

2nd ANNUAL
RESEARCH SYMPOSIUM
UNIVERSITY OF
MAINE

INSTITUTE FOR
QUATERNARY
STUDIES

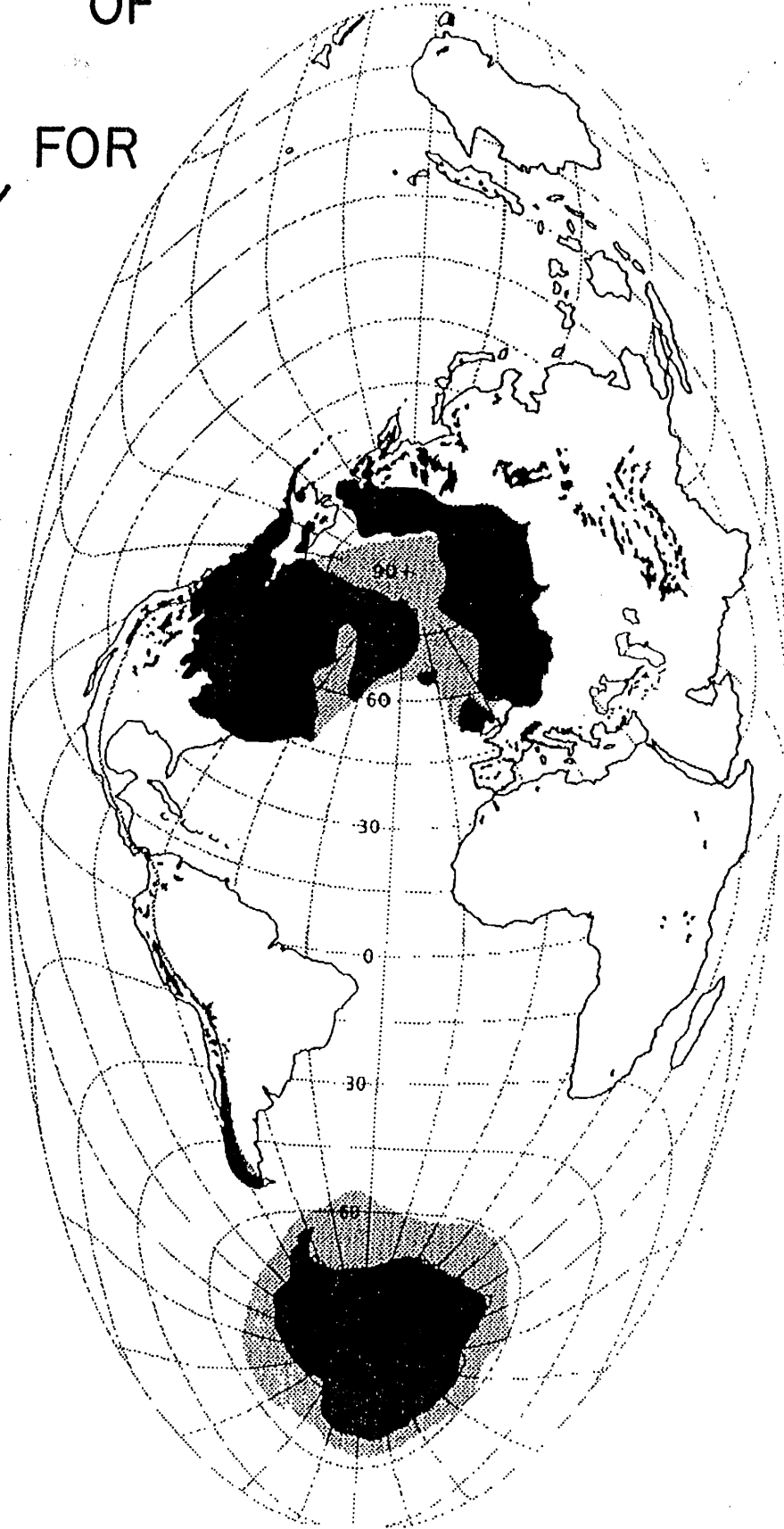
Thurs. — Fri.

