Ireland during the most recent deglaciation (<18,000 BP). The ridges have been interpreted as deposits of an ice sheet drainage system (i.e."eskers") and as such have been used with other data to reconstruct the deglacial history. The traditional deglaciation model shows systematic retreat of ice from south to north. This study which involves an analysis of the ridged landforms using lithofacies, sedimentary structures and paleocurrent data in conjunction with the geomorphology indicates that the pattern and nature of the ridges are not compatible with the traditional model and supports a new model of deglaciation (Warren, 1991) in which the "esker" system formed in an interlobate area during the simultaneous shrinking of two main ice centers. An extensive lake system developed in the lowland between the centers. Ridges form both perpendicular and parallel to the ice margin, involve both active and stagnating ice, consist of both continuous and segmented ridges and are deposited in subaqueous and subaerial environments. Those that form perpendicular to the ice margin are termed eskers; those that form parallel are termed moraines. Distinction between esker types (continuous or beaded subglacial tunnel fills, fluvial ice-channel fills, and subaqueous fans) and moraine types (subaqueous and subaerial deltas/fans) is crucial to the reconstruction of the mode deglaciation.

10:30 AM Gipp, Michael R.

"LIFT-OFF" MORAINES: EVIDENCE FOR ICE RISES AND INTERLOBATE MORAINES ON THE SCOTIAN SHELF, CANADA.

GIPP, Michael. R., Dept. of Geology, University of Toronto, Scarborough Campus, Scarborough, Ontario M1C 1A4, CANADA.

"Lift-off" moraine is a term commonly used to describe acoustically incoherent subparallel ridges observed on sidescan sonograms and high-resolution reflection seismic profiles of glacially-overdeepened basins on the southeastern continental margin of Canada. They are up to 3 m high and 20-80 m wide and often underlie stratified proglacial sediments. Although little is known about them, detailed study of high-resolution seismic profiles from LaHave Basin and Emerald Basin, on the Scotian Shelf, show that their height:width ratio varies with the sounder-seabed separation, suggesting that the ridges may be narrower than they appear. They are likely similar in morphology to DeGeer moraines or cross-valley moraines, both of which form perpendicular to ice flow direction. Their orientations can be estimated at the intersection of seismic lines, so that ice flow directions may be determined, assuming a flow-transverse origin. Since proglacial sediments are draped directly over top of them, they are assumed to record the direction of last ice flow. This directional data suggests that ice not only retreated northwards (to Nova Scotia), but also retreated towards local topographic highs, which acted as anchoring points for ice rises around both Emerald and LaHave Basins.

"Lift-off" moraines are present both north and south of an east-west trending set of large moraines across eastern LaHave Basin, which is suggestive of an interlobate moraine complex. "Lift-off" moraines are not found in the immediate vicinity of the suspected interlobate moraine (in the zone of compressive flow), but are found where transverse basal crevasses would have been expected in the overlying ice. The data is consistent with features that were formed subglacially in transverse basal crevasses during ice retreat.

10:45 AM Ehlers, Jürgen

LARGE-SCALE GLACIOTECTONIC DEFORMATION OF SOFT SEDIMENTS IN THE LAKE MICHIGAN BASIN

EHLERS, Jürgen, Geologische Landsamt, Oberstrasse 88, 2000 Hamburg 13, Germany; LARSON, Grahame J., Department of Geological Sciences, Michigan State University, East Lansing, MI 48824, USA; GIBBARD, Philip , Subdepartment of Quaternary Research, Cambridge University, Cambridge CB2 3EA, England

Large-scale (>10m) glaciotectonic structures have been recognized in the Baltic and North Sea basins and in a number of places in North America, especially Alberta, Saskatchewan and North Dakota, but have not been observed within the Great Lakes basin. Recent field work along the eastern shore of Lake Michigan, however, has revealed that some of the coastal cliffs near Ludington, Michigan have been subject to extensive glaciodynamic deformation. These 60 m high cliffs show small-scale fracturing and shearing to large-scale overfolding and thrusting superimposed on at least six sedimentary strata most of which are of glaciolacustrine origin. The largest folds exceed 45m in amplitude and are truncated at the top by southwardly rising low-angled thrust planes. Both the axes of the fold and fabric of a till unit at the top of the cliffs indicate a deforming force operating from a north northwesterly direction. The glacial advance that caused the glaciotectonic deformation was probably associated with the Port Huron stade.

11:00 AM Cotter, J.F.P.

A COMPARISON OF QUATERNARY AND LATE PALEOZOIC STRIATED & FACETED BOULDER PAVEMENTS; MINNESOTA RIVER VALLEY, U.S.A. AND CAPIVARI, SÃO PAULO STATE, BRAZIL: INSIGHTS ON ORIGINS AND PROCESSES.

COTTER, J.F.P., Geology Discipline, Univ. of Minn., Morris, Morris MN 56267
ROCHA-CAMPOS, A.C., SANTOS, P.R. dos, and CANUTO, J.R., Instituto de Geociências, Universidade de São Paulo, São Paulo, Brazil.

