from an elevation of 3230 m asl in the center of the range, to 2860 m asl at the far western end. Given the sensitivity of the ELA to changes in summer temperature (95 m/deg C) and winter precipitation (-0.3 m/mm) determined by Seltzer (1994), and assuming a summer adiabatic lapse rate equal to the modern value (6.7 deg C/km, determined through analysis of data gathered by active SNOTEL stations) the lowest western paleo-ELAs received up to 2000 mm more precipitation (as snow-water-equivalent, SWE) per winter than the central paleo-ELAs. Modern winter precipitation at these locations is essentially equal (450 to 500 mm SWE). An explanation for this discrepancy is that moisture derived from Lake Bonneville, which was located 100 km upwind of the western Uintas during the Smiths Fork Glaciation, produced tremendous lake-effect snow when westerly airflow was orographically lifted more than 1.5 km over the Wasatch Front and the western Uintas.

2:45 PM Fleisher, P. Jay

CONFIRMATION OF LATE PLEISTOCENE EXPANSION AND COALESCENCE OF BERING/STELLER/MARTIN RIVER GLACIER COMPLEX, ALASKA

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Failure of reconnaissance reports early in the 20th Century to assess relevance of glacial drift beyond recent limits of Bering Glacier resulted in oversight of its great Pleistocene extent. This illusion persisted over 50 years, in spite of knowledge of the offshore Bering Trough. To resolve these inconsistent views, we examined diamict microstructures and verified the extent of muskeg-concealed glacial till. Field data from all sectors seaward of the Bering, Steller and Martin River Glaciers indicate widespread extent of till concealed beneath blanketing muskeg, as well as erratic rocks on beaches, lake strands and fluvial gravel bars. This evidence shows that the expanded Martin River Glacier spread west and south across the divide into the Katalla River valley. Eastward it coalesced with Steller Glacier in mounting stoss slopes and passing into upland through-valleys to join with alpine glaciers of local origin in the Don Miller Hills. To the south and farther east, Bering piedmont lobe extended several kilometers beyond previously known limits. These relationships indicate the Pleistocene confluence of trunk glaciers to be recognized as the Bering/Steller/Martin River Glacier Complex with probable seaward limits that support the presumed glacial origin of Bering Trough. Radiocarbon dating of basal peat, in contact with underlying till, supplements existing Late Pleistocene and Holocene retreat chronology. Yet to be cored are lake sediments from which detailed records of post-glacial sedimentation and Holocene environmental evolution will be obtained.

3:00 PM Gualtieri, Lyn

DID ICE EXIST ON THE CHUKCHI SHELF DURING THE LAST GLACIAL MAXIMUM?

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Recently discovered glaciogenic bedforms, identified by seafloor mapping, suggest that a grounded ice shelf existed during the Last Glacial Maximum (LGM) on the western Chukchi Shelf (Polyak et al., 2001 Nature, pp.453-457). The orientation of the bedforms led Polyak et al. (2001) to infer that ice from Alaskan/Canadian ice streams was deflected by either the continental slope or by the edge of a large "Chukchi ice sheet "- located along the lower portions of the Chukchi Shelf. A likely place to find evidence to support the LGM ice sheet hypothesis is Wrangel Island, which forms the highest point on the shelf.

If such an ice mass was present, Wrangel Island would have been directly affected by either being 1) glacioisostatically loaded by the crust; or 2) covered by the ice mass. If the former were true, then raised marine deposits of post-LGM age would be expected on the landscape. Instead, we have found much older raised marine deposits of early Pleistocene age that correlate with similar deposits in Alaska associated with high eustatic sea levels and not glacioisostatic loading on the shelf. If the island were ice-covered, then LGM-age glacial landforms indicative of northerly ice-flow should be found there. The lack of glacial landforms, deposits, or erratics in major river valleys suggests that Wrangel Island was mostly or completely ice-free during the LGM. Furthermore, paired 10Be and 26Al cosmogenic isotope ages on quartz from boulders on the tops of rounded hills suggest the area was unglaciated for at least the last 35 ka and possibly longer. Thus, it is unlikely that a Chukchi ice sheet, grounded or otherwise, existed on the Chukchi Shelf during the LGM based on our geomorphic and geochronologic evidence, and alternative interpretations regarding the age and origin of the bedforms should be considered.