MAY 12-13, 1994
0830 - 1900

Woolley Room
Community Center
Doris Twitchell
Allen Village

UNIVERSITY OF
MAINE

ORONO



UNIVERSITY OF MAINE
INSTITUTE FOR QUATERNARY STUDIES
AND
EPSCOR GLOBAL CHANGE PROJECT
SECOND ANNUAL RESEARCH SYMPOSIUM

MAY 12-13, 1994

Wooley Room,
Doris Twitchell Allen Village Community Center
UM, Orono, Maine

THURSDAY, MAY 12, 1994

0830 - Welcome and Introduction: Daniel F. Belknap

Session 1 - Archaeology I

0835 - Jennifer L. Thomas - Archaeological Investigations in the Boothbay Region, Maine.

0850 - Karen Mack - Archaeology investigations at the Todd Site (17-11), Muscongus Bay, Maine.

0905 - Benjamin Tupper and Karen Mack - Computerized management of large artifact databases and artifact mapping for the Todd Site (17-11), Muscongus Bay, Maine.

0920 - Mike Sanders - The Chegoggin (Yarmouth, Nova Scotia) archaeological project.

0935 - George L. Jacobson, David Sanger, David C. Smith and others - Have Atlantic Salmon been absent from New England Rivers for most of the Holocene?

****Coffee Break****

Poster Session: (during coffee break)

1000 - Ann Dieffenbacher-Krall - Paleoecology of the Cutler Grasslands, Cutler, Maine.

Session 2 - Vegetation I

1015 - Heather Almquist-Jacobson - Holocene landscape development in the Milford Drainage Basin, Maine.

1030 - Molly Schauffler - What don't we know about the pre-settlement history of forest stands in Maine?

1045 - Doug Maguire - The role of forest regeneration models in predicting response of forest vegetation to global change.

Session 3 - Maine Geology

- 1100 - Woodrow B. Thompson and Thomas K. Weddle - Progress report on Maine Geological Survey investigations of late-glacial stratigraphy and deglaciation chronology in central and southern Maine during 1993.
- 1115 - Jennie E. Donner - The effects of islands on the recession of the Laurentide Ice Sheet in the Gulf of Maine.

Poster Session:

- 1130 - Karl J. Kreutz - Ice marginal paleoceanographic conditions during the Late Wisconsin marine transgression in Maine.
- 1145 - Michael R. Kaplan - The deglaciation of southeastern coastal Maine.

**** Lunch **** - Catered lunch for all who have signed up in advance

- 1300 - Christopher C. Dorion - Chronology, sedimentology, and faunal assemblages of glaciomarine sediments in Maine.
- 1315 - Alice R. Kelley - Late Quaternary evolution of the lower Penobscot River Valley.
- 1330 - Matthew G. Jager - The lower Carrabassett River Valley, Maine - a source of the Embden Formation?

Session 4 - Gulf of Maine

- 1345 - Daniel F. Belknap and Detmar Schnitker - Chronology of deglaciation of the Gulf of Maine, AMS C-14 and amino acid racemization dating in piston cores from offshore basins.
- 1400 - Walter A. Barnhardt, Daniel F. Belknap and Joseph T. Kelley - The isostatic component of postglacial relative sea-level change in coastal Maine, USA.
- 1415 - W. Roland Gehrels - Regional trends of Holocene sea-level change in the northern Gulf of Maine determined from foraminiferal analyses and paleotidal modeling.
- 1430 - Joseph T. Kelley - Fluid-escape seafloor pockmarks: catastrophic or continuous.
- 1445 - Cynthia H. Pilskaln - Particulate POC cycling, marine aggregate dynamics, and future (pending) research in the Gulf of Maine.

****Coffee Break****

Session 5 - Stable Isotope Laboratory

1515 - Douglas S. Introne - The state of the University of Maine
Stable Isotope Laboratory

Session 6 - North Atlantic Ocean

1530 - I. Marianne Lagerklint - Correlation of Heinrich events in
the North Atlantic Ocean with global signals of climate
change.

1545 - Peter L. French - Oceanographic conditions in the North
Atlantic Ocean during Heinrich events.