Boulder Pavements are planar concentrations of glacially modified clasts located between or within tills/tillites. The goal of this study was to determine the origin of Boulder Pavements through a comparative study of the Wisconsinan age pavement of the Minnesota River Valley (M.R.V.) and two parallel (2m apart) pavements exposed near Capivari, São Paulo, Brazil (middle part of the Itararé Subgroup, early Permian). Clast characteristics were analyzed to determine depositional processes and glacial flow parameters. Sedimentary structures, glaciotectonic/shear features, and contacts were described to determine stratigraphic relationships.

The Boulder Pavements studied are very similar. Both are intertill/tillite pavements formed as lag concentrates that were subsequently overridden. At Capivari, provenance analysis indicate pavement clasts were for the most part sourced in the (immediately) underlying tillite. During the overriding of the surface concentration, clasts were faceted, striated and emplaced (not lodgement *sensu stricto*) in the competent (not fluid), underlying tillite (indicated by shearing, dewatering and deformed/involuted features). The origin of the M.R.V. pavement seems more complex. The gentle gradient, the presence of what may be an intermediate till and the association of sands and gravels suggest clasts were concentrated during subaerial exposure by running water (like the Capivari pavements). However, local non-planar clast concentrations, clasts underlain by young till and pavement clasts commonly associated with the overlying till indicate that in places this Boulder Pavement was formed and modified by active subglacial processes (perhaps in part lodgement *sensu stricto*).

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11:15 AM Carson, Robert J.

STONE PAVEMENTS RELATED TO ICE, WITH EXAMPLES OF ALPINE SUBNIVAL BOULDER PAVEMENTS FROM THE WALLOWA MOUNTAINS, OREGON, AND THE BEARTOOTH PLATEAU, MONTANA.

CARSON, Robert J., Dept. of Geology, Whitman College, Walla Walla, WA 99362

Stone (or boulder) pavements related to ice (as opposed to those produced primarily by running water, waves, or wind) are generated by a variety of glacial and periglacial processes. Such pavements consist of "stones," mostly boulders with flat upper surfaces in more or less the same plane. The stones may fit together in a mosaic, and the flat upper surfaces may be striated. Between the stones is a fine-grained matrix ("fines") which extends to within 0.2 m of the pavement surface.

A *glacial* boulder pavement is a single layer of stones with striated upper surfaces; it forms by subglacial erosion of till, including abrasion of tops of stones, and pressing of stones into underlying soft fines (Elson, 1957). A *glaciomarine* boulder pavement originates as a lag deposit (one clast thick) from current winnowing of glaciomarine drift; the pavement develops as grounded shelf ice overrides and abraids the lag deposit (Eyles, 1988). *River, lake,* or *sea ice* may form a boulder pavement with or without striations on the pavement surface; processes include ice being pushed by winds and currents, abrasion by loose boulders on top of the pavement, pressing of stones into fines by the pressure of grounding ice blocks, and winnowing of fines by waves and currents (Hanson, 1983). *Aufeis* many meters thick may form when a stream overflows during freeze-up; movement of the uppermost stones (on the floodplains) into a relatively smooth pavement may result from adjustment under the weight of the overlying aufeis (Porter, 1966).

White (1972) applied the term "alpine subnival boulder pavement" (ASBP) to stone pavements in the Colorado Front Range. ASBPs of the Front Range, Wallowa Mountains, and Beartooth Plateau are above the treeline and are associated with snowfields. The Oregon and Montana ASBPs formed after retreat of Pinedale glaciers. ASBPs near Ice Lake (Wallowas) are in stream channels and slope gently downvalley; the stones (mostly sandstone) are derived from glacial and periglacial debris. ASBPs near Lonesome Mt. (Beartooths) are nearly horizontal and are not near streams; the angular stones are weathered from the granitic bedrock. The annual cycle at the Oregon, Montana, and Colorado sites appears to be similar. Summer meltwater removes fines. In early fall snow drifts downwind of breaks in slope, insulating the still-thawed fines. Thick snow banks may press stones into fines before the ground freezes. Limited snow creep may occur across the pavement. Freezing fractures, heaves, and turns the stones, but with time a stable pavement of tightly packed stones may develop.

11:30 AM Smith, Lisa R.

MAPPING THE SUBSURFACE GEOLOGY OF GLACIGENIC DEPOSITS USING GEOSTATISTICAL PROCEDURES AND COMMERCIALLY AVAILABLE SOFTWARE FOR ANALYSIS AND VISUALIZATION

SMITH, Lisa R., Spatial Analysis and map Production, Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820

Geologic mapping of glacigenic deposits is important in the northern United States because such deposits are ubiquitous, often contain aquifers, and impact decisions relating to human activities. The lithology and other characteristics of glacigenic deposits are highly variable, both vertically and areally, because they are the products of numerous depositional processes that acted during multiple glacial advances. To unravel and map the complex three-dimensional relationships of glacigenic deposits in the subsurface in Illinois, the ISGS has developed computerized procedures that employ geostatistical methods and commercially available software for interactive modeling of surfaces and volumes.

Although lithologic descriptions from large numbers of water wells and other borings drilled in the glacigenic deposits are available in files at the ISGS, most were prepared by the water well drillers. Comparatively few borings have been logged in detail by geologists. The procedures developed at the ISGS allow geologists to interpret and synthesize lithologic and grain size information from large numbers of well drillers' logs to build a coherent picture of the subsurface geology. Geostatistical procedures adapted to four mapping methods are used to