L3 **Monitoring the Ross Ice Shelf: Deep Clustering of Antarctic Seismic Data** (supplemental poster)

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In this study, a form of unsupervised machine learning is applied to seismic data recorded by a 34-station broadband array on the Ross Ice Shelf (RIS), Antarctica from 2014-2017. The RIS seismic data contain signals and noise generated by many glaciological processes that are useful for monitoring the integrity and dynamics of ice shelves. Deep embedded clustering (DEC) automatically groups these signals into hypothetical classes without the need for manual inspection labeling, allowing for comparison of their signal characteristics and spatial and temporal distribution and their association with potential source mechanisms. Eight classes of dominant seismic signals were identified and compared with environmental data such as temperature, wind speed, tides, and sea ice concentration. The greatest seismicity levels occurred at the RIS front during the 2016 El Niño summer, and near grounding zones near the front throughout the deployment. We demonstrate the spatial and temporal association of certain classes of seismicity with seasonal changes at the RIS front, and with tidally driven seismicity at Roosevelt Island.

L4 **Evidence of Post-Stagnation Grounding Zone Retreat at Kamb Ice Stream**

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Antarctica's Ross Ice Shelf (RIS) represents a third of all floating ice on Earth by area. 12 tributary ice streams from both East and West Antarctica sustain RIS with 200 gigatons of ice annually, but ice flux from the Siple Coast streams are known to vary on decadal timescales. Notably, the downstream portion of Kamb Ice Stream (KIS) stagnated circa 1860 leading to accumulation of ice upstream in the KIS trunk, now one of the few positive mass balance regions in West Antarctica. To explore the sequence of events following KIS stagnation, in collaboration with Antarctica New Zealand we deployed a remotely operated underwater vehicle ~4 km downstream from the present KIS grounding zone (GZ) and flew a combined 5 km of survey tracks, up to one km from the hot water borehole. Below the 587 m thick ice, we observed a stratified water column, currents up to 13 cm/s, basal crevasses, and a predominantly meteoric ice base with a patch of sediment-laden basal ice. At the seafloor, banded impressions left by basal crevasses as the ice lifted off are interpreted as evidence of post-stagnation GZ retreat, and considering the present ice flow rate indicate the water column here began to form approximately 50 years ago. Within a basal crevasse we also observed active marine ice formation.

L5 **Discovery of Two Stacked Buried Ice Masses >1.1 Myrs Old; Ong Valley, Antarctica**

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We have collected a core from a debris-rich ice mass covered by a meter thick sublimation till in Ong Valley, Antarctica. Previous dating of the surficial till suggest an ice emplacement age of >1.1 Ma. The aim of this research is to determine its age more precisely, understand the overall history of the ice and evaluate its potential use as a paleoclimate archive.

We compare measured concentrations of cosmic-ray produced nuclides 10Be, 21Ne, and 26Al from the englacial debris with modeled concentrations, in order to constrain the age of the ice, the rates of surface erosion and ice sublimation that have persisted since the ice emplacement. In addition to the cosmogenic nuclide measurements, we have analyzed deuterium and oxygen isotopes in the ice core.

We find that sections of englacial debris downcore consist of both subglacially entrained debris and recycled surface debris having a complex exposure-burial history prior to entrainment. Our results

indicate an ice emplacement during the end of the Pliocene. Further, large increase of cosmogenic nuclide concentrations and $\delta^{18}O$ downcore suggests that the bottom of the core belongs to a separate, older ice mass that has previously been exposed at the surface and then buried during a younger glacial advancement into Ong Valley.

L6 Evidence of West Antarctica Sources for Dropstones and IRD in Amundsen Sea IODP379 Cores, Obtained from Multi-dating and Hf Isotopes

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IODP Expedition 379 cores contain dropstones and dispersed coarse, crystalline detritus recognized as ice-rafted debris (IRD). To establish provenance and gain information about variations in ice sheet extent ~6 – 0 Ma, we obtained zircon U-Pb and eHf isotope, apatite fission track (AFT), 40Ar-39Ar K-feldspar, & same-grain detrital apatite U-Pb & AFT data from IRD-rich sediments. We investigate whether IRD originated in the Thwaites-Pine Island Glacier catchment, other parts of West Antarctica (WANT), or distant East Antarctica (EANT). (IODP379 sites lie seaward of WANT coastal currents & within Antarctic Circumpolar Current; therefore the possibility of far-traveled IRD must be assessed.)

Mesozoic U-Pb and 40Ar-39Ar results fall within the span of magmatism & magmatic flare-ups within the Paleo-Pacific accretionary margin of WANT. U-Pb & 40Ar-39Ar data are not compatible with EANT Cambrian or older crust. Mesozoic detrital apatite U-Pb & Cretaceous AFT from the Pliocene IRD closely agree with published detrital hornblende 40Ar-39Ar & AFT data for WANT, while AFT accord with WANT onshore bedrock. We conclude that IODP379 IRD & dropstones derived mainly from subglacial bedrock of the Thwaites-Pine Island Glacier catchment, with occasional contributions from Antarctic Peninsula.

Thursday, July 15
Session M

M1 Discovery of an Antarctic Ascidian-associated Uncultivated Verrucomicrobia that Encodes Antimelanoma Palmerolide Biosynthetic Capacity

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The Antarctic marine ecosystem harbors a wealth of biological and chemical innovation that has risen in concert over millennia since the isolation of the continent and formation of the Antarctic circumpolar current. Scientific inquiry into marine natural products produced by Antarctic benthic invertebrates led to the discovery of a bioactive macrolide, palmerolide A (pal A). This compound holds considerable promise as an anticancer therapeutic. Although pal A was isolated from the Antarctic ascidian *Synoicum adareanum*, its biosynthesis was hypothesized to be microbially produced given conserved structural features. Through 16S rRNA gene assays we identified a core membership of bacteria that co-occur with the ascidian host, then using this information, metagenome sequencing, metabolome profiling and retrobiosynthetic predictions we identified a candidate gene cluster responsible for the biosynthesis of pal A. This study demonstrates the benefits of integrating interdisciplinary practices to understand host-microbe relationships while the findings pave the way to answering new questions about evolution, adaptation, and physiology of natural products and Antarctic symbioses. Likewise, the doors are now open to pursue a sustainable, biotechnological path of pal A production.