1600 - Detmar Schnitker - *Cibicidoides wuellerstorfi* (Schwager) -
tracer of deep paleocurrents during the glacial to
postglacial transition in the North Atlantic.

1615 - Thomas B. Kellogg - Stable isotope and planktonic
foraminiferal results from multi-species analysis of
North Atlantic core V27-114: preliminary conclusions
and problems.

1630 - Davida E. Kellogg - Siliceous microfossils in North
Atlantic core V27-114 as indicators of glacial
meltwater.

1645-1730 DISCUSSION PERIOD

1730 - Dinner - Buffet for all

FRIDAY, MAY 13, 1994

Session 7 - Archaeology II

0830 - Daniel H. Sandweiss - Environment and archaeology in Cuba:
recent and proposed research.

0845 - Kristin D. Sobolik - Archaeological investigations in Big
Bend National Park.

0900 - Bret A. Achorn - Analysis of lithics excavated from a Late
Prehistoric rock shelter at Big Bend National Park
(site BIBE 252) during the 1993 season.

Session 8 - Vegetation II: Peatlands

- 0915 - Ronald B. Davis, D.S. Anderson, M.E. Perera, and K.E. Bates - Maine peatlands: relationships to present, past and future environments.
- 0930 - Melissa E. Perera and Ronald B. Davis - The relationship between Testaceans (Protozoa: Rhizopoda) and environments in Maine Peatlands: preliminary results and future plans.
- 0945 - Dennis S. Anderson and Ronald B. Davis - Numerical models relating bryophytes and lichens to environmental gradients of Maine peatlands.
- 1000 - Karen E. Bates and Ronald B. Davis - Character and chronology of the first wetland communities in eight shallow-basin fens in Maine.

****Coffee Break****

Poster Session: (during coffee break)

- 1015 - Kirk A. Maasch, Todd K. Dupont and E.W. Boulton - Climate transition in the mid-Pleistocene: was the onset of the 100-kyr cycle gradual or abrupt?

Session 9 - Glacial Geology and Glaciology

- 1030 - Tina M. Dochat - Surficial stratigraphy and geomorphology of Cape Bird, Ross Island, Antarctica: implications for Late Wisconsin glaciation in the Ross Sea embayment.
- 1045 - Harold W. Borns, Jr. and William P. Warren - New evidence for ice-flow directions over coastal, western Ireland.
- 1100 - Sathyanarayana Rajavelu - Modeling the transient thermal distribution in non-steady state glaciers.
- 1115 - George H. Denton - Radiocarbon chronology of drift in the Chilean Lake District and the southern Alps of New Zealand.
- 1130 - Terrence J. Hughes - Can ice sheets trigger abrupt climate change?
- 1145 - Discussion

**** Lunch **** - Catered lunch for all who have signed up in advance

ARCHAEOLOGICAL INVESTIGATIONS IN THE BOOTHBAY REGION, MAINE

Jennifer L. Thomas - Institute for Quaternary Studies

The large amount of archaeological and biological data compiled for the Boothbay area allows archaeologists a unique opportunity to study prehistoric hunter-gatherer adaptations at a regional level. For this paper, material culture data are synthesized with previous seasonality, subsistence, and settlement studies for two prehistoric shell midden sites in the Boothbay Region, Maine. Comparisons between the two sites will highlight site variability and differential prehistoric use within the region. Limitations of the available data sets in relation to the overall goal of determining prehistoric human lifeways in the region will also be discussed.

ARCHAEOLOGY INVESTIGATIONS AT THE TODD SITE (17-11), MUSCONGUS BAY, MAINE

Karen E. Mack - Institute for Quaternary Studies

The West-Central region of the Maine coast has been surveyed, and 620 sites have been documented. One of these sites, the Todd site, is a large multi-occupation shell midden, located on Keene's Neck, Muscongus Bay. Excavations occurred from 1983 until 1984. A number of dark organic rich shell-free layers were identified within the midden's complex stratigraphy. Substantial evidence suggests these layers are the remains of prehistoric dwellings. Preservation of dwellings allows the identification of assemblages of material culture, associated with separate cultural zones or occupations through time. Five cultural zones, spanning 3500 BP to 450 BP, are identified at the Todd site and described in detail in the present study.

