, for future eruption forecasting. We present here a unifying evolutionary model of the magmatic system beneath Deception Island by integrating new petrologic and geochemical results with an exhaustive database of previous studies in the region. The results obtained reveal the existence of a complex plumbing system composed of several shallow magma chambers (≤ 10 km depth) fed by magmas raised directly from the mantle, or from a magma accumulation zone located at the crust-mantle boundary (15–20 km depth). Our conclusions reinforce the perception of Deception Island as a very active and candidate volcano for a new eruption in the near future. This research was supported by the POSVOLDEC (CTM2016-79617-P)(AEI/FEDER, UE) research project.

A090

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Antarctic volcanoes: A remote but significant hazard

Geyer Adelina[1], Alex Martí[2], Giralt Santiago[1†], Folch Arnau[2]

[1]Institute of Earth Sciens Jaume Almera (ICTJA-CSIC), Barcelona, Spain, [2]Barcelona Supercomputing Center, BSC, Barcelona, Spain

Ash emitted during explosive volcanic eruptions can be dispersed over massive areas of the globe, posing a threat to both human health and infrastructures, such as the air traffic. Some of the last eruptions occurred during this decade (e.g. 14/04/2010 - Eyjafjallajökull, Iceland; 24/05/2011-Grímsvötn, Iceland; 05/06/2011-Puyehue-Cordón Caulle, Chile) have strongly affected the air traffic in different areas of the world, leading to economic losses of billions of euros. From the tens of volcanoes located in Antarctica, at least nine are known to be active and five of them have reported volcanic activity in historical times. However, until now, no attention has been paid to the possible social, economical and environmental consequences of an eruption that would occur on high southern latitudes, perhaps because it is considered that its impacts would be minor or local, and mainly restricted to the practically inhabited Antarctic continent. We show here, as a case study and using climate models, how volcanic ash emitted during a regular eruption of one of the most active volcanoes in Antarctica, Deception Island (South Shetland Islands), could reach the African continent as well as Australia and South America. The volcanic cloud could strongly affect the air traffic not only in the region and at high southern latitudes, but also the flights connecting Africa, South America and Oceania. Results obtained are crucial to understand the patterns of volcanic ash distribution at high southern latitudes with obvious implications for tephrostratigraphical and chronological studies that provide valuable isochrones with which to synchronize palaeoclimate records. This research was partially funded by the MINECO grants VOLCLIMA (CGL2015-72629-EXP)and POSVOLDEC(CTM2016-79617-P)(AEI/FEDER, UE), the Ramón y Cajal research program (RYC-2012-11024) and the NEMOH European project (REA grant 34 agreement n◦ 289976).

A108

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

The 1254 C.E. tephra layer and its potential for correlations and synchronization of Antarctic ice cores and marine sediments

Alessio Di Roberto[1†], Ester Colizza[2], Paola Del Carlo[1], Maurizio Petrelli[3], Furio Finocchiaro[2], Gerhard Kuhn[4]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Via della Faggiola 32, 56126 Pisa, Italy, [2]Dipartimento di Matematica e Geoscienze, Universit?di Trieste, Via E. Weiss 2, 34127 Trieste, Italy, [3]Dipartimento di Fisica e Geologia, Universit?di Perugia, Via A. Pascoli, I-06123, Perugia, Italy, [4]Alfred-Wegener-Institut, Helmholtz Zentrum f? Polar- und Meeresforschung, Am Handelshafen 12, D-27570 Bremerhaven, Germany

A cryptotephra, i.e. a layer of volcanic ash invisible to the naked eye, was found in marine sediments of the Edisto Inlet, a fjord located between Cape Hallett and the northern Victoria Land coast, in the western Ross Sea (Antarctica). The cryptotephra has been fully characterized for texture, mineralogy, and major- and trace-element data, obtained on single glass shards. Based on geochemical data, we correlated the cryptotephra with the proximal deposits of an explosive eruption of Mt. Rittmann volcano, in the North Victoria Land and with the 1254 C.E. widespread tephra marker reported in several ice-cores and blue ice fields from East and West Antarctica. The wide dispersal (at least 1x10*6 km2), the sedimentological and textural characteristics of the studied cryptotephra and of the correlatives indicate that these was produced by a prolonged, moderate energy, mostly hydromagmatic eruption. This is the first time that a cryptotephra is identified both in marine sediments of the Ross Sea, both in ice core, so allowing to unequivocally correlate continental cryosphere record and marine sediments in Antarctica. This discovery demonstrates that the study of cryptotephra is feasible in Antarctica and may significantly expand the potential and application of tephrochronology in this region for synchronizing, correlating, and perhaps in some cases, dating Antarctic records. From a purely volcanological point of view, this discovery further confirms the occurrence in historical times of a long-lasting, significant explosive eruption from Mt. Rittmann producing abundant fine ash. This introduce the problem of a proper hazard assessment from volcanoes located at high southern latitudes.

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Early Cretaceous volcaniclastics on the Naturaliste Plateau, offshore SE Australia (IODP Site U1513): Implications for the East Gondwana breakup

Eun Young Lee[1†], Maria Luisa Tejada[2], Erik Wolfgring[3], Carmine Wainman[4], Dennis Harry[5], Alessandro Maritati[6], Seung Soo Chun[1], Irina Borissova[7], Yong-Xiang Li[8], Carl Richter[9], Laurent Riquier[10], Mathieu Martinez[11], Kenneth MacLeod[12], IODP Expedition 369 Science Party[13]

[1]Faculty of Earth Systems and Environmental Sciences, Chonnam National University, Gwangju , Korea, [2]Department of Solid Earth Geochemistry (DSEG), Japan Agency for Marine-Earth Science and Technology, Yokosuka, Kanagawa, Japan, [3]Department of Geodynamics and Sedimentology, University of Vienna, Vienna, Austria, [4]Australian School of Petroleum, University of Adelaide, Adelaide, SA, Australia, [5]Department of Geosciences, Colorado State University, Fort Collins, CO, USA, [6]Institute of Marine and Antarctic Studies (IMAS), University of Tasmania, Battery Point, Australia, [7]Geoscience Australia, Canberra, ACT, Australia, [8]School of Earth Sciences and Engineering, Nanjing University, Nanjing, China, [9]Department of Geology & Energy Institute, University of Louisiana, Lafayette, LA, USA, [10]Institut des sciences de la Terre a Paris (ISTEP), Sorbonne University, Paris, France, [11]Geosciences Rennes, University of Rennes, CNRS, Rennes, France, [12]Department of Geological Sciences, University of Missouri, Columbia, MO, USA, [13]http://iodp.tamu.edu/scienceops/precruise/swaustralia/participants.html, USA

The Naturaliste Plateau (NP) offshore southwestern Australia is a submarine continental fragment left behind during Early Cretaceous breakup of Greater India and Australia-Antarctica, which is a key region to study the effect of breakup-related volcanism in the rifting margin. The NP is bounded by rifted and transform margins, and its southern side is bordered by a steep faulted margin that formed during Late Cretaceous rifting between Australia and Antarctica. The eastern NP is overlain by the western Mentelle Basin (MB), a sedimentary basin formed during the Jurassic-Cretaceous breakup which may possess tectonic links with the Knox subglacial sedimentary basin (KSSB) in the conjugate region of East Antarctica. During the East Gondwana breakup, extensive rift-related volcanism occurred along the conjugate plate margins. The volcanism in the NP could represent early expression of the Kerguelen Plume and inform the role of volcanism in the region affected by rifting. On the NP, the first direct evidence of volcanism and a full sequence of volcaniclastics were recovered at Site U1513 by International Ocean Discovery Program (IODP) Expedition 369 in 2017.

Site U1513 is drilled on the eastern flank of the NP and the recovered overlying Cretaceous and late Miocene-Pleistocene sedimentary sequences are interpreted as part of onlap of the western MB. This study describes the volcaniclastic strata using newly acquired shipboard and post-cruise data and discusses their implications for the East Gondwana breakup. The volcaniclastic core sections were recovered from 454.9 to 690.3 meters below seafloor at Hole D, overlying the volcanic sequence consisting of interlayered basalt flows, breccias and dikes. The high resolution magnetostratigraphy established for the volcaniclastic sequence indicates deposition from the Hauterivian to early Aptian. This suggests that most of the sequence was deposited contemporaneously with rift-related volcanism nearby, which is supported by hydrothermal alteration and dikes observed in the volcaniclastics. The sequence consists mainly of fine- to course-grained sandstone, silty claystone and siltstone with abundant volcanic clasts, lithic fragments and smectite clay minerals which are diagnostic of sediments derived from the volcanic terrain, altered basalts and subaerial erosion. Regularly changing sedimentary facies and nearly absent sedimentary structures together with the lack of paleontological data restrict our interpretation on the depositional processes and paleoenvironmental conditions. Generic interpretations suggest a transition from shallow/shelf to

deep/bathyal environment through time, which is only partly correlated with the Warnbro Group of the adjacent Perth Basin. Using the on-site compaction trend based on porosity data, the burial history with sedimentation rate is modelled. The sedimentation rate generally shows a stepwise decrease with a burial history suggesting influences of eustatic sea-level change and syn- and post-rift subsidence. The slow sedimentation associated with stationary subsidence during the Barremian-early Aptian is analogous across the southwestern margin of Australia, which was tectonically quiescent with slow sedimentation and few hiatuses after the breakup. These new results from the volcaniclastic sequence at Site U1513 show the interplay of volcanism, sedimentation and tectonics that occurred on the NP during the East Gondwana breakup.

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Petrogenetic models for the evolution of alkalic magmas in the Erebus volcanic province, Antarctica

Adam Martin[1 †], Alan Cooper[2], Richard Price[3], Phillip Kyle[4], John Gamble[5, 6]

[1]GNS Science, New Zealand, [2]University of Otago, New Zealand, [3]University of Waikato, New Zealand, [4]New Mexico Institute of Mining and Technology, USA, [5]Victoria University of Wellington, New Zealand, [6]University College Cork, Ireland

Since the heroic era in the early 1900s investigations have been directed towards understanding the petrogenetic evolution of volcanic rocks in the Erebus volcanic province. We have proposed new petrogenetic models in a chapter on the petrology of the Erebus volcanic province in an upcoming Geological Society of London Memoir on Antarctic volcanism (Martin et al. 2020).

Based on field and source characteristics and geographic locations, the province is newly subdivided into five volcanic fields (Terror Rift, Ross Island, Mount Discovery, Mount Morning and the Southern Local Suite). The previous work and petrology of each field is summarised, accompanied by geological maps of the major eruptive centres. A comprehensive dataset of new and published geochemical and isotopic analyses of whole rock, tephra, and glass samples and their associated age determinations have been compiled. Analyses of clinopyroxene from four eruptive centres are used to examine geobarometry and geothermometry across the province. Various hypotheses on the petrogenesis and source characteristics of the Erebus volcanic province magmas are reviewed, and evolutionary models are tested.

The Erebus volcanic province rocks are mainly nepheline normative, with rare, quartz normative compositions attributed to wall-rock assimilation. Eruption in the province commenced by at least 18.7 Ma, but by correlation with distal tephra, may have started as early as 25 Ma. Volcanic activity is ongoing today at Mount Erebus, and several other volcanic centres in the region are considered dormant. Several petrological lineages that record crystal fractionation history have been identified in the Erebus volcanic province, with modelling showing olivine + clinopyroxene + ilmenite/magnetite + titanite ± kaersutite ± feldspar to be important fractionating phases. Modelling and geobarometry show depths of melting are greatest beneath Ross Island and the Transantarctic Mountains, relative to Mount Morning and Mount Discovery volcanic fields which lie between these two localities. The generation of relatively undifferentiated magmas in the province can be modelled by < 10 % partial melting of mixed spinel and garnet lherzolite mantle sources. Equilibration of radiogenic Sr, Nd, Pb and Hf isotopic systems in relatively undifferentiated rocks are best explained in terms of a high time integrated HIMU 'sensu stricto' component in the mantle source, at least beneath Ross Island. The HIMU signature is likely to be older than 0.5 Ga and is thus unrelated to subduction of the palaeo-Pacific plate beneath East Antarctica at c. 0.5 Ga. Relatively undifferentiated whole rock chemistry from the province can also be modelled to show an eclogite component in the source, and spatial (west-east) variations in Sr, Nd and Pb isotopic compositions and Ba/Rb and Nb/Ta ratios can be interpreted to indicate increasing involvement of an eclogitic, oceanic crustal component eastwards. Variable lines of evidence also point to a role for amphibole, enriched mantle-like and carbonatite-like components in the source. Whether melting in the region is related to decompression, possibly from edge-driven mantle convection, or a mantle plume, cannot be unequivocally determined from the chemical and isotopic evidence, and geophysical evidence is interpreted differently by various workers, making this a matter of on-going debate. Despite the long history of petrological investigation into the petrogenesis of the Erebus volcanic province, many questions remain unanswered to challenge a new generation of petrologists.

Martin A. P., Cooper, A. F., Price, R.C., Kyle P.R., Gamble, J. A. 2020. Erebus Volcanic Province II. Petrology. In: Smellie, J.L. Panter, K.S., Geyer, A. (Eds.) Volcanism in Antarctica: 200 Million Years of Subduction, Rifting and Continental Break-Up. Geological Society of London, Memoir.

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Geochemical characterization and correlation of the 1252 C.E. Rittmann tephra in Antarctic ice

Mi Jung Lee[1†], Nels Iverson[2], Jeff Oalmann[3], Philip Kyle[4]

[1]Division of Polar Earth-Sytem Sciences, Korea Polar Research Institute, Korea, [2]New Mexico Bureau of Geology and Mineral Resources, New Mexico Institute of Mining and Technology, USA, [3]Earth Observatory of Singapore, Nanyang Technical University, Singapore, [4]Department of Earth and Environmental Science, New Mexico Institute of Mining and Technology, USA

Tephra are valuable as time stratigraphic markers in ice cores and can be used to make correlations between ice cores and blue ice areas on the East and West Antarctic Ice Sheets. A 13th century tephra was identified almost 20 years ago in an ice core from Talos Dome and is now known in 6 ice cores (Talos Dome, WAIS Divide, Siple, RICE, Taylor Dome, Styx) and 2 blue ice patches in Victoria Land (Rennick Glacier and Brimstone Peak) (Lee et al., 2019). The tephra is dispersed over 2000 km across East and West Antarctica. Other occurrences in northern Victoria Land have been informally reported in personal communications by Italian investigators. The tephra has an age of 1252±2 C.E. in the WAIS Divide ice cores and this is the age we designated for the eruption and deposition of the tephra. This age is within error of the original Talos Dome age (1254±2 C.E.) and the major element compositions of glass shards are consistent with the inferred correlations. The eruptive source of the tephra was not well known, and for years The Pleiades was designated the likely source despite no proximal tephra record. We have used electron microprobe major element analyses of glass shards in samples of the tephra and compared them to older published analyses of the tephra to show they are all similar and are correlatives. New analyses on glass clasts from pyroclastic deposits at Mt. Rittmann are geochemically identical to the tephra and we have proposed Rittmann volcano as the source of the eruption and informally named this widely distributed 1252 C.E. tephra layer, the Rittmann tephra. Here we report on new high precision trace element analyses on some samples of the Rittmann tephra and the correlative glass from Mt. Rittmann. The proximal deposits in northern Victoria Land all have geochemical compositions which are the same within analytical error. However, some of the distal ice core Rittmann tephra samples show some variation in trace element compositions. The trace element data add new insight into the eruption and suggest there may have been several eruptions from a zoned magma chamber and dispersal of several distinct volcanic ash clouds across Antarctica.

Lee, M.J., Kyle, P.R., Iverson, N., Lee, J.I., Han, Y., 2019. Rittmann volcano, Antarctica as the source of a widespread 1252±2 C.E. tephra layer in Antarctica ice. Earth and Planetary Science Letters, (in press)

A402

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Tephra from blue ice areas in Victoria Land, insight into eruptive history of the McMurdo Volcanic Group, Antarctica

Philip Kyle[1†], Nels Iverson[2], Mi Jung Lee[3], Jeff Oalmann[4], Nelia Dunbar[2]

[1]Earth & Environmental Sci., NM Tech, Socorro NM, USA, [2]NM Bureau Geology Mineral Resources, NM Tech, Socorro NM, USA, [3]Korea Polar Research Institute, Incheon, Korea, [4]Earth Observatory Singapore, Nanyang Technological Univ., Singapore

Blue ice patches are widespread along the crest of the Transantarctic Mountains and best known as the sites where meteorites occur and are collected. Typically, the blue ice patches occur where ice flow is stagnant, or the flow is impeded by rock barriers and the ice is thrust up and ablated by wind, exposing old ice. This ice may be very old and at Allan Hills, in southern Victoria Land, it has been suggested there may be ice older than a million years. In Victoria Land many of the blue ice patches contain tephra layers that can be sampled. Tephra provide valuable isochrons in the ice and can be used for constraining the age of the enclosing ice and correlating ice core records. The Victoria Land blue ice tephra are challenging to date, due to syneruptive contamination by basement feldspar, so they have limited use in providing isochrons. A few exceptions exist including a recently discovered widespread tephra erupted in 1252 C.E. from Rittmann volcano in northern Victoria Land that has been geochemically correlated in 6 ice cores across Antarctica and in blue ice on the Rennick Glacier and near Brimstone Peak in southern Victoria Land. A phonolite tephra found in blue ice near Allan Hill and Mount DeWitt was derived from Erebus volcano and has an 40Ar/39Ar age of 39±6 ka. A trachyte found at Allan Hills has an age of 202±7 ka and provides the only radiometric age constraint for this blue ice field. Blue ice tephra are valuable in that they record explosive eruptive activity from nearby volcanoes. Non-local eruptions may be recorded in blue ice patches as cryptotephra, which are fine grained with low concentrations of tephra particles. In undeformed blue ice, tephra layers occur in stratigraphic order and so the changes of regional erupting patterns can be determined.

We have examined blue ice tephra from the Rennick and Larsen Glaciers and Mt Melbourne in northern Victoria Land and large blue ice patches near Brimstone Peak, Allan Hills and Mt DeWitt in South Victoria Land. Based on microprobe analyses of glass shards the northern Victoria Land tephra typically have either basanitic or trachytic compositions. Intermediate compositions are rare but a trachyandesite tephra is found in the Styx ice core.

The trachytes are likely to be from Mt Melbourne, The Pleiades and Rittmann volcano in northern Victoria Land. The basanitic tephra are likely from the many poorly characterized scoria cones scattered in a broad arc across northern Victoria Land. Many of the basanite tephra particles have blocky shapes consistent with formation in phreatomagmatic eruptions. More explosive basanite eruptions occur when the erupting magma interacts with snow and ice and a phreatomagmatic eruption occurs. This produces finer blocky tephra which can be more widely dispersed; a sharp contrast to the large irregular scoria formed in Strombolian to Hawai'ian fire fountain eruptions. A young basanite lava of unknown age in the Cosmonaut Glacier interacted with glacial ice and created a thick hyaloclastite deposit. So far, the tephra from this eruption has not been identified in blue ice areas but presumably it is young and must be locally present.

