241-17 **BTH 123** Heroy, David Carlson

LAST GLACIAL MAXIMUM (LGM) ICE SHEET EXTENT AND GLACIAL RETREAT HISTORY OF ANTARCTIC PENINSULA; PRELIMINARY RESULTS FROM NATHANIAL B. PALMER 2002 CRUISE

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Recent models of maximum extent of ice during the Last Glacial Maximum (LGM) differ widely in terms of thickness and location of grounded ice in the Antarctic Peninsula region, largely due to a lack of adequate ground truth. In addition, the controls and timing of ice sheet retreat are poorly constrained. Such controls include both global (bipolar) forcing mechanisms such as eustasy and climate change, versus internal controls such as ice-bed interactions. It was the goal of the 2002 cruise of the Nathanial B. Palmer to obtain the necessary geological and geophysical data to study the maximum extent of the peninsula ice sheet during the LGM and the deglacial history of the region. During this cruise we obtained multibeam swath bathymetry, high-resolution 3.5 kHz seismic, deep tow side scan sonar, 62 sediment cores, and ~ 2200 km of seismic data to augment existing seismic and core datasets. Preliminary examination of these data reveal geomorphic evidence of grounded ice extending to the shelf break in many areas, such as mega-scale glacial lineations, grooves, drumlins, and line-sourced shelf break gullies. Preliminary analysis of multibeam data from Marguerite Bay Trough reveal interconnected channels interpreted as features created by subglacial meltwater. Sediment cores reveal till on the outer shelf in several locations, covered by ice sheet proximal gravely mud, and draped with glacial marine sediments. Long (> 12 m) sediment cores from Bransfield Basin provide important chrono-stratigraphic benchmarks for deglacial history in the region. Preliminary conclusions include more grounded ice in the region than previously believed, evidence of subice sheet meltwater channels, and no ice shelf over the Bransfield Basin during this time period.

241-18 **BTH 124** Briner, Jason

LAST GLACIAL MAXIMUM ERRATICS PERCHED ON ANCIENT TORS IN ARCTIC CANADA: IMPLICATIONS FOR ICE-SHEET DYNAMICS

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New cosmogenic isotope measurements from the northeastern margin of the Laurentide Ice Sheet (LIS) lead us to conclude that: 1) highly weathered landscapes cannot be used to argue against the presence of LGM ice, and 2) ice streams drained the LIS along northeastern Baffin Island during the LGM.

A long-standing debate over the reconstruction of former ice sheets revolves around the use of relative weathering of landscapes, i.e., the assumption that highly-weathered landscapes have not been recently glaciated. New cosmogenic isotope measurements from northeastern Baffin Island shed light on this debate. Average ^{10}Be and ^{26}Al ages for two tors on a ~500 m upland adjacent to the mouth of Clyde Inlet, a 150-km-long fiord that penetrates interior Baffin Island, are >66.9±5.1 ka and >62.1±1.8 ka (SL, >60 Be PR=5.1 atoms/g; Al PR=31.1 atoms/g). The tors, on local summits ~100 m above the highest lateral moraines and other clear signs of actively-eroding ice, are deeply weathered, exhibiting large weathering pits, grus, and quartz veins and knobs that stand in relief. Three erratics perched directly on the ancient tors have average ^{10}Be and ^{26}Al ages of 16.7±1.3 ka, 11.9±0.6 ka, and 10.5±0.8 ka.

These results suggest that non-erosive ice overran highly-weathered upland surfaces along the northeastern margin of the LIS during the LGM. These data invalidate the use of relative weathering to define LIS margins in the eastern Canadian Arctic, and possibly elsewhere, especially where perched blocks have been described on weathered upland surfaces along the fringes of Northern Hemisphere Pleistocene ice sheets. The proximity of non-erosive plateau ice to erosive fiord ice requires strong gradients in basal thermal regimes, suggestive of an ice-stream mode of glaciation. We propose that this style of glaciation dominated the fiord coastline of northeastern Baffin Island where the topography and glacial geology is similar to the Clyde region. Ice-stream-dominated ice-sheet margins are dynamic and unstable, and consequently, the northeastern margin of the LIS was probably involved in abrupt climate changes, especially those including the coupling of ice sheets and oceans (e.g., Heinrich Events).