3:15 PM Phillips, Fred M.

CORRELATION OF SIERRA NEVADA CONTINENTAL AND PACIFIC MARINE PALEOCLIMATE RECORDS OVER THE LAST GLACIAL CYCLE

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Until recently, the only long-term and high-resolution marine paleoclimate records available to compare with records from most continental locations were benthic foraminiferal delta-18O time series. These reflected largely a combination of global ice volume and bottom water temperature. Comparison with continental records has produced many puzzling discrepancies (e.g., "asynchronous glaciation"). Within the past five years the quality of both the chronology for glaciation in the Sierra Nevada and the temperature history of Pacific Ocean water off the California coast has greatly improved, offering the opportunity for a new regional comparison. Cosmogenic 36Cl ages on moraine boulders are corroborated by glacial rock flour data from Owens Lake (J. Bischoff and K. Cummins). These show major glacial advances at 160-140 ka, ~70 ka, 50-45 ka, and 29-18 ka. These are matched by recently published alkenone temperatures from southern California showing episodes of cold sea surface temperature at 160-145 ka, ~110 ka, ~90 ka, ~70 ka, ~55 ka, and 30-20 ka. Not all cold episodes are matched by glacial advances, possibly because moraines resulting from them were overridden by subsequent, more extensive, advances. However, the close correspondence of the majority of cold phases with glacial advances demonstrates that local marine and continental paleoclimate records are generally synchronous. The apparent disagreement with the global ice volume record may be due to regional differences in climate history, or may simply be due to the long time constant required for response of the huge Pleistocene ice sheets.

3:30 PM Briner, Jason P.

THE HUNT FOR THE LAST GLACIAL MAXIMUM, NORTHEASTERN BAFFIN ISLAND: NEW COSMOGENIC EXPOSURE AGE CONSTRAINTS ON THE EXTENT OF THE LAURENTIDE ICE SHEET

BRINER, Jason P.[1], MILLER, Gifford H.[1], and CAFFEE, Marc[2], (1) INSTAAR and Dept. of Geological Sciences, Univ of Colorado, Boulder, CO 80303, jason.briner@colorado.edu, (2) Lawrence Livermore National Lab, Livermore, CA 94550

A preliminary set of 24 cosmogenic exposure ages combined with new glacial mapping in the Clyde Inlet region (70°N, 70°W) provides a new understanding of the last glacial maximum (LGM) on northeastern Baffin Island. The extent and timing of Laurentide Ice Sheet advances throughout the eastern Canadian Arctic at the LGM have been poorly known largely due to a lack of LGM-age radiocarbon ages for glacial deposits. Recent approaches using lacustrine sediment cores and cosmogenic exposure dating have resulted in significant advances toward understanding Laurentide ice dynamics across southeastern Baffin Island (64° to 67°N, 62° to 68°W; Steig et al., 1998; Bierman et al., 1999; Miller et al., 1999; Marsella et al., 2000; Wolfe et al., 2000; Kaplan et al., 2001). However, unlike in southern Baffin Island where LGM ice left a limited moraine record, the wide coastal forelands of the Clyde region afford the opportunity to study a far more extensive LGM and pre-LGM moraine record.

Our ^{10}Be and ^{26}Al ages range from 19 ka for a terminal moraine on the Clyde foreland, to 13 ka and 9 ka for morphostratigraphically younger foreland and fiord-wall lateral moraines and ice-sculpted bedrock islands within Clyde Inlet. This LGM ice limit is intermediate between earlier depictions of the LGM margin at the fiord head (>100 km inland; Miller and Dyke, 1974), and at the continental shelf break in Baffin Bay (80 km beyond; Hughes et al., 1977), and thus resolves a long-standing controversy. ^{10}Be ages from a higher fiord-wall lateral moraine of 32 ka, along with yet undated terminal moraines on the coastal foreland beyond the 19 ka terminal moraine, indicate that the Laurentide was more extensive during pre-LGM times than during the LGM. We infer that there was relatively extensive ice at high latitudes early in the last glacial cycle, during relatively wet times, versus more restricted ice during the arid LGM (e.g., Miller et al., 1977; Miller et al., 1992); ongoing research will further test this hypothesis.