The blue ice tephra indicate that volcanism in the Melbourne volcanic province is more active than

elsewhere in the McMurdo Volcanic Group in the western Ross Sea or in Marie Byrd Land. The numerous basanitic tephra suggest smaller basanitic eruptions are more common than the volcanic record would indicate and further study of the ages and distribution of basanitic volcanism in northern Victoria Land is warranted. Furthermore, the extensive blue ice tephra record shows there may be a bigger volcanic hazard, especially to aircraft, in the Melbourne volcanic province.

Session04: Antarctic Volcanism and Magmatism: Past, Present and Future

Noble gases and trace element geochemistry of xenoliths in the Ford Ranges of Marie Byrd Land, Antarctica

Erica Maletic [†] , Thomas Darrah

Volcanism occurring within Marie Byrd Land (MBL) is a component of a diffuse alkaline magmatic province that spans from West Antarctica into eastern Antarctica and is closely associated with the West Antarctic Rift System (WARS). The mantle source in this area has been highly debated with explanations ranging from a mantle plume beneath Marie Byrd Land, decompression melting of a fossilized plume head or a stratified mantle source, and mixing of recycled oceanic crust with one or more enriched mantle sources from the deep mantle with no universally accepted hypothesis. A relationship between lithospheric extension and mantle plumes is often assumed for the forces leading to rift evolution, though typically only extension is supported by geological evidence while the existence of a plume is mainly inferred or assumed from geophysical data.
Most previous geochemical work in these provinces has focused on bulk classification, modal mineralogy, major element composition, trace element chemistry, and radiogenic isotopes (e.g., Sr, Nd, and Pb), and has shown that MBL volcanics tend to be highly alkaline, silica undersaturated, and highly enriched in light rare earth elements. Though these techniques are commonly used to distinguish mantle sources from each other, they can be readily recycled between the crust and mantle and have isotopic components that are internally defined, meaning the degree of partial melting or prior melt differentiation changes their composition. Unlike trace elements and radiogenic isotopes, the low concentrations and chemical inertness of noble gases allow them to serve as reliable tracers of volatile sources and subsurface processes. The isotopic compositions of noble gas sources are externally defined and well characterized in the atmosphere, hydrosphere, and crust, as well as multiple mantle (primordial) reservoirs such as plumes, mid-ocean ridge basalt (MORB), or sub-continental lithosphere. Additionally, the well-constrained production rates relating to radioactive decay in the mantle and crust make noble gases instrumental in understanding regional tectonic processes. Here, we present trace element chemistry as well as preliminary noble gas isotope ratios (e.g., 3He/4He, CO2/3He, 40Ar/36Ar, 40Ar*/4He) for a suite of mantle xenoliths from the Ford Ranges in Marie Byrd Land. Preliminary results suggest small contributions from a low partial melt MORB mixing with a more radiogenic endmember, with helium isotope results ranging from 4 to 9Ra. By coupling noble gas geochemistry with more traditional geochemical techniques from the WARS, we can better constrain a magmatic source and provide geological evidence that could support or reject the existence of a mantle plume, HIMU plume, or deconvolve mantle-lithosphere interactions. These parameters can help us to deconvolve geochemical overprinting related to interactions between the mantle source and the lithosphere.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

P-T Evolution of Metapelitic Granulites from the Bunger Hills, East Antarctica: Constraints from Mineral Thermobarometry and Isochemical Phase Diagram Modeling

Ilnur Abdrakhmanov[1†], Nikita Borovkov[2], Yury Gulbin [1], Evgeny Mikhalsky [2]

[1]Saint-Petersburg Mining Institute, Saint-Petersburg, Russia, [2]Institute for Geology and Mineral Resources of the WorldOcean (VNIIOkeangeologia), Saint-Petersburg, Russia

We present conventional thermobarometry and phase equilibria modeling data that document the P-T evolution of garnet–sillimanite–cordierite and garnet–orthopyroxene-cordierite (with spinel, rutile, ilmenite) gneiss exposed in the Bunger Hills area. As a part of a metasedimentary unit, this granulite-facies migmatitic paragneiss is interlayered with subordinate mafic granulites and associated with a tonalitic orthogneiss unit and voluminous plutons of charnockites. Zircon U-Pb data show that the igneous precursors of felsic orthogneiss were formed in the range of c. 1700-1500 Ma, whereas plutonic rocks were emplaced between 1170 and 1150 Ma (Sheraton et al., 1992). The timing of granulite facies metamorphism is constrained between c. 1240-1150 Ma by U-Pb dating of monazite from paragneiss (Tucker, Hand, 2016) and consistent with the age of continental collision events accompanying the Albany-Fraser Orogeny during the amalgamation of Rodinia.

The modeling was done in the system NCKFMASHT. Adjustment of water activity is the essential feature of our modeling procedure. Water activity is limited by a(H2O) < 0.2. The reason is that spinel is in the observed mineral assemblages but disappears under higher a(H2O) values adjusted to calculated models. As a result of modelling we represent the metamorphic evolution as a clockwise P-T path. The beginning of such P–T path is located within the rutile stability field (P > 9 kbar). Further the pressure decreases up to 6 kbar. The temperature range of the decompression is 850-950 °C, it could take place during increasing temperature or under almost isothermal conditions. We select such path based on suggestion that the early stage of metamorphic evolution is characterized by a mineral equilibrium for the assemblage Grt–Sil–Kfs–Qz–Rt–Ilm. As a result of the decompression, rutile is replaced by ilmenite simultaneously with crystallization of hercynite. According to the inferred P–T path, decompression reached 5–6.5 kbar at T > 870 °C when the assemblage Grt–Crd–Sp-Qz–Ilm is stabilized and partial melting occurred. Observed interstitial quartz and perthite rims around cordierite, sillimanite, and garnet grains prove that partial melting took place. Heating resulted in capturing of spinel grains inside the growing garnet grains. Afterwards we suggest isobaric cooling until 750–800 °C when garnet and cordierite have been in equilibrium with each other. The P–T conditions of equilibrium are proved by the intersections of garnet and cordierite compositional isopleths which correspond to measured compositions of minerals. The garnet-cordierite geothermometry provides similar results at 700-750 °C and 5 kbar. So does the Ti-in-biotite geothermometry which shows the same temperature of high-Ti biotitecrystallization (740–770 °C). The latter suggests increasing water activity at the retrograde path.

Reintegrated ternary feldspar compositions and high Al contents in orthopyroxene [Al(M1) = Al apfu/2 = 0.15–0.16] are additional evidence for high peak temperatures (up to 900 °C and more) of metamorphism. These peak conditions followed by post-peak decompression are in agreement with those reported earlier for the area and support the view that studied granulites experienced the collision-related tectonic evolution.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

Thermobarometry of metavolcanic rocks of the Ruker Group, southern Prince Charles Mountains, East Antarctica: Implications on the Prydz Orogeny

Yuri Gulbin[1], Evgenii Mikhalsky[2†]

[1]Saint Petersburg Mining Institute, Russia, [2]VNIIOkeangeologia, Russia

There are diverse geological complexes exposed in the southern Prince Charles Mountains. One of them is the Ruker Group that is a part of the Palaeproterozoic-Neoproterozoic suprastructure of the Ruker Terrane and is composed of metasedimentary (with maximum deposition age of ca 2500 Ma, Phillips et al., 2006) and metavolcanic rocks, deformed and metamorphosed under greenschist facies conditions. Although the age of metamorphism is still unclear, geological data show that the main part of low-grade metamorphic assemblages are synkinematic and have been formed in association with thrust-related deformations. Thrusting of supracrustals is thought to be coeval with high-strain shear zones in the crystalline basement (540–480 Ma, Phillips et al., 2007). Therefore, at this stage, the age of metamorphism in the Ruker Group may be considered Neoproterozoic to Cambrian. The metamorphic episode, being separated from sedimentation and accompanying volcanism by the time interval which is possibly as long as 2 billion years, was coeval with the development of the Neoproterozoic sedimentary Sodruzhestvo basin. The geological similarities between crustal blocks that form the northern and southern margins of the basin advocate its intraplate origin. The bottom of the basin is thought to be listric faulted that flattens southwards (McLean et al., 2008). The observed structure of the Ruker Terrane was created during the Early Palaeozoic basin inversion caused by regional compression which in turn was highly probably a reflection of remote global collisional processes controlling the amalgamation of Gondwana.

In order to estimate metamorphic conditions of the Ruker Group, mineral and major element compositions of mafic metavolcanic rocks were studied and isochemical phase diagrams were calculated. Greenschists contain the mineral assemblage Chl–Ep–Ab–Qz–Ttn Act Bt Ms Cal that is typical of metabasites, and which varies with the bulk rock composition and ratio of components in a water-carbon dioxide fluid involved in phase reactions. The calculated mole fraction of CO2 in the fluid equilibrated with carbonate-bearing parageneses lies in a range between 0.13 and 0.27. A chloritoid schist is essentially composed of Cld, Chl, Ms, and Rt. We believe this rock was genetically related to metamorphism of laterites derived from the basalts. Results of phase equilibria forward modeling, supplemented by chlorite-phengite thermobarometry, indicate that metamorphism of the Ruker Group occurred under conditions of high-P part of the greenschist facies (T = 300–450 oC, P = up to 7–8 kbar). These estimates are significantly higher than the stable continental geotherm and are close to temperatures and pressures corresponding to those along the slow subduction geotherm. According to available geological data, the same geodynamic setting may have taken place as a result of the sinking of parts of the basement to a large depth as a consequence of tectonic stacking during closure of the Neoproterozoic sedimentary basin.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

The structural evolution of the Straumsnutane and western Sverdrupfjella areas, western Dronning Maud Land, Antarctica – implications for the amalgamation of Gondwana.

Adam Bumby[1], Geoffrey Grantham[2†], Neogracious Moabi[3]

[1]Dept. of Geology, University of Pretoria, Pretoria, South Africa, [2]Dept. of Geology, University of Johannesburg, Auckland Park., South Africa, [3]Council for Geoscience, P/Bag X112, Silverton, Pretoria, South Africa

The Straumsnutane Formation lavas underlying eastern Straumsnutane, western Dronning Maud Land show a complex structural history. Early planar and linear fabrics, thrust faulting and folding suggest top-to-NW tectonic transport under low grade conditions. Younger folding, faulting, and quartz veining suggest conjugate top-to-ESE and WNW transport. The later deformation occurred under low grade conditions. Western Straumsnutane and Ahlmannryggen do not show the same complex deformation with intense deformation restricted to NE Straumsnutane.

Western Sverdrupfjella is underlain by highly deformed supracrustal gneisses and younger intrusions of varying age. The deformation history in the gneisses entails four phases comprising top-to-the N and NW D1+D2 folds, top-to-the S and SE D3 folding and brittle faulting D4. The emplacement of granitic and pegmatitic veins are inferred to be syn-D3 at ca. 490Ma.

Comparison of the tectonic history of NE Straumsnutane with western Sverdrupfjella suggests that the early deformation is correlatable with Mesoproterozoic structures in the western Maud Belt. The later D2 deformation in Straumsnutane can be correlated with D3 structures and intrusion of sheeted granites of Cambrian age in the Maud Belt. Radiogenic isotopes from gneisses and Cambrian-age granites in western Sverdrupfjella suggest that western Sverdrpfjella is underlain by Archaean crust at depth.

The latter deformation in western Sverdrupfjella has been inferred to have occurred in the footwall of a meganappe complex. This similarly implies that the eastern edge of the cratonic Ritscherflya Supergroup in Straumsnutane was at least probably partially submerged in the footwall of a mega-nappe structure formed during the amalgamation of Gondwana, involving collision between N and S Gondwana in the Kuunga Orogeny ~500Ma ago. The tectonic evolution is supported by geochronological data which suggests deposition of the Ritscherflya Supergroup at ~1125Ma. No evidence of strike-slip deformation previously reported in Ahlmannryggen was recorded in Straumsnutane or western Sverdrupfjella.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

Island arc–continental arc collision caused protracted eclogite-facies metamorphism in northern Victoria Land (Antarctica)

Forrest Horton[1†], Gianfranco Di Vincenzo[2], Rosaria Palmeri[3]

[1]Woods Hole Oceanographic Institution, USA, [2]Istituto di Geoscienze e Georisorse CNR, Italy, [3]Universita di Siena, Italy

Northern Victoria Land, a region along the Transantarctic Mountains, plays a key role for the reconstruction of the early Paleozoic Ross-Delamerian Orogen along the continental margin of Gondwana. Eclogites from the Lanterman Range in northern Victoria Land record the accretion of an island arc onto this active continental margin. Based on rock textures and geochemistry, we distinguish early low-temperature (~700° C) prograde eclogites from subsequent peak metamorphic (~800° C) eclogites. Our U-Pb dating and trace element analysis of metamorphic zircons indicates that eclogite formation began by ~530 Ma and culminated at ~500 Ma. We infer that these eclogites and their host gneisses subducted to and remained at high-pressure conditions (1.7–2.4 GPa) beneath the continental arc until the outboard accretion of the island arc clogged the subduction zone and induced peak metamorphic conditions ~30 Myr later. These results challenge the conventional view that small (ultra)high-pressure terranes spend relatively short periods.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

Sri Lanka - Correlation with N. Mozambique and Antarctica at the heart of Gondwana: North and South.

Geoffrey Grantham[1]
[†], Sanjeewa Malaviarachchi[2], Dilshan Bandara[2], Bruce Eglington[3], P. Dharmapriya[2]

[1]University of Johannesburg, South Africa, [2]University of Peradeniya, Sri Lanka, [3]University of Saskatchewan, Canada

Grantham et al., (2008) positioned Sri Lanka adjacent to N. Mozambique, prior to Gondwana breakup, in a position requiring ca 90degrees clockwise rotation (Reeves 2004) with the result that the Vijayan Complex is correlatable with the Nampula Terrane (NT) of N. Mozambique. The Lurio Belt, bounding the Nampula Terrane to the N. was correlated with the shear zone separating the Vijayan and Highland Complexes. Exposures in N. Mozambique are poor, hampering studies of structural kinematics within the Lurio Belt.

Lithologies and structures in the Vijayan Complex (VC) exposed in quarries and along the S. coast of Sri Lanka show that the rocks consist dominantly of migmatitic tonalite and granitic (mostly porphyroclastic augen) gneisses with strong, mostly shallow dipping, planar fabrics. At one quarry, banded migmatitic tonalitic gneisses show strong folding and shearing. The folds and shears typically show a top-to-the east geometry (top to the south In Gondwana). Lineations plunge shallowly N and S. The data suggest a transpressional deformation setting.

Comparison of lithologies and structures from the VC with data from the Nampula Terrane (NT) of N. Mozambique show that the tonalitic and granitic gneisses are similar to the Mocuba and Culicui Suites of the NT. The geometry of structures in the VC, rotated ca 90o, consistent with its position in Gondwana, are comparable to structures from northern Mozambique from the NT. Plunges of lineations in the NT in the Meconte-Monapo areas cover a broad arc of westerly to NE with three crude groups of WNW, NW to NNE and NE respectively. The WNW direction, is largely seen in the north of the Meconte-Monapo sheet, approaching the Lurio Belt. Its orientation is similar to the rotated orientation of lineations from S. Sri Lanka. The Meconte-Monapo sheet lineations plunge dominantly NW to NNE over most of the area but rotate sinistrally toward the Lurio Belt in the north. Broad fold patterns show two phases with ENE oriented fold axial traces and cross-cutting NNW fold axial traces. Planar fabrics in Mozambique dip dominantly SE. Limited planar fabric data from Sri Lanka, rotated through 90o dip to the S.

Comparison of limited radiogenic isotope data (Sr,Nd) from the NT with new and published data from the VC show that they are similar. Comparison of published zircon crystallisation and metamorphic ages show peaks of ~1000-1100Ma and ~550Ma respectively. Available structural, isotopic and geochronological data consequently support correlations between the Vijayan Complex of Sri Lanka with the Nampula Complex of northern Mozambique and its extensions via the Barue Complex, N. Mozambique to the Maud Belt of western Dronning Maud Land, Antarctica.

A440

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

Nature of subglacial geological terrains in and around Gamburtsev Mountains, Antarctica: New insights from heavy mineral studies of site 739, ODP 119

Rashmi Gupta[1], Mayuri Pandey[1†], Devsamridhi Arora[2], Naresh Pant[2], N. V. Rao[1], Shivam Sahu[1]

[1]1. Department of Geology, Institute of Science, Banaras Hindu University, Varanasi, India, India, [2]2. Department of Geology, University of Delhi, Delhi, India, India

Dome Argus of Gamburtsev Subglacial Mountains (GSM) is the most distal source of the Lambert-Amery glacial drainage system in Antarctica followed by the well-studied Prince Charles Mountains (PCM); both of them supply sediments to the Prydz Bay. The most proximal sources of sediments supply are the coastal outcrops present in and at the coastal fringe of Princess Elizabeth Land (PEL). The present work examines the heavy media separates of the samples obtained from Site 739, which is ~200 km from the land and 140 km from the Amery Ice Shelf at 67°16' 34"S, 75°04'55"E and represents the most seaward of the sites drilled on the Prydz Bay shelf during ODP119. Multiple sourcing of sediments at this site provides an extreme complex heavy media population. Preliminary data confirms the presence of garnet, amphiboles (calcic dominantly), clinopyroxene, chlorite, epidote, aluminosilicates, staurolite, and ilmenite in the order of their dominance.

Garnets of more than one range of compositions are present. Pyrope (Py42Alm30Gr27Sp1) and almandine (Alm94Py2Gr2Sp2) are the most dominant varieties. Composition of garnets (as per the classification of Mange and Morton 2007) reveals that they are derived mainly from (i) high-grade granulite-facies metasedimentary rocks, (ii) charnockites and (iii) intermediate felsic igneous rocks. Charnokites are reported from PCM and PEL whereas the granulites facies of metasedimentary and felsic sequences, which are known from Princess Elizabeth Land, are the most likely proximal source for garnets present in the site 739 of ODP 119.

Magnesio-hastingtite, magnesio-hornblende, ferro-hornblende, edenite, actinolite, and ferro-tschermakite are the dominant calcic-amphiboles identified. Magnesio-hastingtite and magnesio-hornblende are usually found as primary amphiboles in basalts (alkali-calc alkaline type)/gabbros and therefore indicate presence of unmetamorphosed basic rocks whereas actinolite, ferrohornblende, edenite, ferroschermakite are present as constituents of the regionally metamorphosed basic or ultrabasic rocks and are stable under a wide range of P-T conditions ranging from the greenschist to lower part of the granulite facies. Actinolite is characteristically present in low grade regionally metamorphosed ultrabasic rocks and are found in association with epidote and chlorite. Comparatively higher dominance of calcic amphiboles at this site indicates a shift in the supply of sediments from a farther source (GSM and/or PCM). The mineral data also provides an opportunity to examine the role of the Permian and Cretaceous East Antarctic rift system developed around GSM is also speculated in the light of sediment flux transfer.