241-19 **BTH 125** Johnston, John W.

LATE HOLOCENE QUASI-PERIODIC LAKE-LEVEL FLUCTUATIONS IN THE UPPER GREAT LAKES

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Sedimentological analysis of hundreds of beach ridges preserved in embayments along the upper Great Lakes coastline has greatly improved the understanding of past water-level fluctuations, vertical ground movement, and shoreline behavior over the past 5,000 years. Comparing several continuous overlapping relative lake-level records from multiple sites around a common lake permits the removal of vertical ground movement from each site to produce a combined hydrograph for the entire lake. The hydrograph provides a framework to study shorter-term fluctuations superimposed on longer-term fluctuations and, thus, a proxy for paleoclimate.

Three different superimposed quasi-periodic water-level fluctuations having average durations of approximately 33 years, 160 years, and 1,500 years have been identified in the hydrograph for Lake Michigan. Statistical analysis of 90 radiocarbon dates from five different study sites indicates that a 33-year water-level fluctuation forms a beach ridge and a 160-year water level fluctuation forms a group of beach ridges, commonly five in each group. The more qualitative 1,500-year water level fluctuation seems to correlate to the Nipissing II phase, Algoma phase, and an unnamed phase centered around 1,700 calendar years before present. Preliminary analysis of data from Lake Superior suggests these fluctuations also occurred in Lake Superior.

Evaluating past water-level fluctuations is difficult because of two complications: each water-level fluctuation is not equal in amplitude or period (quasi-periodic) and quasi-periodic fluctuations are superimposed on each other . These complications become very important when attempting to forecast water levels. A range in water-level amplitude and periodicity must be calculated to account for the quasi-periodic nature, and the interaction of multiple fluctuations superimposed on each other must be accounted for. The quasi-periodic fluctuations of 33, 160, and 1,500 years in duration provide a framework to properly evaluate shorter duration events. In the worst case scenario, if all three quasi-periodic high water-level fluctuations occur simultaneously, the effects would be additive and an even shorter-term fluctuation, such as an annual high water level event, would elevate water levels significantly higher.

241-20 **BTH 126** Carrara, P.E.

MOVEMENT OF A LARGE LANDSLIDE BLOCK DATED BY TREE-RING ANALYSIS, TOWER FALLS AREA, YELLOWSTONE NATIONAL PARK, WYOMING

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Tree-ring analysis can be a valuable tool to date geomorphic events in regions lacking long historical records. In this study, the latest movement of a section of a large landslide block in the Tower Falls area of Yellowstone National Park, Wyoming, was dated by tree-ring analysis of Douglas-firs (Pseudotsuga menziesii var. glauca). The movement tilted many of the trees and damaged their root systems. In August 2000, thirteen old, tilted Douglas-firs, at three sites, were sampled within the section of the landslide block that moved during the life of these trees. In addition, ten young, upright, undisturbed Douglas-firs were also sampled at the sites in order to establish a minimum age for the movement. The oldest of the ten young, upright trees had an age of about 135 years, indicating that the latest movement of the landslide block occurred prior to 1865 A.D. The youngest of the 13 old, tilted trees germinated in about 1630 A.D., providing a maximum age for this latest landslide movement. The majority (11) of the large, tilted Douglas-fir sampled on the section of the landslide block near Tower Falls recorded an abrupt reduction in annual ring width that began in 1694 A.D and lasted for 2 to 16 years. As no other period in the tree-ring record between 1865 and 1630 A.D. revealed such an abrupt reduction in annual ring width, landslide movement is thought to have occurred sometime between the end of the 1693 A.D. growing season and during the 1694 A.D. growing season. Attribution of this part of the tree-ring record to landslide movement is further supported by the absence of similar tree-ring reductions in chronologies within the region. A tree-ring chronology of Douglas-fir at a site near Gardner, Montana (Drew, 1975), about 30 km northwest of Tower Falls, as well as trees at two other nearby sites, do not display any significant climate-related reduction in tree-ring width during the 1690s A.D. Because Yellowstone National Park is within the Intermountain Seismic Belt, a zone of pronounced seismic activity, movement of the landslide block may have been caused by an earthquake at that time.