3:45 PM Smith, Jacqueline A.

COSMOGENIC DATING OF GLACIATION IN THE PERUVIAN ANDES: >400 ^{10}BE KA TO LAST GLACIAL MAXIMUM

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In glacial valleys bordering Lake Junin in the central Peruvian Andes, moraines deposited during the last glacial maximum (LGM) are smaller and much farther up valley than well-preserved lateral moraines deposited during previous glaciations. Cosmogenic dating (^{10}Be) of four moraines in the Alcacocha Valley (S 11° 03', W 75° 58', elev. 4300 m, length ~14 km) indicates that the most extensive moraines are at least 400,000 years old. In contrast, the LGM is represented mainly by a low, broad terminal moraine located approximately 7 km up valley and 200-250 m higher than the limit of glaciation in the Alcacocha Valley. Within the LGM limit, a recessional moraine dams Laguna Alcacocha. The median ^{10}Be date on the recessional moraine is 17+/-0.4 ka, which is consistent with an end to the LGM in the region at 21 k cal yr BP based on the sedimentary record in Lake Junin. Down valley of the LGM limit, larger lateral moraines date from approximately 240 to more than 400 ^{10}Be ka. An overall picture emerges of a relatively minor glaciation in the tropical Andes during the LGM, following at least three previous larger glaciations. The pattern is repeated in neighboring valleys. This relationship between the LGM moraines and older moraines is in contrast to the SPECMAP oxygen isotope record, which indicates that global ice buildup during the LGM was similar in magnitude to that of previous glacial periods. These findings invoke a mechanism for maintaining a relatively reduced ice extent in the tropics while allowing significant ice build-up in the high latitudes during the LGM. One possible mechanism might be the disruption of ocean circulation patterns such that the transfer of warmer ocean water from the tropics to the poles was impeded, preventing the tropics from cooling to the same extent as higher latitude regions.

4:00 PM Clark, D. H.

GLACIAL ASYNCHRONY IN THE KUNLUN SHAN, NORTHWESTERN TIBET

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Glaciation in much of interior Central Asia appears to have been controlled by the deep rain shadow of the western ranges – the Karakorum and the Pamir – that blocked moisture-bearing frontal systems during the height of the last glaciation, at the global Last Glacial Maximum (LGM). Cosmogenic ^{10}Be and ^{26}Al exposure dates from tillstones exposed on moraines show the local "LGM" in the Karakax Valley (36°N, 78°E) of the Kunlun Shan occurred at least 65-70 ka. We find no evidence of large marine isotope stage (MIS) 2 glaciers in the Karakax, only Little Ice Age moraines (<1 ka) and active glaciers upvalley of the ~70 ka moraines. In contrast to the moraine record, exposure ages on adjoining alluvial fans in the Karakax Valley indicate that they formed during periods of maximum insolation (~6 ka and ~110 ka; Ryerson et al., 1999) rather than maximum glaciation.

Moraines that date to MIS 2 or the late glacial in the Aksayqin Basin (35°N, 80°E) on the northwestern Tibetan Plateau are within 1 km of the modern glacier termini. An older, much larger, and more weathered set of moraines lie well outside of the MIS 2 moraines, and appear to be equivalent in age to the early Wisconsinan moraines below the Karakax glaciers. This pattern of large early-Wisconsinan glaciers also occurs in parts of the Tien Shan to the north: cosmogenic dates from several locations (e.g., DieHanJeLe Gou, 43°N, 88°E; Muzart He, 42°N, 81°E) suggest that glaciers there attained maxima during both the early part of the Wisconsinan (~40-75 ka), but also during MIS 2 (13-28 ka), with the former advance being slightly larger. The pattern suggested by these findings is that, in the hyperarid Kunlun Shan, during the LGM it may simply have been too dry to support large glaciers despite low temperatures. During somewhat warmer, less "glacial" climates (e.g., early Wisconsinan), the local glaciers throughout the region were able to grow because of increased delivery of precipitation. Thus, local glacial maxima were asynchronous with glacial maxima in Europe and western North America, and even in the Himalaya, such that the local LGM occurred early in the 10^5-year-long glacial cycle phase rather than near its end.

THURSDAY

PM