Session05: The Neoproterozoic to Cambrian Orogenies and their precursors in Antarctica and adjacent continental blocks

Geology of the eastern Dronning Maud Land, East Antarctica: Missing link to Sri Lanka

Kazuyuki Shiraishi[1,2]
[†], Tomokazu Hokada[1,2], Yoshikuni Hiroi[1,3], Yoshihumi Nogi[1,2], Yoichi Motoyoshi[1,2]

[1]National Institute of Polar Research, Japan, [2]SOKENDAI, Japan, [3]Chiba Ubiversity, Japan

The Neoproterozoic to early Paleozoic tectonic evolution in Antarctica related to the final amalgamation of Gondwana supercontinent has been contentious. This presentation aims to discuss the tectonic relation among the discrete plutono-metamorphic terranes in eastern Dronning Maud Land (eDML: approx. 20˚E to 45˚E) which is located in the boundary zone of the East Gondwana and the West Gondwana. Three Neoproterozoic to early Paleozoic plutono-metamorphic terranes have been recognized in the eDML; Lützow-Holm Complex (LHC), Yamato-Belgica Complex (YBC) and the Sør Rondane Mountains (SRM) from east to west. LHC is characterized by the progressive high-grade metamorphism of the medium pressure type with a clockwise pressure-temperature (P-T) path from upper amphibolite facies in the east to granulite facies metamorphism with ultra-high temperature metamorphism in the southwest. YBC is characterized by widespread granitoid plutonism associated with amphibolite facies and granulite facies metamorphic rocks. In contrast to LHC, YBC was metamorphosed relatively lower pressure condition. The main metamorphism of the LHC and the YBC was during the late Neoproterozoic to early Cambrian (630-550Ma). In SRM, two adjacent granulite facies metamorphic terranes with the contrast P-T paths, are bounded by the Main Boundary Thrust. The southwestern part of the SRM is occupied by early Neoproterozoic (1000-900 Ma) metatonalite. Various types of granitoid rocks are widely exposed in SRM. The main metamorphic stage is defined at 650-600 Ma and the hydration event associated with many igneous activities took place at 560-550 Ma. Geochemistry, geochronology and recent aeromagnetic data suggested the SRM is underlain by late Mesoproterozoic to early Neoproterozoic juvenile crust, whereas provenance of YBC is not definitive due to the scarce of isotopic data. Aeromagnetic data of the eDML show the significant N-S lineament along the ca. 36˚E in longitude and the NW-SE lineament along the Shirase glacier, suggesting major tectonic boundaries between YBC and LHC. On the other hand, late Neoarchean crust (ca. 2.5 Ga) was reported in the southwest LHC and it was proposed that the late Mesoproterozoic northern LHC block collided the Neoarchean southwest LHC block by the late Neoproterozoic high metamorphic event. These findings constrain the reconstruction of Gondwana fragments such as adjacent Sri Lanka and India. Previous literatures placed Sri Lanka in adjacent to the Lützow-Holm Bay area in East Antarctica. The Highland Complex (HC) and the Wanni Complex (WC) of Sri Lanka has been comparable to LHC by many authors in terms of lithology, petrology, petrochemistry and geochronology, while the origin and tectonic position of the late Mesoproterozoic Vjayan Complex (VC) of eastern and southeastern Sri Lanka remains controversial. The basement geology of YBC and the west coast of the Lützow-Holm Bay and, to the further north, the ice-covered Riisar-Larsen Peninsula is crucial to understand the final amalgamation of the Gondwana.

A033

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

MESOZOIC-CENOZOIC STRESS FIELD EVOLUTION IN TASMANIA FROM FAULT POPULATION ANALYSIS IN RELATION TO AUSTRALIA-ANTARCTICA PLATE SEPARATION

Adolfo Maestro[1†], Fernando Bohoyo[1], Jesús Galindo-Zaldívar[2], Ronald Berry[3]

[1]Instituto Geologico y Minero de Espana, Tres Cantos, Madrid, Spain, [2]Universidad de Granada, Granada, Spain, [3]University of Tasmania, Hobart, Tasmania, Australia

The separation of the Australian and South American plates with respect to the Antarctic Plate during the Cenozoic was the origin of the development of the Tasmania and Drake oceanic passages respectively. These passages are key in the interoceanic connection between the Atlantic, Indian and Pacific oceans, the Antarctic continent isolation and the Antarctic Circumpolar Current establishment. This current has contributed to the development of the Antarctic ice cap and is part of the ocean currents present-day system that is one of the main mechanisms of heat and nutrients transport and modulate the climate change on Earth. In order to better understand how the continental fragmentation and the plates drift occurred, it is important to establish the stress orientation and regime that have acted during the formation of these oceanic passages.

With the aim to contribute to the knowledge of the tectonic evolution of the Tasmanian Passage, approximately 1000 faults distributed in 44 sites located in metamorphic, igneous and sedimentary rocks of ages between the Cambrian and the Quaternary have been measured in Tasmania. The fault population analysis has been carried out using the methods of Etchecopar, y-R, Right Dihedral and Stress Inversion. The fault orientation analysis shows a predominant orientation ESE-WNW and secondary directions NE-SW, NW-SE and N-S. In general, the most of the fault planes dips are subvertical. Considering the faults movement sense, 313 dextral faults, 194 sinistral faults, 422 normal faults and 62 reverse faults have been identified. Dextral faults show an ESE-WNW orientation with subvertical dip. Sinistral faults have a predominant orientation N-S and dip also subvertical. Normal faults have a main NW-SE orientation and a NE-SW secondary direction with a modal dip value of 65°. Reverse faults have a predominant NE-SW direction with two modal dip values of 35° and 70° respectively. The σ1 orientation shows a dominant NW-SE direction. Moreover, another common stress regime is characterized by a preferentially NE-SW σ3 orientation (with σ1 vertical). The σy direction is dominantly NW-SE, although it shows a secondary mode with NE-SW orientation.

The NE-SW extensional direction can be related to the development of sedimentary basins with NW-SE trend during the late Jurassic to the late Paleocene. The development of these basins is linked to the rifting stage between the Australian and Antarctic plates, with the Australian Plate slowly displaced northwards during the middle Cretaceous, and with the beginning of the spreading stage of the Tasman Sea during the late Cretaceous until the late Paleocene. The NW-SE compressional direction is related to the Australian Plate northward shift along a left-lateral transcurrent zone during the late Paleocene-early Eocene. This compressional direction remains until present-day, as has been determined from earthquakes focal mechanisms, borehole breakouts and hydraulic fracturing. Recent and present-day stress field orientation has been explained in relation to the convergence interaction between the Pacific and Australian plates.

A179

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

Contourite features distribution and water masses circulation in the Eastern Bransfield Basin (Antarctic Peninsula)

Marga Garcia[1†], Francisco Hernandez-Molina[3], Estefania Llave[2], Lara Perez[4], Carlota Escutia[1], Fernando Bohoyo[2], Ariadna Salabarnada[1], Adrian Lopez-Quiros[1], Francisco Lobo [1]

[1]Andalusian Institute of Earth Sciences (CSIC-UGR), Spain, [2]Royal Holloway University of London, United Kingdom, [3]Spanish Geological Survey, Spain, [4]British Antarctic Survey, United Kingdom

This work investigates contouritic features from swath bathymetric data and parametric sounder profiles (TOPAS) acquired during the DRAKE2018 cruise in the Eastern Bransfield Basin (EBB), a NE-SW oriented strait at the easternmost sector of the Bransfield Basin. It is bounded by the Antarctic Peninsula to the SE and the South Shetland and Elephant islands to the NW. A bibliographical compilation of the water masses recently carried out by the TASMANDRAKE Group has been used to relate contourite features to the intermediate and deep-water circulation.

Three sets of contouritic features have been identified at distinct water depth: a) the shallower contourite system (1100-1500 meters water depth, mwd), includes contouritic terraces associated with plastered drifts and a mounded drift surrounded by contourite moats. They occur mainly at the SE margin of the basin, showing lateral continuity on a relatively flat area parallel to the basin axis orientation. A small terrace has been identified on the NW margin; b) the intermediate contourite system (1500-2000 mwd) consists of terraces and associated plastered drifts, as well as small elongated depressions interpreted as contourite moats along the SE margin of the EBB; and c) the deep contourite system in the deep, flat sub-basins at around 2300 mwd, includes sheeted and mounded drifts prograding towards the margins of basins and bounded by contourite moats at the foot of the margins. Contourite drifts appear interlayered with chaotic bodies interpreted as mass-transport deposits (MTDs) and that overlie a deeper, buried mounded contourite drift that displays a more marked progradation towards the NE flank of the basin.
The data reveal a complex water masses circulation pattern at definite depths pattern within the EBB, involving deep-water exchange with the Central Bransfield Basin to the SW, and with the Powell Basin and the Hesperides Trough to the E and NE, respectively. Following the oceanographic compilation, we infer that: a) the shallow contourite features on the EBB SE flank result from the flow of the Warm Deep Water (WDW), which flows towards the SW from Powell Basin and re-circulates to generate the mounded drift, while the shallow contourite features on the NW flank of the basin are originated by the northwestward flow of the Bransfield Strait Water (BSW); b) The intermediate contourite features are the result of the southwestward flow of the Weddell Sea Sill Water (WSSW) together with the WDW, that would occur only along the SE flank of the basin; and c) the deep contourite features relate to the flow and deep cyclonic circulation of the East Bransfield Basin Deep Water (EBDW), that is a mix of the Central Basin Bottom water (CBBW) and the WDW from Powell Basin and the WSSW that enters the EBB from the East.
This work evidences the potential of morphological studies for indirectly inferring intermediate and deep-water masses circulation in areas of difficult access for oceanographic surveys. It has been funded by projects TASDRACC (CTM2017-89711-C2-1-P), SCORE (CGL2016-80445-R; AEI/FEDER, UE) and TALUS (CGL2015-74216-JIN) and results from the collaborations within the Drifters Research Group.

A200

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

Understanding the sensitivity of WAIS to 2 degree Celsius warming: A Science Plan for Crary Ice Rise

Molly Patterson[1]
[†], Justin Dodd[2], Irina Filina[3], Sarah Feakins[4], Gaylen Sinclair[5], Benjamin Keisline[6], David Harwood[3], Robert DeConto[6]

[1]Department of Geological Science and Environmental Studies, Binghamton University SUNY, USA, [2]Geology and Environmental Geosciences, Northern Illinois University, USA, [3]Earth and Atmospheric Sciences, University of Nebraska, Lincoln, USA, [4]Department of Earth Sciences, University of Southern California, USA, [5]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, USA, [6]Department of Geoscience University of Massachusetts Amherst, USA

Ice-sheet simulations assessing Antarctica's impact on future sea level rise imply a possible contribution of more than a meter by 2100 and more than 15 meters by 2500. However, the same model, using a variety of physical parameters produces a large range of change in global mean sea level (+1.07 m to +7.54 m) during the last interglacial. These simulations associated with the high-end estimates imply oceanic gateways in the Siple Coast region and a complete collapse of the interior of the marine based WAIS. The lower-end estimates demonstrate only a modest change in WAIS and grounded ice along the Siple Coast.

Currently, about 40% of the ice discharge of the entire West Antarctic Ice Sheet occurs from ice streams that feed the southern Ross Ice Shelf along the Siple Coast, and in the region of the Crary and Steershead ice rises. Over short timescales the velocity of these ice streams is highly variable. Thus, ice sheet reconstructions over centennial to millennial time scales along the Siple Coast, particularly during past warm periods, are needed to provide a long-term perspective on the ice sheet's behavior and to assess potential future Antarctic Ice Sheet contributions to global sea level.

We aim to develop a coordinated science plan between the international Antarctic science communities and U.S. based investigators to carry out an integrated effort to better characterize the ice sheet history along the Siple Coast during the last interglacial period, and other past warm periods during the Neogene and Quaternary that are of keen interest to the broader scientific community. Short term goals include utilizing existing (i.e., hot water drilling) and rapidly developing new technologies through our international partners to carry out shallow drilling of the Crary and Steershead ice rises in order to recover and date sediments directly underlying the ice shelf. Recent geophysical surveys of Crary Ice Rise demonstrate sequences of gently dipping strata. While the ages of these strata are unknown, reworked Miocene and Pliocene diatoms in Holocene sediments recovered in short cores from the J-9 site and at RIS HWD Site 2 indicate open marine conditions occurred in West Antarctica at times during the Neogene. Recovery of in-situ strata at Crary, and through the integration of recent findings from IODP Exp. 374 from the outer continental shelf, will allow us to constrain environmental boundary conditions under which the paleo-WAIS advanced to the outer continental shelf or collapse and retreated to terrestrial margins. While these sediments have value as records of Neogene and Quaternary paleoenvironments they also will provide vital information relating to till deformation processes.

A256

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

The origins of southern part of Madagascar Plateau and Del Cano Rise, based on re-estimated seafloor spreading history of Southwest Indian ridge 35°E to 55°E

Taichi Sato[1,2†], Yoshifumi Nogi[3], Hiroshi Sato[3], Masakazu Fujii[4]

[1]Geological Survey of Japan, AIST, Japan, [2]Earth Dynamics Research Group, The Institute for Geoscience Research (TIGeR), School of Earth and Planetary Sciences, Curtin University, Australia, [3]Geoscience Group, National Institute of Polar Research, Japan, [4]Department of Business Administration, Senshu University, Japan

We estimated seafloor ages by using magnetic reversal patterns in the middle part of Southwest Indian Ridge (SWIR) between Discovery Ⅱ and Indomed fracture zones (FZs), where Oceanic Large Igneous Provinces (O-LIPs) -Madagascar Plateau, Del Cano Rise, Crozet Plateau, and Conrad Rise - are located on both off-axes area. The identified oldest seafloor age is the anomaly C31n. Between the anomaly C21n and C30n, seafloor spreading rate was 17-18 km/Ma, classifying as ultraslow spreading like as present-day SWIR. We found that the southern part of Madagascar Plateau and Del Cano Rise had formed once a single topographic high before the anomaly C30n. Although these have been considered as O-LIPs formed by Marion hotspot – SWIR interaction, but based on their gravity signatures, crustal structures, and ambiguous magnetic reversal patterns, we propose that the southern part of Madagascar Plateau and Del Cano Rise are partly consisted of non-Oceanic crust and overwritten by later volcanic activities.

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

The nature, timing and implication of green-clay authigenesis: A reliable paleoenvironmental indicator for the Antarctic Cenozoic climate history

Adrián López-Quirós[1†], Carlota Escutia[1], Antonio Sánchez-Navas[2], Fernando Nieto[2], Antonio García-Casco[2], Agustín Martín-Algarra[3], Dimitris Evangelinos[1], Ariadna Salabarnada[1]

[1]Instituto Andaluz de Ciencias de la Tierra (CSIC-Universidad de Granada), Granada, Spain, [2]Department of Mineralogy and Petrology, Universidad de Granada, Granada, Spain, [3]Department of Stratigraphy and Paleontology, Universidad de Granada, Granada, Spain

Clay minerals ('hydrous phyllosilicates') are major constituents of materials deposited at the marine environments. Green-clay authigenesis, particularly in the marine and diagenetic realms, has played an important role in the understanding of Earth's past climate. The nature, depositional setting control and paleoenvironmental effects of authigenic green-clays in Antarctic regions are loosely constrained. Here, late Eocene glaucony-bearing facies from ODP Site 696, deposited in a shallow-sea environment at the South Orkney Microcontinent (SOM), was studied by conventional petrographic microscopy, X-ray diffraction (XRD), spectrometric study of color (UV-VIS-NIR), and electron microscopic methods (ESEM, EPMA and HRTEM-AEM). This integrated sedimentological, mineralogical and geochemical approach allows to undertake the challenges of assessing the physico-chemical conditions that prevailed during green-clay authigenesis in the northern Weddell Sea before the Eocene-Oligocene transition. Paleogeographic implications based on green-clays should be done only when the real nature of the mineral is established.

Green-clay authigenesis at the late Eocene (~35.5-34.1 Ma [1, 2, 3]) occurred mainly by the glauconitization of pellets. The K-rich (>0.66 atoms p.f.u.), flaky/rosette-shaped clay nanostructures, and complex pellet shape reflects an evolved (mature) stage and a long term (>0.1 Ma) authigenic process. The mineralogy, chemistry, morphology, and textural properties illustrate that glaucony has formed in situ (autochthonous) and consists mainly by smectite-poor interstratified ~10Å glauconite-smectite. Syn-sedimentary conditions that prevailed during late Eocene deposition controlled the green-clay authigenesis at the SOM plateau, as slightly reducing conditions trigger Fe-enrichment, whereas oxidising conditions favour Fe-depletion. Glauconitization in the vicinity of the SOM shelf-break developed thus under sub-oxic, partially reducing conditions nearby the sediment water interface. These environmental conditions were triggered in an open shelf setting, deeper than 50 m water depth, where low sedimentation rates and recurrent winnowing action led to stratigraphic condensation. We conclude that green-clay authigenesis was related to continuous rising sea levels pre-dating the onset of Cenozoic Antarctic glaciation in the northwestern Weddell Sea. Sediment burial, drop of O2 levels, and ongoing reducing (postoxic to sulphidic) conditions at Hole 696B, resulting in iron-sulphide precipitation, were a key limiting factor for the green-clay authigenesis by sequestration of Fe2+.

References

[1] Wei and Wise, 1990. Scientific Results, 113. ODP, College Station, Texas, 639–666.
[2] Houben et al., 2013. Science 340, 341–344.
[3] Houben et al., 2019. American Geophysical Union; doi: 10.1029/2019GC008182

A352

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

Drift sediments on the eastern Falkland Plateau: Insight on Antarctic Circumpolar Current (ACC) history in the Southwest Atlantic

Jude Castelino[1†], Robert Larter[1], Claus-Dieter Hillenbrand[1], Steven Bohaty[2]

[1]British Antarctic Survey, Cambridge, United Kingdom, [2]University of Southampton, Southampton, United Kingdom

The role of the Antarctic Circumpolar Current (ACC) in the thermal isolation of Antarctica and the Cenozoic development of Antarctic ice sheets is an ongoing debate. The eastern Falkland Plateau region, including the Maurice Ewing Bank (MEB) and West Georgia Basin, in the subantarctic Southwest Atlantic contains thick sedimentary sequences that are well positioned to record the history of the ACC. In the modern ocean, the deep water masses Upper (UCDW) and Lower Circumpolar Deep Water (LCDW) flow across the shallower areas of the MEB (~500–3000 m), while Antarctic Bottom Water (AABW) fills the deepest parts of Georgia Basin (~ >3600 m) and flows northwards along the base of the eastern slope of MEB.

Multichannel seismic data acquired during RRS Discovery cruise DY087 in Jan–Feb 2018 on the MEB and in the West Georgia Basin provide new insight on the history of ACC development. Piston cores recovered during the expedition and previous Deep Sea Drilling Project sites provide tentative age constraints on seismic reflectors in the study area.