SESSION NO. 242, 1:30 PM

Wednesday, October 30, 2002

T106. Remotely Sensed Data for Geologic and Environmental Studies (*GSA Geophysics Division*)

Colorado Convention Center, C105/107

242-1 **1:30 PM** Ramsey, Michael S.

MONITORING, ASSESSMENT AND MITIGATION OF VOLCANIC HAZARDS USING THE SPACEBORNE ASTER INSTRUMENT

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The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) is proving extremely valuable for the study of many earth processes such as glacial monitoring, heat balance determinations, and volcanic observations. The latter includes eruption monitoring of >1500 active volcanoes. ASTER has an increased spectral and spatial resolution two and four times greater than Landsat ETM images. In addition, its greater dynamic range provides unsaturated data from high temperature volcanic targets. ASTER has a nominal repeat time of 16 days, reduced to as little as 5 days through the instrument's unique ability to point off nadir. With these features plus the ability to generate digital elevation models (DEMs), ASTER should be the premiere instrument for volcanic hazard monitoring. However, the data flow from sensor to scientist is convoluted and limits the near real-time availability. These issues are currently being investigated through integration with high temporal, low spatial resolution instruments.

Two volcanic eruptions have been examined in detail in the two years that ASTER has been operational: Bezymianny, Russia (June-December 2000) and Mt. Etna, Italy (July-August 2001). At Bezymianny, ASTER data have been compared to AVHRR near-real time data, with ASTER revealing much more detail on the dome's surface. Thermal anomalies covering hundreds of pixels were present for a much longer period than AVHRR observed. The data highlight the non-eruptive thermal state of the volcano and show a thermal concentration along a fissure prior to the larger eruption in late October. This was detected by AVHRR and resulted in the formation of a hot flow deposit only seen in the ASTER data. The multispectral thermal data have also allowed the dome's compositional and textural changes to be mapped. During the Etna activity, pre-, syn-, and post-eruption ASTER images were acquired and permitted the mapping of lava flow areal extent and estimates of thermal flux. Typical ASTER-derived pixel integrated temperatures were ~250°C-350°C for active flows. In addition, ASTER-derived DEMs allow for quantitative documentation of the summit crater topography and estimates of lava flow volumes. ASTER also provided detailed multispectral observations of the airborne ash and SO2 plumes.

242-2 **1:50 PM** Knudson, Amy Trueba

MULTISPECTRAL THERMAL INFRARED ANALYSIS OF MAFIC VOLCANIC ROCKS NEAR GILA BEND, ARIZONA

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Mapping the variability of rocks on the surface of Mars provides one means of studying the geologic history of the planet. The igneous rock types identified on Mars using the Thermal Emission Spectrometer (TES) include basaltic to andesitic compositions. These rock types are distinguishable in the thermal infrared using spectral resolutions afforded by spectrometers such as TES, but they have not been well characterized using multispectral instruments such as the Thermal Emission Imaging System (THEMIS). The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) and the Thermal Infrared Multispectral Scanner (TIMS) offer an opportunity to study terrestrial mafic rock compositions with multispectral instruments where there is the opportunity to compare results to field based studies and laboratory analysis of collected samples. Both the TIMS and ASTER instruments have coarser spectral resolution than THEMIS. TIMS provides 6 bands and ASTER provides 5, in contrast to the 9 unique bands