The depositional rates and pattern of prominent sedimentary units on the southeast margin of MEB change significantly between different phases since Paleogene. Initial interpretation of the DY087 seismic and piston coring data indicates a strong influence of bottom currents since the Oligocene on sediment deposition in the region. Many current-controlled features are observed along the slope from the top of MEB towards Georgia Basin, including elongated wedges, prominent sediment waves, eroded surfaces, buried and active channels, a thick pile of sediments on the lower slope, and sheeted and plastered drifts. Post-Miocene sediment accumulation is restricted to the lower slope and West Georgia Basin, where exceptionally high sedimentation rates (up to 24 cm/kyr) are observed due to sediment delivery by the bottom currents emerging from the Falkland Trough. The depositional pattern and emplacement of drift bodies may have been influenced by tectonic changes in Central and East Scotia Sea. Importantly, the position of South Georgia, and the opening of Georgia Passage and Shag Rocks Passage played an important role in the transport of sediments from Scotia and Weddell Sea. Further investigation through scientific drilling is needed to provide a more detailed timeline of ACC evolution.

A409

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

The evolution of the Antarctic Circumpolar Current across the Tasman Gateway during the last 30 million years

Dimitris Evangelinos[1†], Carlota Escutia[1], Tina van de Flierdt[2], Johan Etourneau[1], José-Abel Flores[3], Emmanuelle Ducassou[4], Luis Valero[5,6], David Harwood[7], Katharina Kreissig[2], Marie-Claire Perello[4], Claire Huck[2], Liam Holder[2], Adrián López-Quirós[1], Ariadna Salabarnada[1]

[1]Instituto Andaluz de Ciencias de la Tierra, CSIC-UGR, Av. de las Palmeras, 4, 18100, Armilla , Spain, [2]Department of Earth Science and Engineering, Imperial College London, South Kensington Campus, Prince Consort Road, London SW7 2AZ, United Kingdom, [3]Department of Geology, University of Salamanca, Salamanca, 37008, Spain, [4]Universite de Bordeaux, UMR 5805 EPOC, Avenue Geoffroy St-Hilaire, CS 5023, 33615 Pessac Cedex, France, [5]Laboratory of Paleomagnetism CCiTUB and CSIC-Institut de Ciencies de la Terra Jaume Almera, Barcelona , Spain, [6]Universitat Autonoma de Barcelona, Facultat de Ciencies, 08193 Bellaterra, Barcelona, Spain, [7]Department of Earth & Atmospheric Science126, Bessey Hall, University of Nebraska-Lincoln, Lincoln, NE 68588-0340 , USA

The evolution of the Antarctic Circumpolar Current (ACC) during the last 30 million years is not fully understood, mainly because of the lack of records at strategic locations along and across its pathway. Here we present sedimentological archives collected by the Deep Sea Drilling Project (DSDP) at three strategic locations across the Tasman Gateway: Site 269, offshore Wilkes Land margin (Southeast Indian), Site 278, Southern Emerald Basin (Southwest Pacific), and Site 274, offshore the Cape Adare (Southwest Pacific). While Sites 269 and 278 remained located within the proto-polar front zone since the Oligocene Miocene Transition (OMT), Site 274 was situated close to a major export pathway of Ross Sea Bottom Water (RSBW). Studying these sites thus provide new insights into the proto-Circumpolar Deep Water (CDW) pathway across both sides of the Tasman Gateway and into the production of RSBW and its contribution to the proto-CDW over the last 30 Myrs. To track the evolution of the ACC, we first investigated changes in the paleo polar front characteristics across the Tasman Gateway during the OMT, using (i) sedimentological (detailed facies analysis) and (ii) microfossil assemblage data (calcareous nannofossils, diatoms). We also (iii) generated neodymium isotope ratios (εNd) from fossil fish teeth and debris to reconstruct regional water mass signatures and ocean circulation during this transition. We then extended our studied time interval towards the Pleistocene using Site 278 records to reconstruct the evolution of the polar frontal system and CDW in the Southwest Pacific, combining (i) mean grain size of sortable silt (SS) data with (ii) primary productivity proxies including biogenic silica (BSi) and calcium carbonate (CaCO3), and (iii) neodymium isotope ratios (εNd) from fossil fish teeth and debris. Our results indicate a weaker Southern Ocean frontal system during the OMT, compared to that of the present-day, across the Tasman Gateway. In addition, differences between the εNd values across the Tasman gateway, along the proto-CDW pathway suggest the absence of a modern-like, homogenous, deep-reaching ACC flow along the proto-polar front zone between the Indian and the Southwest Pacific. Furthermore, our results from the Southwest Pacific document a step increase in CDW flow speed, concomitant with the establishment of the modern-like polar front. Almost synchronously the εNd values of the CDW in the Southwest Pacific converge with the Atlantic-Indian endmember range and modern-like CDW values, suggesting that today's strong, homogenous and deep-reaching ACC likely established during the Pliocene-Pleistocene.

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

Late Eocene foraminifera assemblages in the southeastern margin of the South Orkney Microcontinent, Drake Passage, Antarctica: preliminary results

Carlos Expósito-Ceballos[1, 2 †], Adrián López-Quirós[1], Carlota Escutia[1], Juan C. Braga[2]

[1]Instituto Andaluz de Ciencias de la Tierra. CSIC-Universidad de Granada, 18100, Armilla, Granada , Spain, [2]Department of Stratigraphy and Paleontology. University of Granada, 18002, Granada., Spain

Keywords: Foraminifera; Late Eocene; ODP Site 696; Drake Passage; South Orkney Microcontinent.

The timing and impact of the opening of the Drake Passage during the Eocene-Miocene on global climate remain controversial. The development of the present-day southern limit of this gateway encompasses the opening of the Powell Basin that formed as the South Orkney Microcontinent (SOM) was rifted from the Antarctic Peninsula during the Late Eocene. In the present work, we aim to better elucidate the regional paleoenvironmental conditions in the southern margin of the SOM shelf prior the main proto-Powell rifting phase.

This study focuses on sediments recovered in the SOM by the Ocean Drilling Program (ODP) Leg 113, at Hole 696B (61°50.959'S, 42°55.996'W, 650 mbsl water depth), dated from ~36.9 to ~35.5 Ma [1, 2, 3, 4]. A total of 25 samples from the lithologic Unit VII (cores 58-62R [1]) have been analysed under binocular and scanning electron microscope.

The studied samples are poorly sorted and structureless sandy mudstones with matrix formed predominantly by smectite. The detrital fraction mainly consists of abundant angular-rounded quartz, feldspar, rock fragments, and mica grains. Glaucony grains are also present throughout the studied terrigenous sequence. The biogenic carbonate components consist of common benthic foraminifera and varying amounts of planktonic foraminifera assemblages. Millimetre-size mollusks fragments (bivalves and possibly gastropods) were also observed throughout, along with diatom and radiolarian specimen. Furthermore, carbonate-cemented sandy mudstone intervals occur in cores 58R-1; 598 mbsf and 62R-7; 643 mbsf. Bioturbation is intense to moderate and well-de-fined burrows (e.g. Ophiomorpha, Asterosoma or Teichichnus) are preserved. Moderate sedimentation rates can be inferred from the structureless, moderate to intense bioturbated sediments and the widespread occurrence of Ophiomorpha.

Our preliminary work reveals that the thick terrigenous sequence was deposited in a shallow-water (neritic) environment below the wave base and without vigorous currents or tidal influences. The dominant benthic foraminiferal species recurrent in Hole 696B (e.g. Marginulina tenuis, Sphaeroidina bulloides, Pleurostomelle sp., Hanzawaia ammophila, Fissurina spp., Cyclammina sp., Stensieoina beccariformis, Laevidentalina sp., Spiroplectammina, Siphonodosaria jacksoensis, Siphonodosaria spp., Cibicides sp., Siphonodosaria cf. lepidula, Lenticulina sp., Melonis, Anomalinoides barleeanum, Bulimina sp., Globobulimina sp. and Elphidium cf. excavatum.) and planktonic (e.g. Subbotina eocaena sensu Blow, Globorotalia spp. and Sphaeroidina bulloide) foraminiferal species are common in the studied section from Hole 696B. Their presence suggest their deposition occurred under the influence of low-latitude (temperate) derived currents and the progressive increase in reduced-oxygen/salinity conditions established at the SOM shelf during the late Eocene (from ~36.9 to ~35.5 Ma).

These preliminary evidences need to be corroborated by further sedimentological analysis, which will be presented during the ISAES2019 conference.

References

[1] Barker et al., 1988. Initial Reports, 113. ODP, College Station, Texas.
[2] Wei and Wise, 1990. Scientific Results, 113. ODP, College Station, Texas, 639–666.
[3] Houben et al., 2013. Science 340, 341–344.
[4] Houben et al., 2019. American Geoph

Session07: Circum-Antarctic Gateways: formation, evolution and global implications

Geochronology and geochemistry of the northern Scotia Sea: a revised interpretation of the North and West Scotia ridge junction

Teal Riley[1], Andrew Carter[2], Philip Leat[1, 3], Alex Burton-Johnson[1] †, Joaquin Bastias[4], Richard Spikings[4], Alex Tate[1], Charlie Bristow[5]

[1]British Antarctic Survey, United Kingdom, [2]Department of Earth and Planetary Sciences, Birkbeck, University of London, United Kingdom, [3]School of Geography, Geology and the Environment, University of Leicester, United Kingdom, [4]Department of Earth Sciences, University of Geneva, Switzerland

Understanding the tectonic evolution of the Scotia Sea is critical to interpreting how ocean gateways developed during the Cenozoic and their influence on ocean circulation patterns and water exchange between the Atlantic and Southern oceans. We examine the geochronology and detrital age history of lithologies from the prominent, submerged Barker Plateau of the North Scotia Ridge. Metasedimentary rocks of the North Scotia Ridge share a strong geological affinity with the Fuegian Andes and South Georgia, indicating a common geological history and no direct affinity to the Antarctic Peninsula. The detrital zircon geochronology indicates that deposition was likely to have taken place during the Upper Cretaceous. A tonalite intrusion from the Barker Plateau has been dated at 49.6 ± 0.3 Ma and indicates that magmatism of the Patagonian-Fuegian batholith continued into the Eocene. This was coincident with the very early stages of Drake Passage opening, the expansion of the proto Scotia Sea and reorganization of the Fuegian Andes. The West Scotia Ridge is an extinct spreading centre that shaped the Scotia Sea and consists of seven spreading segments separated by prominent transform faults. Spreading was active from 30 – 6 Ma and ceased with activity on the W7 segment at the junction with the North Scotia Ridge. Reinterpretation of the gravity and magnetic anomalies indicate that the architecture of the W7 spreading segment is distinct to the other segments of the West Scotia Ridge. Basaltic lava samples from the eastern flank of the W7 segment have been dated as mid-Cretaceous in age (131 – 97 Ma) and have a prominent arc geochemical signature indicating that seafloor spreading did not occur on the W7 segment. Instead the W7 segment is likely to represent a down-faulted block of the North Scotia Ridge of the Fuegian Andes continental margin arc, or is potentially related to the putative Cretaceous age Central Scotia Sea.

Associated Article:
Riley, T. R., Carter, A., Leat, P., Burton-Johnson, A., Bastias, J., Spikings, R. A., Tate, A. J. & Bristow, C. S. (Accepted). Geochronology and geochemistry of the northern Scotia Sea: a revised interpretation of the North and West Scotia ridge junction. Earth and Planetary Science Letters.

A162

Session09: Permafrost and Periglacial ice free areas in Antarctica

Bedrock erosion rates and the development of weathering features in Antarctica

Daniel Morgan[1†], Mauro Guglielmin[2], Alessandro Longhi[2], Greg Balco[3]

[1]Vanderbilt University, USA, [2]Insubria University, Italy, [3]Berkeley Geochronology Center, USA

Bedrock surfaces in Antarctica frequently exhibit weathering patterns such as weathering pits, tafoni, and weathering rinds, but there are multiple hypotheses to explain the formation of these features. This study will quantify bedrock erosion rates with cosmogenic nuclides to determine if differences in subaerial erosion rates can help explain the development of these types of weathering characteristics. Granite and sandstone bedrock samples were collected from Northern Victoria Land and the McMurdo Dry Valleys regions in Antarctica. We compared samples from the bottom of weathering pits and within tafoni to those from adjacent areas, and those that had well-developed weathering rinds. Before crushing each rock sample, we used a FieldSpec HandHeld 2 Spectroradiometer to collect the reflectance patterns for the 325 – 1,075 nm wavelengths of each sample. We collected reflectance data from the side of the rock that had been exposed to the elements, and, in turn, been affected by weathering and erosion, and compared that to a freshly cut surface on the side of the sample. This comparison can begin to provide a quantitative value to the amount of weathering a sample has undergone. Then, we prepared each sample by extracting quartz grains for cosmogenic nuclide analysis with standard lab procedures, and the concentration of Neon-21 was measured at the Berkeley Geochronology Center with noble gas mass spectrometry. Production rates of cosmogenic Ne-21 were calculated using the Lifton, Sato, and Dunai (2014) scaling scheme. The measured Ne-21 concentrations indicate erosion rates between 0.16 – 1.04 m/Ma. Some pairs of samples indicate that the bottom of weathering pits are eroding faster than samples from the adjacent bedrock, which can help explain the occurrence of these features. But other sites show comparable rates of erosion within and beyond the weathering pits. Sandstone samples with well-developed weathering rinds are among the lowest erosion rates, at 0.18 m/Ma. We do not observe any significant trends between the erosion rates and the elevation or latitude of the sites, or with the spectral reflectance patterns of the samples.

A225

Session09: Permafrost and Periglacial ice free areas in Antarctica

Geophysical and Geomorphological investigations of Polygonal Patterned Ground in continuous Antarctic permafrost as a Mars analog.

Mauro Guglielmin[1 †] , Rossana Raffi[2], Hugh French[3], Emanuele Forte[4]

[1]Dept. Theoretical and Applied Sciences, Insubria University, Varese, Italy, [2]Department of Earth Sciences, Universit?La Sapienza, Roma, Italy, [3]Departments of Earth Sciences and Geography, University of Ottawa and Department of Geography, University of Victoria, Canada, [4]1Department of Mathematics and Geosciences, University of Trieste, Trieste, Italy

The results of a combined geophysical and geomorphological investigation of thermal-contraction-crack polygons in Northern Victoria Land (Antarctica) are reported. An area of ~30,000 m2 characterized by random orthogonal polygons was investigated using 10 GPR and 2 ERT surveys.
The terrain consists of Holocene-age raised beaches. The polygons are well developed only on beaches that are >14 m above current sea level. Uplift curves for the region suggest the beaches formed between 4.2 and 6.3 ka BP. Sections were excavated through two of the fissures that form the polygons. There was good correlation between field observations and GPR (250 Mhz) data. It is concluded that the polygons are composite in nature because the shallow linear depressions that outline the polygons are underlain by fissures that can contain both sandy gravel (i.e., sand wedges) and foliated gravelly ice (i.e., ice wedges) in the same polygon network. Generally, the ice infill is less common than the sandy gravel infill. While thermal-contraction-cracking is the principle mechanism for polygon formation, it is suggested that local micro-site conditions, mainly snow distribution, leads to the different type of fissure infill.

A242

Session09: Permafrost and Periglacial ice free areas in Antarctica

Active layer modeling at Signy Island (maritime Antarctica) and the role of the surface type

Stefano Ponti[1†], Francesco Malfasi[1], Peter Convey[2], Nicoletta Cannone[3], Mauro Guglielmin[1]

[1]Department of Theoretical and Applied Sciences, Insubria University, via J.H. Dunant, 3 - 21100 Varese (VA), Italy, [2]British Antarctic Survey, Natural Environment Research Council, High Cross, Madingley Road - Cambridge CB3 0ET, United Kingdom, [3]Department of Science and High Technology, Insubria University, via Valleggio, 11 - 22100 Como (CO), Italy

Several models have been proposed to assess the active layer thickness (ALT) in polar regions, often relying on the thawing degree days (TDD) [1]. However, none of them directly consider the properties of the surface, such as the vegetation type and the grain size. Indeed, it has been demonstrated how the vegetation type affects the ground surface temperature (GST) and in turn the ALT [2, 3, 4, 5]. In Antarctica this phenomenon is studied but often confined to circumpolar active layer experiment (CALM) grids [2, 5] that hardly consider the topography variability. Here, a new ALT distribution model is proposed over a large maritime Antarctic area. It is based on the air TDD and the elevation. In addition, a quantification of different surface types on the ALT is evaluated. The study site distributes on the whole Signy Island (South Orkney Islands, 60.7° S, 45.6° W). During the Antarctic summer, a frost probe method and a GPS were used to assess the thaw depth (TD) and the elevation respectively at different sites between 24-01-18 and 14-03-18. A total of 182 sites were investigated and for each site (3-meter ray circle) 6 measurements, one per each main surface type (fine bare ground, coarse bare ground, Andreaea depressinervis, Sanionia uncinata, Cyanobacteria, Usnea sp.), were carried out. Moss banks and snow perennial banks were excluded from the analyses. Climatic data were obtained from 4 automatic weather stations (AWS), located at different elevations. The TDD at each probing day and site were extrapolated through linear regressions of AWS TDD-elevation. AWS TDD-elevation linear regressions showed good results (overall $R2 > 0.76$, $p < 0.001$), especially during March ($R2 > 0.97$, $p < 0.001$). Therefore, the extrapolated values of TDD per site were calibrated with the measured average TDs of March (end of summer) that likely represent a matching with ALT.

Statistical analyses underlined how the sites with Andreaea depressinervis surfaces showed thicker ALT (+3.1 cm), whereas Sanionia uncinata surfaces had thinner values (ca -1 cm) respect to the average of each site.

In conclusion, localized (altitudinal) air TDD seems to be a good representative of ALT at Signy Island, maritime Antarctica. The reason of this good relation with the air TDD could be related to the very low values of incoming radiation in this Antarctic sector. However, the surface type plays a key role in enhancing or buffering the TD/ALT. This effect is maintained at all the elevations even when the surfaces do not form a significant amount of peat or organic matter underneath as below the moss banks occurring on the island.

REFERENCES

[1] Riseborough, D., Shiklomanov, N., Etzelmüller, B., Gruber, S. and Marchenko, S. (2008). Recent advances in permafrost modelling. Permafrost and Periglacial Processes, 19(2), 137-156.

[2] Guglielmin, M., Dalle Fratte, M. and Cannone, N. (2014). Permafrost warming and vegetation changes in continental Antarctica. Environmental Research Letters, 9(4), 045001.

[3] Cannone, N., Evans, J. E., Strachan, R. and Guglielmin, M. (2006). Interactions between climate, vegetation and the active layer in soils at two Maritime Antarctic sites. Antarctic Science, 18(3), 323-333

[4] Guglielmin, M., Evans, C. J. E. and Cannone, N. (2008). Active layer thermal regime under different vegetation conditions in permafrost areas. A case study at Signy Island (Maritime Antarctica). Geoderma, 144(1-2), 73-85.

[5] Guglielmin, M., Worland, M. R. and Cannone, N. (2012). Spatial and temporal variability of ground surface temperature and active layer thickness at the margin of maritime Antarctica, Signy Island. Geomorphology, 155, 20-33.

A316

Session09: Permafrost and Periglacial ice free areas in Antarctica

Statistical analysis of soils properties from Antarctica based on a large database

Mayara Daher[1 †], Carlos Ernesto Schaefer[1], Marco Antonio Silva[1], Elpídio Fernandes Filho[1], Márcio Francelino[1]

[1]*Departamento de Solos, Universidade Federal de Vicosa, Minas Gerais, Brazil*

In 2002, the TERRANTAR Research Group, linked to the Brazilian Antarctic Program (PROANTAR), began soil studies on King George Island (South Shetland Islands Group - SSIG). Throughout these 16 years of research, soil collection has expanded to the neighboring islands, reaching as far as the Weddell Sea (James Ross Island group - JRIG) and Continental Antarctica. The research group currently accounts for approximately 20% of all soil collection conducted in Antarctica, with a compiled database of 412 soil profiles from the SSIG and JRIG combined. It allows us to examine and compare the physical and chemical properties, through a descriptive statistical analysis of the soils of these distinct climatic regions. The results point to a predominance of parent material inheritance and over physical weathering over chemical weathering, although in a specific condition, chemical weathering is more influential. The mean pH values of JRIG semi-arid soils are closer to those found in arid Continental Antarctica. SSIG soils are the most acidic in Antarctica, due to either the presence of sulfides on the marked biological influence under greater moisture and temperature. In the JRIG, the values of Na are much higher due to drier climates. Conversely, greater precipitation in the SSIG region favors greater leaching of the exchangeable bases, particularly Na and K. The highest bioavailable P values (Mehlich-1) found in the two regions are attributed to external inputs of bird guano, mainly by penguins, which are more significant in the SSIG, where a greater population occurs. In both regions, soils affected by bird activity have the highest amount of organic material, thereby resulting in high total organic carbon content. Climate is the key factor for the development of SSIG soils. Greater precipitation combined with higher temperatures considerably increases vegetation growth, organic matter accumulation and leaching of base elements, resulting in a more acidic pH. On the other hand, in the JRIG, alkaline soils with higher salt contents, have negligible vegetation, low organic matter contents, closely matching aridic soils from Dry Valleys of Continental Antarctica.

A335

Session09: Permafrost and Periglacial ice free areas in Antarctica

Microbial life in the brine of cryo-environments in the Northern Victoria Land (Antarctica)

Maria Papale[1†], Maurizio Azzaro[1], Anderson Cabral[2], Gabriella Caruso[1], Alessandro Cosenza[1], Ermanno Crisafi[1], Emanuele Forte[3], Rosabruna La Ferla[1], Angelina Lo Giudice[1,4], Giovanna Maimone[1], Rodolfo Paranhos[2], Alessandro Rappazzo[1], Mauro Guglielmin[5]

[1]Institute of Polar Science, National Research Council, Italy, [2]Institute of Biology, Federal University of Rio de Janeiro, Brazil, [3]Department of Mathematics and Earth Sciences, University of Trieste, Italy, [4]Department of Chemical, Biological, Pharmaceutical and Environmental Sciences, University of Messina, Italy, [5]Department of Theoretical and Applied Sciences, University of Insubria, Italy

The recent discovery on Mars of brines has increased interest in analogous environments in Arctic and Antarctica. In fact, several polar environments (glacial lakes, glaciers, etc.) encapsulate sometimes brine pools characterized by a unique combination of extreme conditions. In order to find new extreme ecological niches of life in Antarctica, in the framework of the Italian National Research Programme in Antarctica (PNRA), during two Ground Probing Radar (GPR) surveys (2014 and 2017), several brine pockets were discovered in the Northern Victoria Land. Two study areas were investigated: Tarn Flat and Boulder Clay. A total of nine brine were collected. An integrated approach including traditional and next-generation methods was performed including: prokaryotic (Bacteria and Archaea) diversity by Ion Torrent sequencing; microbial abundances, cell-shape, viable (Live/Dead) and respiring cells (5-Cyano-2,3-ditolyl-tetrazolium chloride stain) by Image Analysis; virus abundance by flow cytometry. Moreover, the physiological profiles by Biolog-Ecoplate™ were determined as well as the potential ectoenzymatic activities rates (leucine-aminopeptidase, LAP; ß-glucosidase, β-GLU; alkaline-phosphatase, AP).
Results highlighted differences in the analyzed samples in terms of diversity, abundance and metabolism. The analysis of DNA sequences showed that different microbial populations harboured the study environments, in fact only few OTUs (ranged between 2.2 and 22%) were common between samples. The prokaryotic and virus abundances were in the order of 107-109 cells l-1 and 109-1011 particles l-1, respectively. The physiological profiles described wide metabolic potentials by the prokaryotic community and revealed differences in the quality of used substrates within the studied environments. Decomposition rates suggested selective microbial abilities, highlighting the presence of cells particularly able to decompose proteins rather than organic phosphates and polysaccharides. The studied cryo-environments were different each other and also with respect other of the Northern Victoria Land.
In conclusion, the screening of prokaryotic assemblages in the brines of these unexplored Antarctic cryo-environments fills some gaps on the knowledge of these peculiar ecological niches and allows insights on geochemical processes affecting microbial life.

A346

Session09: Permafrost and Periglacial ice free areas in Antarctica

Thermal diffusivity of Antarctic soil estimated using Carslaw-Jaeger and finite element methods

Heejung Kim[1], Jin-Yong Lee[2,3†]

[1]School of Earth and Environmental Sciences, Seoul National University, Korea, [2]Department of Geology, Kangwon National University, Korea, [3]Critical Zone Frontier Research Laboratory (CFRL), Kangwon National University, Korea

Permafrost is closely related to climate change since it plays a critical role to regulate carbon dioxide levels. Therefore, a quantification of the heat transfer for permafrost becomes important and understanding its thermal properties is essential. Thermal diffusivity is one of the most important properties of an Antarctic soil. The generally adopted method estimating thermal diffusivity is the Carslaw and Jaeger (C-J) method and it gives the temperature distribution of soil at different depths and times. The thermal diffusivity of soil can be estimated by best-matching calculated temperature with measured temperature. The C-J method needs a time-series of surface temperature and its solution is expressed as an integral of the convolution of a surface temperature function and a transfer function. Field-measured temperature is obtained at a specified time interval. As the integral uses the average temperature of a time interval, even a very short one, an error between the accurate solution and its approximation cannot be avoided. In order to reduce the error, it is essential to adjust the time interval and the depth at which field temperature is monitored, with respect to a range of thermal diffusivities. This study examined the C-J method using mathematical examples. Results from the finite element method (FEM) and the C-J method are graphically displayed for a simple hypothetical temperature boundary condition, and the error trend is examined. And then surface temperature data are generated using field-measured data from the Antarctic region and used as the input for the two methods. The applicability of the FEM is compared with that of the C-J method.

A422

Session09: Permafrost and Periglacial ice free areas in Antarctica

ELECTRICAL RESISTIVITY IMAGING TO STUDY PERMAFROST DISTRIBUTION IN A MARINE TERRACE IN BYERS PENINSULA, LIVINGSTON ISLAND, MARITIME ANTARCTICA

Antonio Correia[1†], Marc Oliva[2], Jesus Ruiz-Fernandez [3]

[1]University of Evora, Evora, Portugal, [2]University of Barcelona, Barcelona, Spain, [3]University of Oviedo, Oviedo, Spain

Geoelectrical methods are very effective to unveil permafrost distribution and permafrost conditions in polar environments; as a matter of fact, geoelectrical methods are particularly well adapted to study time and spatial distribution of permafrost because of its high electrical resistivity in comparison with electrical resistivities of soil and rocks with water above 0 ºC; electrical resistivity tomography has been used with success in the study of permafrost space and time evolution. In the South Shetland Islands permafrost is considered to be marginal to discontinuous up to elevations of 20 - 40 m a.s.l., changing to continuous at higher altitudes. However, there are no specific data about the distribution of permafrost in the recently deglaciated areas in the Byers Peninsula of Livingston Island, in Maritime Antarctica, which is the largest ice-free area in the South Shetland Islands. With the purpose of better understanding the existence (or inexistence) of permanent frozen conditions in this area, a geophysical survey using an electrical resistivity tomography methodology was carried out during the field season of 2015. Three electrical resistivity tomographies of 78 m each were done along the same profile which ran from the coast to the highest marine terraces. For each tomography 40 electrodes were used in a Wenner configuration; adjacent electrodes were 2 m apart. The software RES2DINV was used for inverting the apparent electrical resistivity values (apparent electrical resistivity pseudosections) into two-dimensional models of electrical resistivity of the ground. The models are a representation of the distribution of the electrical resistivity of the ground to depths of about 13 m along the 78 m long profiles. The snowy conditions during the cold season in 2014 in Byers Peninsula have conditioned a late melting of snow in 2015, which must be taken into account when interpreting the data related to frozen conditions inferred from the geoelectrical survey. Several patches of high electrical resistivity are found along the three profiles done from the coast to the highest marine terraces, which are interpreted as patches of sporadic permafrost. This may suggest the lower limits of sporadic permafrost in the area. In addition, an attempt to correlate the insulation effect of moss patches with the existence of permafrost is done.

A104

Session12: Geological records of ocean and ice sheet change from the Ross Sea

High resolution seismo-stratigraphic evidence from the Edisto Inlet fjord, western Ross Sea (Antarctica)

Francesca Battaglia[1†], Luca Baradello[2], Laura De Santis[2], Emiliano Gordini[2], Chiara Sauli[2], Vedrana Kovacevic[2], Danilo Morelli[3], Leonardo Langone[4], Florence Colleoni[2], Ester Colizza[3], Gualtiero Bohm[2], Michele Rebesco[2], Daniela Accetella[2]

[1]Department of Science and Management of Climate Change, Ca Foscari University of Venice, Italy, Italy, [2]OGS, National Institute of Oceanography and Applied Geophysics, Trieste, Italy;, Italy, [3]Department of Mathematics and Earth Sciences University of Trieste, Italy, Italy, [4]ISMAR CNR, Bologna, Italy;, Italy

Edisto Inlet, located along the northern Victoria Land coast, is a small fjord about 15 km long and 4 km wide, carved by glacial processes and separated by a sill from the larger Moubray Bay.
The bathymetry shows a reversed slope and ranges from 670 m in the innermost sector of the bay to 100 m near the entrance of the bay.
The Edisto Inlet is seldom accessible due the presence of persistent sea ice but in 2017 during the PNRA (Programma Nazionale delle Ricerche in Antartide) OGS Explora expedition, exceptional sea-ice free conditions allowed for the first time the acquisition of a wealth of data (including sub-bottom chirp profiles, multibeam swath bathymetry, Acoustic Doppler Current Profiler measurements as well as two gravity cores) inside the fjord.
The geophysical dataset combined with previous echo-sounding data collected in the outer sector of the fjord reveal the presence of sediment drifts that hypothetically formed under the influence of bottom currents. The sediment drifts are characterized by a very high sedimentation rate and are potential excellent paleoclimatic archives.
Paleoclimate records are crucial for understanding current changes taking place in the Antarctica; However, paleoclimate and oceanographic reconstructions, especially from the Antarctic fjords, as well as the circulation and processes impacting their exchange with the shelf and wider ocean, are scarce.
Here we present the first report of the integrated analysis of all geophysical dataset aimed to understand relationship between the seabed morphology and present day velocity and direction of the currents. Moreover, the evolution over the late deglaciation phase can be inferred by comparing the results with the stratigraphic information from existing sediment cores.
The comparison of all data and observations with the numerical simulation of ocean dynamics, will permit to understand the climatic evolution of the fjord. Link with the climatic evolution of the Victoria Land coast and with other Antarctic sectors of the same area will allow to understand the interaction between East and West Antarctica.

A130

Session12: Geological records of ocean and ice sheet change from the Ross Sea

The STREAM project: Late Quaternary evolution of the ocean-ice sheet interactions - the record from the Ross Sea continental margin (Antarctica)

Ester Colizza[1†], Boo-Keun Khim[2], Paola Del Carlo[3], Laura De Santis[4], Federico Giglio[5], Sangbeom Ha[1], Jong Kuk Hong[6], Sungham Kim[6], Su Kwan Kim[6], Jae LI Lee[6], Min Kyung Lee[6], Patrizia Macri'[7], Romana Melis[1], Stefano Prato[8], Franco Talarico[9], Fiorenza Torricella[10]

[1]Dipartimento di Matematica e Geoscienze - Universita' di Trieste, Italy, [2]Department of Oceanography Pusan National University, Korea, [3]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Italy, [4]Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, OGS - Trieste, Italy, [5]Istituto di Scienze Marine - CNR, Italy, [6]Korea Polar Research Institute - KOPRI, Korea, [7]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Roma, Italy, [8]A.P.E. Research Company - Trieste, Italy, [9]Dipartimento di scienze fisiche, della Terra e dell'ambiente - Universita' di Siena, Italy, [10]Dipartimento di Scienze della Terra - Universita' di Pisa, Italy

In the framework of the twelfth executive programme for scientific and technological cooperation between the Italian republic and the Republic of Korea for the years 2019-2021, the STREAM project has been selected as a significant research project. Over past decades, many different types of data (sediment cores and geophysical data) were collected by Korean and Italian institutions in the Ross Sea, in the frame of specific projects separately funded by national agencies, although linked by bilateral agreements. The interpretation of these partially published data strengthened the collaboration and highlighted the need to fully integrate all Korean and Italian geological and geophysical data. This amount of data provides a unique opportunity to constrain the magnitude of ocean-ice interactions and to bind projected sea level changes.

To this aim, this project proposes to complete the remaining sediment core analyses and integrate them with all the existing data from the Ross Sea continental slope and rise to reconstruct the ocean-ice sheet interaction changes over the late Quaternary. This integrated approach will facilitate the interpretation of the sedimentary sections newly recovered during the International Ocean Discovery Program (IODP) Expedition 374 in 2018 in which Korean and Italian members participated. The Korean (Pusan National University-PNU) and Italian (University of Trieste-UT) project proponents have been collaborating since 2012. This collaboration follows the Italian-Korean MoU signed by the Italian proponent and Korea Polar Research Institute (KOPRI). In the framework of this MoU, PNU and UT analyzed sediment cores, and OGS and KOPRI examined the geophysical data, collected in the frame of the PNRA/Rosslope, PNRA/Odyssea, PNRA/whispers and KOPRI K-Port projects. In the framework of the new project both the Korean and Italian scientific parties will engage in a collaboration over the next three years to achieve a record of late Quaternary ocean-ice sheet interactions from the Ross Sea continental margin integrating analysis of different data sets, using a multidisciplinary approach.

Our main objective is to reconstruct the Ross Sea environmental changes recorded in the late Quaternary sediments by analysing the data collected at the shelf edge and along the continental slope and rise. The specific task is to reconstruct the frequency and duration of AIS advances and retreats as well as to identify the mechanisms contributing to these ice sheet dynamics (e.g. interaction with water masses) during the late Quaternary glacial-interglacial cycles. This information will be inferred from the sediments that recorded past changes in oceanic temperature, productivity, sea ice extent, bottom current strength and pathways, all indicative of fully glacial, transitional, or open water depositional setting. The focus of research will be on the Ross Sea continental margin key areas where the sediments eroded by the AIS in the inner shelf were deposited during times of maximum AIS expansion. The selected area for the first year is the Central Basin slope-basin system located at the

mouth of the Joides Basin in the Ross Sea. This area is a semi-closed depression, one of the overflow areas of dense and cold bottom water of the Ross Ice Shelf.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

New Chronologies on East Antarctic Ice Sheet Stability – Surface Exposure Ages from Bennett Platform, Transantarctic Mountains

Julia Lindow[1†], Mark Kurz[1], Robert Ackert[2]

[1]Woods Hole Oceanographic Institution, USA, [2]Harvard University, USA

The East Antarctic Ice Sheet is the largest ice mass on Earth. Understanding the timing of past ice-sheet instabilities is crucial to constraining glacial history and predicting the impact of future warming. Landscape chronologies and geomorphology data from the Transantarctic Mountains have been used as evidence for a stable East Antarctic Ice Sheet since at least early Miocene (~8 million years ago). In contrast, marine sediment core data from the Ross Sea suggest that the East Antarctic Ice Sheet was much smaller than present, as recently as Pliocene (~ 3 million years ago). Marine diatoms deposited in Sirius Group tillites, (high-elevation glacial sediments in the Transantarctic Mountains) are considered an additional indication for warmer temperatures and smaller East Antarctic Ice Sheet in the Pliocene. However, the origin of these diatoms, their depositional age and context remain unknown.
Measurements of in situ cosmic-ray-produced nuclides in surface samples of the Sirius Group provide important independent age information. Only a few of the known exposures have been studied so far, and it is unclear if they were formed at one discrete time interval, and when. Here we present first cosmogenic 3He and 21Ne minimum ages from Bennett Platform, a key Sirius Group outcrop in the central Transantarctic Mountains near Shackleton Glacier. Our preliminary results indicate a 3He minimum age range of 7.51 to 2.74 Ma with the majority averaging at ~ 5.49 Ma (excluding the youngest sample), and 9.78 to 8.79 Ma for cosmogenic 21Ne. These minimum ages pre-date the youngest bio-stratigraphic age constraint derived from the marine diatoms, suggesting a diatom deposition after the formation of the glacial tillite and no large-scale glacial activity since then in the Bennett Platform area. Existing minimum surface exposure ages from previous studies range from

A157

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Multiple Glaciation in the Middle Segment of the Western Ross Sea: Revealed by Intermediate-Resolution Seismic Data

Zhongyan Shen[1†], Jinyao Gao[1], Sheng Zhang[1]

[1]*Second Institute of Oceanography, Ministry of Natural Resources, China*

The Western Ross Sea is an important place to study the historical dynamics of the East Antarctic Ice Sheet (EAIS). It has preserved critical geological records of EAIS advances and retreats. The intermediate-resolution seismic data (IRSD) obtained by GI guns have significant advantages in studying glaciation on the scale of millions of years because they have higher vertical resolution compared with those low-resolution seismic data (LRSD) in the Ross Sea. IRSD in the Western Ross Sea are mainly concentrated in the Northern Basin of the northern segment of the Western Ross Sea. In 2016 and 2017, we collected ~1,000 km of IRSD in the Drygalski Basin and the Crary Bank in the middle segment of the Western Ross Sea. After interpretation of these data together with other available LRSD and IRSD, we have found multiple glaciation in this area. Especially, under the regional unconformity RSU2, there are large-scale glacial troughs and infilled deposits, which indicate that there were large-scale paleo-ice streams before RSU2. Over RSU2, the Crary Bank is generally characterized by clinoform-like deposits dipping to the west, indicating that there is a long-living ice cap on it after RSU2. These glacial phenomena can provide important constraints for reconstructing the EAIS dynamics on the scale of millions of years.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Assessing the orbital response of the WAIS from a Ross Sea deep ocean perspective since the Late Pliocene

Molly Patterson[1†], Natalia Varela Valenzuela2[2], Brian Romans[2], Jeanine Ash[3], Denise Kulhanek[4], Benjamin Keisling[5], Robert McKay[6], Christiana Rosenberg[1], Katie Horisk[1], Harold Jones[1], Tim van Peer[7], Laura De Santis[8], IODP Exp. 374 Scientists

[1]Department of Geological Science and Environmental Studies, Binghamton University SUNY, USA, [2]Department of Geoscience, Virginia Tech University , USA, [3]Department of Earth, Environmental and Planetary Sciences, Rice University , USA, [4]International Ocean Discovery Program, Texas A&M University, USA, [5]Department of Geoscience University of Massachusetts Amherst , USA, [6]Antarctic Research Centre, Victoria University of Wellington, New Zealand, [7]National Oceanography Centre Southampton, University of Southampton, United Kingdom, [8]Geofisica Della Litosfera Instituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Italy

The growth and decay of ice sheets during the Pliocene and Pleistocene (5.3 Ma to recent) is paced by variations in Earth's orbit around the sun. However, the role and feedbacks related to the influence insolation has on ice sheets and its downstream consequence on sea level, surface ocean and deep ocean processes is not well understood, especially in the context of changing boundary conditions throughout the last 5.3 Ma.

The International Ocean Discovery Program (IODP) Expedition 374 recovered a nearly continuous high resolution Late Pliocene-Pleistocene sedimentary record from 2394 m water depth on the southeastern levee of the Hillary Canyon at Site U1524. The Hillary Canyon is one of the largest conduits for newly formed Ross Sea Bottom Water (RSBW), a type of Antarctic Bottom Water (AABW) that eventually baths the Indian-Pacific Ocean sectors of the deep ocean. Notably, this site also lies beneath the modern day westward-flowing Antarctic Slope Current (ASC).
The shipboard sedimentological team identified two lithostratigraphic units spanning the Late Pliocene to Pleistocene record of U1524. Unit I is characterized by diatom-bearing muds interbedded with diatom-rich muds. Unit II spans the Late Pliocene and grades downhole into diatom-rich muds interbedded with diatom ooze. Detailed core descriptions imply that lithostratigraphic units reflect depositional environments reflecting debris flow, low density turbidities, ice-rafting, pelagic and hemiplegic deposition.

We integrate shipboard-board visual core observational data (i.e., core descriptions) with chronostratigraphic, physical property, x-ray fluoresces (XRF) core scanning, and additional shore-based discrete bulk minerology x-ray diffraction (XRD) data sets to better understand the depositional processes as they relate to: lithofacies, the stratigraphic architecture of these lithofacies and long-term depositional processes that characterize the Late Pliocene to Pleistocene from Site U1524.
Given the high resolution sampling of physical property and XRF data sets and continuous nature of deposition at Site U1524, we use a variety of statistical techniques to assess the role of external periodic forcing (e.g. orbital) and quasiperiodic millennial-scale forcing from localized non-periodic processes as they relate glacial dynamics. We specifically utilize a variety of noise models and statistical techniques to account for contamination of time series data by stochastic controls on climate and sedimentation rates. Our findings are placed in the context of far-field sea level and deep ocean records that imply Antarctic ice sheet variability and its down-stream influence on deep ocean circulation in the Indian-Pacific Ocean sectors for the last 3.3 Ma in.

A214

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Preliminary results of geochemical proxies (biogenic opal, TOC, and CaCO3) at IODP Site U1523 on the Ross Sea Continental Shelf

Sunghan Kim[1†], Jae Il Lee[1], Min Kyung Lee[1], Rob McKay[2], the IODP Expedition 374 Scientists [3]

[1]Korea Polar Research Institute, Korea, [2]Victoria University of Wellington, New Zealand, [3]http://iodp.tamu.edu/scienceops/expeditions/ross_sea_ice_sheet_history.html, USA

It is important to understand past ice sheet dynamics. Because the West and East Antarctic Ice Sheets merged on the Ross Sea, understanding the ice sheet variation particularly in the Ross Sea is crutial. Geochemical proxies respond to surface environmental changes on the shelf in association with ice sheet advance/retreat. Site U1523 was collected from the Ross Sea continental shelf during International Ocean Discovery Program (IODP) Expedition 374. We measured biogenic opal, total organic carbon (TOC), and CaCO3 concentrations from the top 16 m of Site U1523 to reconstruct the late Pleistocene surface water productivity changes in response to ice sheet advance/retreat and to reconstruct bottom water corrosivity changes. Since our preliminary results of biogenic opal and TOC concentrations show cyclical variations, the variation may be related to degree of duration of sea ice associated with ice sheet advance and retreat on the Ross Sea. Because CaCO3 preservation is related to bottom water mass property and surface carbonate production, changes in CaCO3 concentration would provide information on past changes in bottom water corrosivity or surface carbonate production on the Ross Sea. Generally, increased CaCO3 concentrations occurred togherther with increases in C/N ratio, indicating that CaCO3 preservation on the Ross Sea continental shelf is related to ice sheet advance. Because this is preliminary results, more detailed study will be done in the future.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Plio-Pleistocene Antarctic Slope Current in the outer Ross Sea, and linkages to West Antarctic Ice Sheet variability.

Benjamin Griffin[1†], McKay Robert[1], De Santis Laura[2], Kulhanek Denise[3], Gales Jennifer[4], Patten Jenna[3], Patterson Molly[5], Prunella Cat herine[6], Shevenell Amelia[6], IODP Expedition 374 Scientific Party [3]

[1]Victoria University Of Wellington, New Zealand, [2]Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Italy, [3]International Ocean Discovery Program, Texas A&M University, USA, [4]University of Plymouth, United Kingdom, [5]Binghampton University, USA, [6]University of South Florida, USA

The marine-based West Antarctic Ice Sheet (WAIS) is currently experiencing accelerated retreat, with shifts in wind-driven oceanic currents observed to be transporting warm waters towards the ice margin, resulting in ice shelf thinning and accelerated loss of WAIS over the past four decades. The Ross Sea embayment provides a location where the WAIS has repeatedly advanced and retreated in response to orbitally-induced palaeoclimate change in the geological past. The International Ocean Discovery Program (IODP) Expedition 374 drilled five sites that were strategically located in a setting where models indicate the WAIS was most sensitive to oceanic heat flux changes during past glacial /interglacial cycles.

Here, we present a sedimentological study of IODP Site U1523, which is located on the south-eastern flank of the Iselin Bank, at a depth of 828m, and directly located beneath the easterly-flowing Antarctic Slope Current (ASC). To test hypotheses for oceanic triggers of past ice sheet retreat, we aim to constrain changes in the relative vigor of the ASC at Site U1523 since the Late Miocene. Changes in the vigor of the ASC are proposed to have acted as a regulator of warm-water incursions onto the Ross Sea continental shelf in the past, and been a trigger for marine-based WAIS retreat. Correlation to the inner shelf legacy core ANDRILL-1, which provides a record of WAIS retreat since the Late Miocene, allows for linkages of oceanic change to ice sheet variability to be made. Proxies for oceanic change are only preserved during the interglacials in ANDRILL-1, as grounded ice occupied that site during glacial periods. However, Site U1523 provides a more continuous record of offshore oceanographic changes through numerous glacial and interglacial cycles, at the gateway where warm-subsurface waters intrude onto the continental shelf. Thus, this site provides a unique opportunity to investigate changes in offshore oceanographic currents leading into a WAIS deglaciation event. Our study compiles sediment cores from Holes U1523A, U1523B, and U1523E. . The sediments are predominately composed of diatom-rich muds, diatom-bearing sandy muds, foraminifer-bearing sands, and various diamictites/gravel layers. Cyclic variations in facies occur downhole, while three distinct lithostratigraphic units are defined based on longer-term shifts in facies associations. The presence of gravel layers at this site presented numerous challenges with coring, and using a combination of lithological descriptions, downhole logs and drilling parameters, we have develop a composite stratigraphy across the three cored holes at this site. Here, we present this stratigraphy of U1523, complimented by high resolution grain-size data, to provide a first order assessment of changes in ASC vigor since the Late Miocene. We also present a preliminary model of oceanic controls of past WAIS variability via correlations to the ANDRILL-1 record.

A297

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Paleoceanographic changes during the past one million years in the Central Basin, northwestern Ross Sea

Min Kyung Lee[1†], Kyu-Cheul Yoo[1], Jae Il Lee[1], Christian Ohneiser[2], Sunghan Kim[1], Robert McKay[3], Olya Albot[3], Christina Riesselman[2], Michael Bollen[2], Richard Levy[4], Ho Il Yoon[1]

[1]Korea Polar Resarch Institute, Incheon, Korea, [2]University of Otago, Dunedin, New Zealand, [3]Victoria University of Wellington, Wellington, New Zealand, [4]GNS Science, Wellington, New Zealand

The Central Basin is located in the northwestern Ross Sea continental slope and rise. A 11.75 m-long core RS15-LC42 was collected from the southwestern part of the Central Basin (71° 49′ S, 178°35.′E, 2084 m deep) by the Korean RVIB Araon in 2015. The chronology is established based on paleomagnetism and diatom biostratigraphy. This core covers about 1.3 million years. Ohneizer et al. (2019) reported Brunhes-Matuyama reversal (0.78 Ma) at 8.26 mbsf of this core, and according to paleo-intensity records the sedimentation is almost continuous although there is a hiatus near 9.54 mbsf. LC42 core is composed of two distinct sedimentary facies: 1) well-laminated greenish gray diatom-rich silty mud, and 2) massive/bioturbated light gray sandy mud. Well-laminated facies include high content of TOC, opal and carbonate with no IRD (clasts > 2 mm), while massive/bioturbated sandy mud facies show high MS value and bear clasts IRDs. The laminated silty mud facies has abundance in illite while smectite and kaolinite is relatively rich in sandy mud facies. The chlorite content does not change as a whole. The difference in clay mineral composition between two facies indicates that two facies originated from different sources. The diatom assemblage in LC42 include reworking indicator species (early-Pliocene and Miocene taxa), and the tendency of reworking is evident in the lower part of the boundary between 2.8 and 3.25 mbsf. This result suggest that there was a significant shift in the oceanographic regime in this region around 0.3 Ma.

A337

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Antarctic Holocene deglaciation and environmental evolution of the eastern Ross Embayment

Laura Penrose[1], Christina Riesselman[1,2†], Christian Ohneiser[1]

[1]University of Otago, Dept. of Geology, New Zealand, [2]University of Otago, Dept. of Marine Science, New Zealand

Holocene climate in Antarctica is characterised by climatic and oceanic fluctuations where warming in the early Holocene resulted in retreat of grounded ice in the Ross Embayment. However, few cores have been collected from the eastern Ross Embayment, limiting our knowledge of the timing and drivers of deglaciation and post-glacial Holocene environmental evolution in the region. Here, we present a new multi-proxy reconstruction of deglaciation and Holocene evolution of the eastern Ross Embayment, using an archived marine sediment core, NBP96-01 17JPC. This study utilises geochemical proxies (weight percent biogenic silica, δ13C, and δ15N) to understand the diatom biomass and nutrient availability in the water column, and diatom assemblage data (relative and absolute diatom abundance) to reconstruct stratification, sea ice, and other environmental parameters.

Lithological and biogenic silica data provide evidence for open marine conditions following a rapid retreat of a grounded ice sheet between 7 and 6.7 ka. Ocean and thermodynamic ice sheet and ice shelf models coupled with ice core temperature records indicate that a combination of atmospheric warming and upwelling Circumpolar Deep Water (CDW) caused ice sheet collapse and subsequent retreat in the Ross Embayment. Following deglaciation, proxy data from this study indicates three incursions of CDW, upwelling onto the continental shelf in the eastern Ross Embayment. Transport of CDW onto the shelf is closely related to atmospheric circulation and influences the basal melting rate of the Ross Ice Shelf, sea ice cycle, and primary production within the Ross Embayment. This study suggests that the position of the Southern Hemisphere Westerly Wind belt influences the position of the Antarctic Slope Current, thus controlling upwelling of CDW onto the continental shelf in the Ross Embayment.

As atmospheric greenhouse gas concentrations are expected to continue to rise into the future, it is predicated that the Southern Annular Mode will be forced into its positive phase, leading to more extreme El Niño events in the tropical Pacific. In such a scenario, teleconnection between these two regions could increase, causing an overall decline in sea ice extent, a decrease in Antarctic ice sheet stability, and decrease in bottom-water formation and subsequent slow-down of the thermohaline circulation, thus modifying CO2 drawdown through upwelling of CO2-rich waters and primary production. Understanding deglaciation and the evolution of the Ross Embayment through the Holocene will therefore aid in understanding how the climate and oceanography of the region will be impacted in the coming decades.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Using sedimentology and geochemistry to elucidate Antarctic Ice Sheet extent in the late Miocene to Pliocene: Results from IODP Site U1522 on the Ross Sea Continental Shelf

Denise Kulhanek[1†], Molly Patterson[2], Jack McLaughlin[1], Jenna Patten[1], Rob McKay[3], Laura De Santis[4], IODP Expedition 374 Scientists[1]

[1]Texas A&M University, USA, [2]Binghamton University, State University of New York, USA, [3]Victoria University of Wellington, New Zealand, [4]Instituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy

Understanding how ice sheets respond to warmer temperatures is critical to predicting future sea level rise. The marine-based West Antarctic Ice Sheet is particularly vulnerable to increasing ocean temperatures; however, a lack of ice-proximal records limits the ability of modelers to use paleoclimate data to better constrain potential future ice sheet retreat. International Ocean Discovery Program (IODP) Expedition 374 collected Neogene sequences at five sites on the Ross Sea continental shelf and slope/rise that provide insight into ice sheet advance and retreat. Site U1522, in the Glomar Challenger Basin on the Ross Sea continental shelf, was cored in 558 m of water, penetrated to ~702 m below seafloor (mbsf), and recovered ~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. Our study targets the more consolidated sediments below 200 mbsf, which consist of Pliocene diatom-bearing sandy to muddy diamictite interbedded with diatom-bearing mudstone and upper Miocene diatom-bearing to diatom-rich diamictite and diatomite. We present X-ray fluorescence (XRF) core scanning results, calibrated with major and trace element analyses on discrete samples using inductively coupled plasma-mass spectrometry (ICP-MS) and XRF, that provide a high-resolution record of late Miocene to Pliocene sedimentary geochemical variations. These data, coupled with X-ray diffraction (XRD) bulk mineralogy and sedimentary facies analyses, are used to evaluate late Miocene to Pliocene changes in relative ice sheet proximity and sediment provenance. Initial results reveal cyclical (m to 10s of m) 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.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

XRF sediment geochemistry from IODP Site U1523, outer Ross Sea continental shelf, and its utility to distinguish sediment input from various water masses

Jenna Patten[1] [†], Denise Kulhanek[1], Benjamin Griffin[2], Rob McKay[2], Molly Patterson[3], Maxine King[4], Jenny G ales[4], Catherine Prunella[5], Amelia Shevenell[5], Laura De Santis[6], IODP Expedition 374 Scientists[1]

[1]Texas A&M University, USA, [2]Victoria University of Wellington, New Zealand, [3]Binghamton University, State University of New York, USA, [4]Plymouth University, United Kingdom, [5]University of South Florida, St. Petersburg, USA, [6]Instituto Nazionale di Oceanografia e di Geofisica Sperimentale , Italy

International Ocean Discovery Program (IODP) Site U1523 was cored on the outer continental shelf of the eastern Ross Sea in a location never covered by grounded ice. 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 and the late Pliocene 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 sediment to examine changes in current strength as a proxy for oceanic forcing (heat flux) using sediment geochemistry records. We collected X-ray fluorescence (XRF) core scanning data and calibrated it with major and trace element analyses on discrete samples using inductively coupled plasma-mass spectrometry (ICP-MS) and XRF. We also measured total carbon and weight percent carbonate on select samples. These data allow us to construct high-resolution (~2 cm spacing) records of major and trace element sediment composition. Initial results show cyclical variations in some the 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 (between ~0.5 and 5 wt%), although a few samples record higher carbonate content (up to ~12 wt%). We will use multivariate statistical analysis to identify distinct sediment geochemical signatures that may represent different water mass sources. Our data can be combined with records collected by other science party members to elucidate changes in ocean heat flux and its influence on Antarctic ice sheet stability.

A388

Session12: Geological records of ocean and ice sheet change from the Ross Sea

A preliminary study of the relationship of chemical data with the diatoms assemblage in the coastal core sediment of the Antarctic Ross Sea.

Younho Noh[1,2], Ho Il Yoon[1†]

[1]1Korea Polar Research Institute (KOPRI), Korea, [2]University of Science and Technology(UST), Korea

This poster studies climate change recorded in the Antarctic coastal core sediment. In the piston core (RS 14-GC04) collected from the Antarctic Sea of loss sea, Age dating, XRF, TC, TIC, TOC belonging to chemical data, diatom assemblage which is biological data and X-ray and sedimentary facies which are image data were analyzed. Ages represent about 7,000 years, and bulk samples were analyzed using AMS. The chemical analysis data, XRF analysis was used ITRAX, TC, TN is a Thermo Flash 2000, TIC was analyzed by UIC Coulometer, TOC is the TIC value subtracted from TC. The biological data, diatoms assemblage, was observed under a microscope (ZEIZZ Primo Star) by making slides. The slides were made by sedimantation method in the setting container. Large and small climate changes have occurred since the Holocene and are recorded in the sedimentary layers. In order to understand this more accurately, will study the paleoclimate change in relation to diatoms assemblage and chemical data.

Session12: Geological records of ocean and ice sheet change from the Ross Sea

Petrography of gravel size clasts from IODP_exp374 drillcores (Ross Sea - Antarctica): implications for Miocene ice flows

Luca Zurli[1†], Matteo Perotti[1], Franco Talarico[1,2], Gianluca Cornamusini[1,6], Rob McKay[3], Laura De Santis[4], Denise Kulhanek[5], IODP Expedition_374 Scientists[5]

[1]University of Siena - Department of Physical, Earth and Environmental Sciences, Italy, [2]National Museum of Antarctica - University of Siena, Italy, [3]Antarctic Research Centre - Victoria University of Wellington, New Zealand, [4]Istituto nazionale di Oceanografia e Geofisica Sperimentale (OGS) - Trieste , Italy, [5]International Ocean Discovery Program - Texas A&M University, USA, [6]Centre of Geotechnologies - University of Siena, Italy

The International Ocean Discovery Program (IODP) Expedition 374 drilled five sites from the outer continental shelf to rise in the eastern Ross Sea (Antarctica) to investigate the West Antarctic Ice Sheet evolution during Neogene and Quaternary. Detailed petrographic investigation of gravel size clasts is a key tool to identify the source of those sediments and consequently the paleo-ice flow shifts during time. The high resolution clast logging involved the Early Miocene sequence of the drilling site U1521 in the Pennel Basin and the Late Miocene sequence of the site U1522, located in the Glomar Challenger Basin; more than 26.000 gravel size clasts were macroscopically identified, logged and grouped in seven major lithological groups: igneous rocks, quartz fragments, volcanic rocks, dolerite clasts, sedimentary rocks, meta-sedimentary rocks and metamorphic rocks. Moreover, 220 clasts were sampled for detailed petrographic and minero-geochemical analysis. Four major clasts assemblage changes have been recognized in the westernmost drilling site (U1521), marked by the variability in the basalt and dolerite abundance; the main lithological groups are the meta-sedimentary rocks (40-45%) and the felsic granitoids (30-40%). Petrographic analysis shows that granitoid rocks are dominated by isotropic, lightly porphyritic, monzo-granites to granodiorites, with rare foliated tonalites; the meta-sedimentary group is characterized by low- to medium-grade facies of meta-sandstones and meta-siltstones, with a weak thermo-metamorphic overprint. The sedimentary group have a wide variability, with quartz-arenites, sub-arkoses and limestones/meta-limestones. This lithological assemblage would be consistent with a source in the Transantarctic Mountains basement type; however, a local provenance from basement highs in the Ross Sea can not be excluded. In the easternmost studied site (U1522) the main lithological group is represented meta-sedimentary rocks (45-70%); secondly, felsic to mafic granitoid rocks are present (20-40%); two changes in the clast assemblage have been recognized, marked by the basalt abundance variations. Thin section analysis shows that meta-sedimentary group is composed by low- to medium-grade meta-sandstones and meta-siltstones, with a weak thermo-metamorphic overprint; rare high-grade metamorphic rocks are present (migmatitic gneisses). Igneous rocks are mainly composed by monzo-granites, granodiorites and tonalites, with rare gabbros; porphyries are also present, with rhyolitic composition more common than syenitic ones. Dolerites are rare and basalt clasts are common; the sedimentary group is less represented and is mainly composed by quartz-arenites and limestones. The Late Miocene sequence of the site U1522 shows a quite different clasts assemblage compared to the Early Miocene assemblage of the site U1521. Further detailed petrographic analyses and the characterization of minero-geochemical composition of granitoid and basalt clast minerals are needed to better identify the source of clasts.

A431

Session12: Geological records of ocean and ice sheet change from the Ross Sea

LATE QUATERNARY PALEOENVIRONMENT AND PALEOCLIMATE OF THE NORTHERN DRYGALSKI BASIN (ROSS SEA, ANTARCTICA) USING MICRORGANISM ASSEMBLAGES AND SEDIMENT CHARACTERISTICS: PRELIMINARY RESULTS

Fiorenza Torricella[1†], Romana Melis[2], Ester Colizza[2], Alessio Di Roberto[3], Andrea Gallerani[4], Federico Giglio[4], Paul Albert[5]

[1]Dipartimento di Scienze della Terra, Univerisit?degli Studi di Pisa, Italy, [2]Dipartimento di Matematica e Geoscienze, Universit?degli Studi di Trieste, Italy, [3]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Pisa, Italy, [4]Consiglio Nazionale delle Ricerche-Istituto di Scienze Marine (CNR-ISMAR), Bologna, Italy, [5]School of Archaeology, University of Oxford, England., United Kingdom

Diatoms are one of the major phytoplankton groups blooming in cold, nutrient rich regions, such as Antarctica, where silica contribution is not limited. High diatom productivity together with good preservation in Antarctica marine sediments, allow using diatoms to study the late Quaternary paleoceanographic and paleoclimate changes. Foraminifers too, are known as useful tools to interpret palaeoenvironmental changes related to the glacial history in Antarctic areas.
We present a study of diatoms assemblages associated to the sedimentological and compositional characteristics in two piston cores collected in the northern Drygalski Basin (Western Ross Sea) in the framework of the PNRA-Project TRACERS (TephRochronology and mArker events for the Correlation of natural archives in the Ross Sea), Antarctica. Core TR1703_PC is characterized by muddy sand alternating to sandy mud whit some levels containing abundant foraminifers. Two distinct tephra layers are present along this core. Core TR1704 _PC is characterized by sandy silt alternating to clayey silt. Four tephra layers have been described in the sediment sequence Preliminary data allows to recognizing three different facies. Facies 1 is a glaciomarine diamicton present at the bottom of both cores. Facies 2, which represents a transition from glacial to open sea environments, is recorded in core TR1703_PC, only. Facies 3, recognized at the top of both cores, represents open water environmental conditions with evidences of seasonal sea ice, as suggested by the significant presence of Fragilariopsis curta and Actinocyclus actinochilius, subordinately. The benthic foraminifer distribution suggests a repetitive variation from sub-ice-shelf and grounding-zone proximal settings conditions, culminating with the ice-shelf collapse.
Physical (magnetic susceptibility) and chemical-geochemical (organic and total carbon, major and trace elements) analyses support the results.

A021

Session16: Significance of Antarctic Inland Freshwater Bodies - Revealing Past Processes and Projecting Responses to Change

Hydrochemistry, mass balance and ice-cover dynamics of Lake Untersee (Queen Maud Land).

Benoit Faucher[1]
[†], Denis Lacelle[1], David Fisher[2], Nicole Marsh[2], Ian Clark[2], Dale Andersen[3], Christopher McKay[4]

[1]Department of Geography, Environment and Geomatics, University of Ottawa, Canada, [2]Department of Earth and Environmental Sciences, University of Ottawa, Canada, [3]Carl Sagan Center, SETI institute, USA, [4]NASA Ames Research Center, USA

Lake Untersee (-71.342°S, 13.479°E) is a large perennially ice-covered lake in central Queen Maud Land, East Antarctica (Stackebrandt, 1995; Schwab, 1998). The largest freshwater lake in the region and with a local climate dominated by intense evaporation and sublimation but with little melt (Andersen et al., 2015), Lake Untersee has physical characteristics that are quite different from other perennially ice-covered lakes around the continent: 1) it does not develop a moat during the summer; 2) there is no evidence of surface melt flowing into the lake; and 3) little is known about the modern water hydrochemistry mass balance of the lake. Toward understanding the potential impacts of climate change upon ecosystem structure and function within Lake Untersee, the focus of this study is to: 1) investigate the energy and water mass balance of the lake and its ice cover; 2) examine the hydrochemistry of the lake water and ice cover; and 3) develop a model of evolving lake water hydrochemistry. Preliminary results indicate that: 1) ice cover thickness ranges from 1.9 to 3.9 m; 2) water loss occurs mainly through sublimation of the ice cover at rates ranging from 16-93 cm yr-1; 3) between 60 and 80 % of the lake's water input comes from englacial meltwater (Anuchin Glacier); 4) lake water has distinct chemistry with δD-δ18O values plotting above the global meteoric water line (confirming the closed nature of the lake). Our ongoing research efforts will improve our understanding of the inherent effects of local climate and climate change on the hydrochemical and physical dynamics of surface lakes across the Antarctic continent.

References:

Andersen, D. T., McKay, C. P., and Lagun, V. (2015): Climate conditions at perennially ice-covered lake untersee, East Antarctica. J. Appl. Meteorol. 54, 1393–1412. doi: 10.1175/JAMC-D-14-0251.1

Stackebrandt, W. (1995): Moraines around Lake Untersee - indicators of the Late-Quaternary regional glacial history. - In: Bormann, P. & Fritzsche, D., (eds.): The Schirmacher Oasis, Queen Maud Land, East Antarctica, and its surroundings: Gotha, 237-242.

Schwab, M. J. (1998): Rekonstruktion der spatquartaren Klima- und Umweltgeschichte der Schirmacher Oase und des Wohlthat Massivs (Ostantarktika). Ber. Polarforschung 293: 1–128

A221

Session16: Significance of Antarctic Inland Freshwater Bodies - Revealing Past Processes and Projecting Responses to Change

Change at 85 Degrees South: Heekin Valley Proglacial Lakes from 1960 to 2018

Melisa Diaz[1], Christopher Gardner[1†], David Elliot[1], Byron Adams[2], W. Berry Lyons[1]

[1]School of Earth Sciences and Byrd Polar and Climate Research Center, The Ohio State University, USA, [2]Department of Biology and Evolutionary Ecology Laboratories, Brigham Young University, USA

Over the last two decades, anomalous warming events have drastically altered coastal Antarctic regions. A two week melt event during December 2001 – January 2002 in the McMurdo Dry Valleys resulted in a lake level increase of 0.65 m in Lake Fryxell, a 600% increase from the 30-year average increase of 0.09 m yr-1. While dramatic warming events have been documented across the Ross Sea region, the Antarctic interior has been believed to be buffered from these events. Lake Wilson is a prominent exception. Once believed to be the world's southern-most lake (80° S), Lake Wilson experienced a lake level increase of 25 m from 1975-1993, which was quasi-synchronous with lake level increases in the McMurdo Dry Valleys. In this work, we present data from a series of small proglacial lakes located in Heekin Valley (85° S, 177° W) along the Shackleton Glacier in the Transantarctic Mountains. We photographed and sampled the lakes in January 2018 and compared these images and water chemistry to previous data from 1996. Additionally, we include aerial photography from 1960 and newer satellite imagery from 2009 to 2018. We compared the areal change of the lakes to the discharge of the Onyx River in the McMurdo Dry Valleys, the longest river in Antarctica, with an annual discharge record reaching back to 1969. We found that areal changes in these lakes are not synchronous with the Onyx River meltwater volume, as a refilling event in the Heekin lakes in 2012 does not correspond to a large melt event in the Dry Valleys. Additionally, lake areas increased since 1996, and the water-soluble ion chemistry indicates a freshening of lake water, likely from increased glacial melt as illustrated by stable isotopes of water. These changes will be used to back-calculate potential glacier melt rates to understand and predict how high southern latitude ice-free regions respond to climate change.

A410

Session16: Significance of Antarctic Inland Freshwater Bodies - Revealing Past Processes and Projecting Responses to Change

Spatiotemporal Heterogeneity of Climatic Controls on Snow Persistence on the Lakes of Taylor Valley, east Antarctica and Implications for Primary Productivity

Maddie Myers[1†], Peter Doran[1], Krista Myers[1]

[1]*Louisiana State University, USA*

Snow accumulation on McMurdo Dry Valley (MDV) lake ice reduces Underwater Photosynthetically Active Radiation (UWPAR) and acts as an ecological disturbance. Although annual snowfall values in the MDVs are low (3 to 50 mm water equivalent), trends of increasing snowfall and persistence under future warming conditions could amplify the local impact. Here, we present a new record of the spatiotemporal heterogeneity of climatic controls on precipitation and persistence throughout Taylor Valley, east Antarctica from land-based automated weather stations (AWS), high-resolution satellite imagery, and camera data. Multiple regression analysis of AWS data and photographs suggest once snow has accumulated on the lake ice, meteorological controls on snow persistence vary between lake and by time of year. The correlation is greatest near the coast and decreases inland. Data also suggest the importance of the thermal properties of the lake ice in maintaining a snow cover. We observe an increase in annual snow persistence at Lake Hoare by about 7 days per year since 2008 and attribute the increase to increased spring/fall precipitation. Although inherently lower, summer snow persistence appears to follow a different trend. More work is required for attribution. Lake ecosystems are well shade adapted and punctuated snowcover during peak annual radiation is unlikely to have broad implications for net primary productivity. Conversely, increased snowcover during low solar angles could have a lasting impact on early- and late-season productivity by shortening the UWPAR season. It is therefore necessary to understand the variability of climatic drivers on the MDVs in order to accurately project the ecosystem response to climate-induced changes in snow cover.

A425

Session16: Significance of Antarctic Inland Freshwater Bodies - Revealing Past Processes and Projecting Responses to Change

GEOELECTRIC SURVEY TO STUDY THE AQUIFER FORMATIONS NEAR THE PERUVIAN ANTARCTIC STATION OF MACHU PICCHU, KING GEORGE ISLAND, MARITIME ANTARCTICA

Antonio Correia[1†], Wai Cutipa[2], Luis Cornejo[2], Esteban Falcon[3], Pedro Mendes[1]

[1]University of Evora, Evora, Portugal, [2]Instituto Geologico Minero y Metalurgico, Lima, Peru, [3]Instituto Antartico Uruguayo, Montevideo, Uruguay

Under the framework of the projects Hydrotomo and Hydroperma of the Portuguese Polar Program, and the Peruvian Polar Program, and the Uruguayan Antartic Program, a geoelectrical survey using electrical resistivity imaging was started in January 2018 near the Peruvian Antarctic Station of Machu Picchu, located in the Admiralty Bay of King George Island of the South Shetland Islands archipelago. In February 2019 a new geoelectrical survey was carried out to include areas that were not covered by geoelectrical profiles in 2018. The main objective of both surveys was to try to delineate the geoelectrical structure of the aquifer that provides water for domestic use to the station; in particular, we were interested in finding the aquifer's lateral and depth extensions so that a water volume could be estimated and a better exploration and exploitation plan could be devised; furthermore, since the station is located a few meters from the cost, the work also aimed at identifying areas of possible saline intrusion. Machu Picchu Antarctic Station is a temporary station that is open during the antarctic summer only; however, there are plans to transform it in the future into a permanent station which implies a more rigorous aquifer management. The study area (about 90,000 m2) presents glacial, alluvial-glacial, alluvial, alluvial-fluvial, and marine sediments (mostly sandy gravels with some silty gravel layers); the area where the aquifer is believed to exist was covered by several electric resistivity tomographies with lengths that varied from 100 to 300 m long. Hydrogeologic data were obtained from piezometers located within the area where electrical resistivity tomographies were carried out; water samples from the piezometers have electrical resistivity values ranging from 25 to 50 Ω.m. Preliminary processing of the geoelectric data (apparent electrical resistivity pseudosections) obtained along different directions indicates that several tomographic profiles crossed the aquifer which appears to be several meters deep; the bedrock is deeper than 60 m. The aquifer formation presents electrical resistivity values that range from about 100 to 400 Ω.m. A preliminary geoelectrical model of the aquifer is under construction.

A034

Session18: Antarctic sea ice variability and ice shelf processes

Characterization of ocean mixing during the 2017 Weddell Polynya event

Jhon Mojica[1†], Daiane Faller[1], Diana Francis[1], Clare Eayrs[1], David Holland[2]

[1]Center for global Sea Level Change (CSLC) New York University Abu Dhabi (NYUAD), UAE, [2]Courant Institute of Mathematical Science (NYUNY), USA

This study aims to characterize the internal structure of the ocean layer in the Weddell Sea Polynya area for the period 2015-2018 through in situ observations and ocean model reanalyzes results. In particular, diapycnal and isopycnal mixing processes were mainly developed over the Maud Rise leading the exchange of properties in the water column. The vertical structure was variable showing a relevant weak stratification during the recording period while over the Northern Maud Rise areas there is a stable layer between 80 – 180 m depth. This layer works as a boundary layer, where energy is storage blocking the warm sub-surface waters influence but remains evidence of convective processes.

A study was performed to isolate the role of the Maud Rise in the observed structure. Comparing in situ data with reanalysis results it was founded that similar features are observed as the increment of potential density, the location of an energy reservoir layer, and the incidence of lateral convection. Those are mainly driven by the salinity, the weak stratified structure and the incidence of the Weddell Gyre respectively. All together works as the ocean preconditioning to develop and maintain the polynya event. Another remarkable feature is the warmer surface summer layer, which transfers heat to intermediate layers where the energy is stored. This exchange of energy is quantified through the heat flux between the waters layers, allowing us to quantify the amount of energy storage at intermediate water to help in the development of the 2017 Polynya event.

A054

Session18: Antarctic sea ice variability and ice shelf processes

Particulate matter in the polynya of Terra Nova Bay in the western Ross Sea: record of 2014 to 2016

Boo-Keun Khim[1†], Hyeong Jeek Kim[2], Kyu-Cheul Yoo[3], Hyun Cheol Kim[3], Kota Katsuki[4], Sunghan Kim[2], Sangbeom Ha[1]

[1]Pusan National University, Korea, [2]KIOST, Korea, [3]KOPRI, Korea, [4]Shimane University, Japan

The Terra Nova Bay in the western Ross Sea is bound to the south by the Drygalski Ice Tongue originating from David Glacier and acting as a physical barrier by preventing the northward drifting of pack ice. The Terra Nova Bay is also characterized by the completely ice-free area by the katabatic winds originating over the Antarctic continental plateau and blowing persistently offshore, which maintains the polynya open by moving the sea ice eastward. KOPRI mooring system has been operated at Site X1 (74º50.27'S, 166º15.89'E, 1,050 m) during March 2014 to Dec. 2016 in the trough of Drygalski Basin of the Terra Nova Bay. The bottom-tethered mooring system was deployed at 250 m below sea level (mbsl) at Site X1, consisting of a 13-cup time-series sediment trap. However, sediment trap system was not operated during a year of 2015 and couple of months of 2016 due to the malfunction and unknown reason. Total mass and biogenic opal flux of sediment trap particles show the distinct seasonal change; high during March and April and low during the rest of year. The seasonality of biogenic opal flux was supported by the δ13C and δ15N values of organic particles as well as the diatom flux. In particular, the abundance peak of Chaetoceros spp. resting spore occurred in the late Jaunary whereas Fragilariopsis curta was highest in late March to April. Biogenic opal flux occupies more than half of total mass flux, indicating that the seasonal diatom bloom is a key process to contribute to the biogenic opal composition. Particularly, more than 80% of total mass flux occupied biogenic opal flux during the late March in 2016, representing that the extremely increased bloom occurred during a very short time. Although variation of CaCO3 and organic carbon flux follows the similar seasonal pattern, these fluxes were still high during May. It is of note that the peak of CaCO3 flux was delayed by the peak of biogenic opal flux, which implies successive blooming of biogenic component. In addition, all these flux data are characterized by the inter-annual variation. For example, total mass flux of late March in 2016 is higher by three times than that in 2014, despite the comparison of only two years. The seasonal and inter-annual changes of particulate matter flux are closely related to the degree of primary productivity, ice cover dynamics, and hydrographic conditions in the polynya of Terra Nova Bay.

A275

Session18: Antarctic sea ice variability and ice shelf processes

Operational iceberg A68 monitoring with remote sensing and information services

Hyangsun Han[1†], Sungjae Lee[1], Jae-In Kim[1], Hyun-cheol Kim[1]

[1]*Korea Polar Research Institute, Korea*

Iceberg A68 is a supersized iceberg that calved from Larsen C Ice Shelf in July 2017. The area of Iceberg A68, when it was calved from the ice shelf, was about 5800 square kilometers which accounts approximately for 12% of the area of Larsen C Ice Shelf. Iceberg A68 is currently the largest iceberg in Antarctica. Due to the split with Iceberg A68, the flow velocity of Larsen C Ice Shelf may change, which can change the oceanic outflow of the ice sheet and cause a change to the sea level. In addition, the occurrence of a supersized iceberg can affect the surrounding marine ecosystem and the sea ice forms, so continuous and constant monitoring for the iceberg is necessary. The Korea Polar Research Institute (KOPRI) have monitored Iceberg A68 and the changes in the surrounding environment by using satellite remote sensing and provided the iceberg information from the satellites through a web-based services (http://kosmos.kopri.re.kr/). High-resolution SAR image enables precise surface observation without being affected by weather conditions and sun altitudes. Changes in the area and drift of Iceberg A68 are monitored by using Sentinel-1 and KOMPSAT-5 SAR images. The split with iceberg A68 may result in a change in the ice flow velocity of Larsen C Ice Shelf. The flow velocity of Larsen C Ice Shelf is monitored by offset tracking of Sentinel-1 SAR images. Using CryoSat-2 altimetry observations, changes in the thickness of iceberg A68 is monitored. The thickness is estimated by using the freeboard height of the iceberg observed monthly through the satellite altimeter. The web-based services of the iceberg information from satellite remote sensing can be used in various research fields such as predicting global environmental change, sea-level change, oceanography, biology, and glaciology.

A336

Session18: Antarctic sea ice variability and ice shelf processes

Beryllium-10 concentration of West Antarctic marine sediments and its relationship to ice shelf ocean circulation and depositional environments

Matthew Jeromson[1]
[†], Toshiyuki Fujioka[2], David Fink[2], Krista Simon[2], Alexandra Post[3], James Smith[4], Marcello Bl axell[1], Simon Foster[1], Duanne White[1]

[1]Institute for Applied Ecology, Faculty of Science and Technology, University of Canberra, Bruce, ACT 2617, Australia, Australia, [2]Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, NSW, 2234, Australia , Australia, [3]Geoscience Australia, Symonston, ACT, 2609, Australia, Australia, [4]British Antarctic Survey, High Cross, Madingley Road, Cambridge CB3 0ET, UK, United Kingdom

Ice shelves play an important role in regulating the rate at which ice sheets flow into the ocean. The development of proxies from modern ice shelves is imperative for developing reconstructions of ice shelf history, and for improving the parameters of models for the future. In this study, we assess the environmental factors affecting the deposition of meteoric beryllium-10 in ice shelf environments by measuring 10Be concentrations in open water Antarctic shelf sediments and sub-ice shelf environments. Concentrations of 10Be were determined using accelerator mass spectrometry following a 6M hydrochloric acid leach. Preliminary results for West Antarctic ice shelves show that 10Be concentrations vary by up to two orders of magnitude between ice shelves. Variations within the same system, however, are much lower. The HCl extractable 10Be concentrations from open marine environments tend to be higher than sub-ice shelf environments within or proximal to the same system. The 10Be values beneath the ice shelf vary in a non-linear way relative to the calving margin. The 10Be concentrations beneath the ice shelf may reflect complex circulations patterns, with a general decrease in concentration along sub-ice shelf current flow paths. The association between 10Be concentrations and sub-ice shelf current flows may provide a proxy for determining palaeo-circulation patterns in down core sediment records. The enrichment of 10Be in open water relative to sub ice shelf samples may provide a proxy for reconstructing past ice shelf configurations.

A338

Session18: Antarctic sea ice variability and ice shelf processes

Arctic sea ice thickness retrievals from CryoSat-2: seasonal and interannual comparisons of three different products

Mengmeng Li[1], Chang-Qing Ke[2†], Hongjie Xie[3], Xin Miao[4], Xiaoyi Shen[1], Wentao Xia[1]

[1]School of Geography and Ocean Science Nanjing University, China, [2]School of Geography and Ocean Science Nanjing University,Collaborative Innovation Center of Novel Software Technology and Industrialization,University Corporation for Polar Research, China, [3]Department of Geological Sciences University of Texas at San Antonio, USA, [4]Department of Geography Geology and Planning Missouri State University, USA

As a fundamental climate state variable, sea ice thickness (SIT) has exhibited a declining trend over the past several decades. Here, we present a quantitative comparison of three CryoSat-2 (CS-2) SIT products from the Alfred-Wegener-Institute (AWI), the National Snow and Ice Data Center (NSIDC), and the European Space Agency (ESA) during the growth season (October to April) from 2010 to 2018 with Operation IceBridge (OIB) data. The results show that the NSIDC SIT product is the closest to the OIB SIT, with ESA SIT exhibiting the highest bias. During each growth season, the SIT differences between AWI and NSIDC gradually decrease, while such differences between ESA and NSIDC increase for first-year ice (FYI) and decrease then increase for multiyear ice (MYI). The difference between ESA and NSIDC is larger than that between AWI and NSIDC. Moreover, the rather large differences between ESA and NSIDC are mainly located in thin ice areas. The mean SIT in the data release area (DRA) continually decreased from 3.02 m to 1.47 m from the submarine era (1958-1976, 1993-1997) to the ICESat period (2003-2007); however, the continuous decline trend is interrupted by the variability during the CS-2 period (2010-2018). The variability rate in NSIDC SIT over the CS-2 period is rather small, with values of 0.01 m yr-1 and 0.03 m yr-1 in winter and fall, respectively. The sources of the differences in SIT between the products mainly originate from the sea ice density and freeboard retrieval methods. The choices of different waveform retrackers and threshold assignments significantly influence the MYI freeboard retrievals due to the relatively thick snow depth and high surface roughness over MYI.

A133

Session19: Tropical-Polar teleconnection and Antarctic climate change

Anomalous heat fluxes over Indian Ocean in association with the Arctic Oscillation during boreal winter

Yi Chen[1], Dao-Yi Gong[1†]

[1]*Beijing Normal University, China*

In the study authors analyzed the inter-annual relationship between the Arctic Oscillation (AO) and the western tropical Indian Ocean(TIO) net surface heat flux in boreal winter. After removing the EI Nino/Southern Oscillation(ENSO) signal, the AO index is significantly correlated with the regional mean net surface heat flux of the western TIO(5°S-10°N and 50°-65°E), r=0.46. By diagnosing the heat flux sub-items, it is clear that this change under the influence of AO is mainly achieved by the latent heat flux. Further linearizing the heat flux anomalies, relative importance among observed anomalies in sea surface temperature, surface air temperature, and wind in determining the anomalous latent heat flux is assessed. And the relative importance of wind direction and speed on latent heat flux variability is determined. Specifically, during positive AO winters, the northern wind anomalies appear in western TIO, meaning that the winter monsoon tends to strengthen. The enhanced wind carries water vapor away from the sea surface, which is conducive to more release of latent heat. AO plays an important role in wind, which is achieved by atmospheric Rossby waves. However, the significant link between AO and net heat flux is modulated by ENSO to some extent. During the warm phase of ENSO, over western TIO region the winter monsoon becomes weaken and then decreases the contribution of latent heat flux to net heat flux. The decline of winter monsoon is supported by the atmospheric circulation changes related to inhibition of convection in the western Pacific warm pool. During the cold phase of ENSO, the result reverses.

A151

Session19: Tropical-Polar teleconnection and Antarctic climate change

Unstable Interannual relationship between Arctic Oscillation and Indian Ocean During Boreal Winter: Different Regimes of Air–Sea Interaction

Yiwen Shi[1], Daoyi Gong[1†]

[1]*Beijing Normal University, China*

The interannual relationship between Arctic Oscillation (AO) and Indian Ocean Sea Surface Temperature (SST) during boreal winter is investigated, using monthly data from 1950-2017. The SST anomalies can induce anomalous convection through triggering surface evaporation and moisture flux convergence. Anomalous atmospheric convection can further exert a significant feedback on SST from cloud-radiation, wind-evaporation effect and wind-induced oceanic mixing and upwelling. This two-way interaction scenario suggests that the SST anomalies caused by AO over the Indian Ocean may partly arise from the local atmosphere-ocean interaction. In this study, define the Indian Ocean March SST anomaly minus January SST anomaly as SST tendency, indicating the relative importance of the SST and atmospheric forcing in the SST-atmospheric correlation. After removing the El Nino and Indian Ocean dipole signals, it is found that the AO-SST tendency relationship displays remarkable decadal variations in the late 1960s and the 1990s. For the most significant negative correlation region over 10°S-20°S, 60°E-80°E, their relationship displays pronounced differences among the three periods of 1950-1967, 1968-1994 and 1995-2017. To understand the roles of different processes in producing SST changes, the present study identifies three distinct regimes of local air-sea interactions for the three periods, and analyses the associated atmospheric and oceanic circulations caused by AO as well as their contribution to SST anomalies during boreal winter.

A198

Session19: Tropical-Polar teleconnection and Antarctic climate change

Increasing difference of surface air temperature between Eastern Antarctica and Antarctic Peninsula in future climate : A multimodel ensemble analysis

Rui Mao[1†], Seong-Joong Kim[2], Daoyi Gong[1], Xiaohong Liu[3], Xinyu Wen[4], Liping Zhang[7], Qi Zong[1], Feng Tang[5], Cunde Xiao[1], Minghu Ding[6], Sang-Jong Park[2]

[1]State Key Laboratory of Earth Surface Processes and Resource Ecology, Faculty of Geographical Science, Beijing Normal University, Beijing 100875, China, China, [2]Korea Polar Research Institute, Incheon 406-130, Korea, [3]Department of Atmospheric Science, University of Wyoming, Laramie, WY 82071, USA, [4]Department of Atmospheric and Oceanic Sciences, School of Physics, Peking University, Beijing 100871, China, [5]Xinhua Middle School, Shenzhen 518000, China, [6]Institute of Polar Meteorology, Chinese Academy of Meteorological Sciences, Beijing 100081, China, China, [7]GFDL, USA

The principal pattern of surface air temperature (SAT) over Antarctica is indicative of influence of large-scale climatic factors on Antarctic climate. Using empirical orthogonal function (EOF) analysis and simulations of 21 models in the Climate Model Intercomparison Project 5 (CMIP5), changes in the principal pattern of austral summer SAT (December to February) from 1979-2099 over Antarctica are examined at an interannual time scale. The CMIP5 shows a dipole structure of the EOF of SAT anomalies during 1979-2004, i.e., a large area of negative ones over high plateau and coastal regions of Eastern Antarctica (EA) and a small area of positive ones over Antarctic Peninsula (AP). This pattern is evidenced by EOF analysis on the SAT from the Reference Antarctic Data for Environmental Research (READER) project and the European Centre for Medium-Range Weather Forecasts Interim Reanalysis dataset. Moreover, under the representative concentration pathway 8.5 scenario, the dipole structure of SAT anomalies derived by the CMIP5 is more intense in the 2051-2099 than 1979-2004, revealed by a larger difference of anomalies in the EOF between AP-Weddell Sea and EA in 2051-2099. The enhanced dipole structure of SAT anomalies in the EOF indicates a larger SAT difference between EA and AP-Weddell Sea in the future warming scenario, which is associated with negative geopotential height anomalies over EA and the Amundsen Sea and positive height anomalies over the east of the Weddell Sea at 850 hPa level in the troposphere. The negative height anomalies over the Amundsen Sea and positive height anomalies over the East of Weddell Sea mean greater onshore flow of warmer maritime air over the Peninsula and to the west of the Weddell Sea, which will increase SAT there. Meanwhile, the negative height over the EA indicate a weaker pressure gradient between EA and middle latitudes, which induces a cooler SAT over EA because of a weakening in the strength of the katabatic flow over the continent. These findings imply that although SAT over Antarctica will be increased in the future, the large difference of SAT between EA and AP may usually occurs on an interannual time scale.

A203

Session19: Tropical-Polar teleconnection and Antarctic climate change

A numerical simulation of a strong wind event in January 2013 at King Sejong station, Antarctica

Hataek Kwon[1], Sang-Jong Park[1], Solji Lee[1], Baek-Min Kim[2], Seong-Joong Kim[1†]

[1]Korea Polar Research Institute, Korea, [2]Pukyong National University, Korea

A strong wind event (SWE), so-called “severe gale”, with a 10 min average wind speed of above 22m/s occurred on 7 January 2013 at the King Sejong station (KSJ) on the tip of the Antarctic Peninsula (AP). We examine the cause of the SWE and assess the short-term predictability of such an event, using the state-of-the-art Polar Weather Research and Forecasting (Polar WRF) model. The simulation results, initialized at 0000UTC 6 January 2013, the day prior to the occurrence of the SWE, produce the most accurate representation of the SWE in terms of strength (~94% of the peak wind speed). Both model results and observational records reveal that the SWE ismainly caused by the approach of a deep depression with the central pressure of 950 hPa. On top of this synoptic configuration, a particular shape of topography of the AP plays a non-negligible role for further intensification of the wind at KSJ. As the cyclone approaches theAP, the sea-level pressure becomes lower and is deformed around the AP due to the topography, driving southeasterly winds traversing the AP.

The continuous flow overriding the AP generates a downslope windstorm at the lee side of the AP. The windstorm effect driven by the deformation of sea-level pressure by the topography of the AP is not properly represented in the coarser-resolution (27 km) model domain compared with higher (3 and 9 km) resolutions. We conclude that the SWE at KSJ on 7 January 2013 is caused by the combined effect of a synoptic-scale low-pressure system with local topography of the AP.

A240

Session19: Tropical-Polar teleconnection and Antarctic climate change

Performance of Amundsen Sea Low Variation in CAS FGOALS-f2 Model

Jing Yang[1†], Shan Xu[1], Sicheng He[1]

[1]*Beijing Normal University, China*

Since Amundsen Sea Low (ASL) plays a crucial role in Antarctica climate variation, its realistic simulation is necessary for the prediction & projection of Antarctica climate. Based on both absolute and relative central pressure, the performance of ASL is comprehensively evaluated in the new released CAS FGOALS-f2 model compared with CMIP5 models. First, the annual cycle of ASL intensity can be well reproduced in FGOALS-f2 as well as most of CMIP5 models, with its minimum/maximum amplitude in austral winter/summer. However, the semiannual variation of ASL intensity with two maximum absolute intensity respectively in January-December and June almost failed to be exhibited, which is only captured by MIROC5 model. The seasonal variation of ASL location, which features westward shift in austral summer and southward migration in austral winter, is well identified by CAS FGOALS. In addition, ASL exhibits a significant decreasing trend of 1.2hPa decade-1 in austral summer in the period of 1980-2000, which is only caught by MIROC4h and CCSM4 with statistically insignificance.

A280

Session19: Tropical-Polar teleconnection and Antarctic climate change

Dynamical mechanisms of the poleward intensification of the southern hemispheric westerlies during the Last Glacial Maximum

Joowan Kim[1], Hyeong-Gyu Kim[1], Sang-Yoon Jun[2†], Seong-Joong Kim[2]

[1]Kongju National University, Korea, [2]Korea Polar Research Institute, Korea

Structures of the southern hemispheric westerly during the Last Glacial Maximum (LGM) are examined using a general circulation model (GCM). The GCM simulation with the standard LGM forcings reproduces the tropospheric cooling and stratospheric warming reasonably. Partic-ularly, an enhanced cooling over Antarctica and the poleward intensification of the southern hemispheric westerlies are clearly observed in the LGM simulation compared to the preindustrial run, which are also reported in many Paleoclimate Modelling Intercomparison Project (PMIP) simulations. The poleward intensification of the tropospheric westerlies is well explained by an enhanced meridional temperature gradient due to the Antarctic amplification of cooling com-pared to the mid-latitude regions. The same but a stronger intensification of the westerlies are found in the stratosphere, which is largely driven by combined impacts from the tropospheric and stratospheric cooling over the Antarctic region. This Antarctic cooling in the stratosphere is well coupled with weakened poleward heat flux and slowdown of the stratospheric overturning circu-lation. However, this stratospheric cooling is only observed in prescribed-SST (atmosphere-only) simulation, while tropospheric cooling is robustly simulated in both atmosphere-only and ocean coupled simulations.

A451

Session19: Tropical-Polar teleconnection and Antarctic climate change

A reconstruction of the ASL intensity using multiple linear regression model during 20th century

Chang-Kyu Lim[1], Joo-Hong Kim[2†], Seong-Joong Kim[1]

[1]Division of Polar Climate Sciences, Korea Polar Research Institute, Korea, [2]Unit of Arctic Sea-Ice Prediction, Korea Polar Research Institute, Korea

In recent decades, West Antarctic has experienced extremely climate change with increase temperature in Antarctic Peninsula and change sea ice. The Amundsen Sea Low (ASL) is climatological low system in Antarctic. ASL is major factor of West Antarctic climate change such as warming in Antarctic Peninsula and loss of Bellinghausen sea ice but increase of Ross sea. So in understanding the Antarctic climate, ASL has the same importance as Antarctic Oscillation (AAO). Past climates studies can reduce the uncertainty of future forecasts (Henderson et al., 2009). In other words, the reason for studying the changes of the ASL in the past twentieth century is that the understanding of the past can reasonably predict the future. However, because the history of observations in-situ is not long, it is difficult to understand the past through observation data. so, in this study we chose a statistical approach based on teleconnection with ASL to overcome this problem. And we conducted a multi-linear regression model to reconstruct the past of ASL intensity. Three reanalysis data to be used in this statistical models have been selected such as JRA-55 of JMA, ERA-40 of ECMWF, and NCEP reanalysis 1 of NCEP. The CRUTEM4, HadSLP2, HadSST3 data from Met Office is suitable for use as predictor because it provides monthly average of 5° by 5° grid from data observed at ground stations, ships and buoy since 1850. As the first step in the construction of the statistical model, the central pressure of the ASL was calculated from the reanalysis data for each available period. According to the previous study of Hosking et al., the lowest MSLP in the sector of 60°S ~ 80°S and 170°E ~ 298°E was calculated as the central pressure of the ASL. The calculated central pressure showed a tendency to increase the central pressure of the ASL in all seasons. In the next step, the predictor domain was determined from the observed data. In the predictor domain, the grid box was drawn around the area with the highest correlation through the correlation analysis between the average of central pressure of the ASL from the reanalysis data and each weather field such as sea air temperature, sea surface temperature, sea level pressure and we calculated a representative value for each weather variable of area through spatial average. The predictor candidates determined for all season. Finally steps, the model training was conducted for the period 1958 to 2000 with the central pressure of the ASL obtained from three reanalysis data such as JRA-55, ERA-40, NCEP reanalysis 1 because this period is reliable due to a lot of points of observation assimilated to reanalysis data.

The ASL intensity reconstructed from statistical models was compared to the central pressure calculated from the 20th century reanalysis data such as ERA-20C and NCEP 20th. The reconstructed central pressure tended to increase in all seasons and was almost consistent with the tendency of 20th century reanalysis data. Especially, in the SON season, the reconstructed central pressure was stronger than the 20th century reanalysis data.

We also constructed each reanalysis data with 1000 ensemble members through random sampling within error range of observed data and examined long-term trend of whole ensemble. The results of reconstruction show that ASL had deepened during 20th century. In addition, there was deepening trend of ASL at 95% significant level in austral spring season.