COMPUTERIZED MANAGEMENT OF LARGE ARTIFACT DATABASES AND ARTIFACT MAPPING FOR THE TODD SITE (17-11), MUSCONGUS BAY, MAINE

Benjamin Tupper - Institute for Quaternary Studies

Karen Mack - Institute for Quaternary Studies

The 1983-84 excavations of the Todd Site recovered a substantial number of artifacts, including lithic debris (>8,000), pottery sherds (>13,000), and bone tools (>100). A 57.25 m² sample of cultural deposits was excavated consisting of 20 different levels. The task of organizing and mapping the artifacts is complicated by the lack of horizontal stratigraphy at the site. We describe a computer program written to address the difficulties encountered when working with large artifact databases and mapping artifact locations. Examples of database searches and artifact mapping are presented.

THE CHEGOGGIN ARCHAEOLOGICAL PROJECT

Michael Sanders - Department of Anthropology

Although, in the past, models of the culture prehistory of the Gulf of Maine area were developed and applied to the entire region, very little systematic archaeological research had been conducted in Nova Scotia. Since 1987, David Sanger (U.M.) and Stephen A. Davis (Saint Mary's University) have jointly directed a research project designed to gather archaeological data from the Chegoggin area, near Yarmouth in southwestern Nova Scotia. The results of the project indicate an affiliation between peoples of coastal Maine and southwestern Nova Scotia existing as early as 5000 BP, challenging established models.

HAVE ATLANTIC SALMON BEEN ABSENT FROM NEW ENGLAND RIVERS FOR MOST OF THE HOLOCENE

George L. Jacobson (in collaboration with David Sanger, David C. Smith and others) - Institute for Quaternary Studies, Department of Plant Biology and Pathology.

Several lines of evidence suggest that climate and hydrology of the early and mid-Holocene may not have been conducive to survival and successful reproduction of Atlantic salmon in rivers in the southern portion of its present range. When data concerning seasonality, paleohydrology, paleovegetation, historical climatology, and linguistics of modern Native American languages are compared with faunal evidence from archaeological sites in Maine, a case can be made that the presence of Atlantic salmon in New England rivers may be limited to the past few centuries.

PALEOECOLOGY OF THE CUTLER GRASSLANDS, CUTLER, MAINE

Ann Dieffenbacher-Krall - Department of Plant Biology and Pathology, Institute for Quaternary Studies

Although the extensive grasslands of North-Central Cutler appear to have developed as a result of post-European settlement fires, human intervention is apparently not required to maintain them. The Cutler grasslands consist of about 800 hectares of nearly homogeneous stands of *Calamagrostis canadensis* (bluejoint bentgrass) on rolling hills. Pollen records reveal that the grasslands developed shortly after the first European settlers began to clear land in the region. The timing of the grassland's origin is consistent with historical record of extensive fires in Eastern Maine. Maine Forest Service records indicate that the grasslands have not burned extensively since at least 1967, yet the boundaries have remained remarkably stable. As in many logged sites of Alaska and Western Canada, *C. canadensis* seems to prevent tree regeneration (1) by shading, (2) by producing a thick mat of dead stems which prevents tree seeds from reaching soil before germinating, and (3) by insulating the ground and thus delaying the warming of soil in the spring.

HOLOCENE LANDSCAPE DEVELOPMENT IN THE MILFORD DRAINAGE BASIN, MAINE

Heather Almquist-Jacobson - Institute for Quaternary Studies

This ongoing study will provide an environmental context for the archaeological evidence from several important settlements and travel routes in the Milford Basin of the Penobscot River, Maine. The nature of the local upland vegetation during the past 10,000 years has been inferred from a fossil-pollen stratigraphy from Hatch Pond, a small kettle lake located along an esker in Alton, Maine. Fossil charcoal, sediment characteristics, and pollen of aquatic macrophytes from the same sediment core indicate significant changes in Holocene water balance.

Today, low areas within the Milford Basin contain peatlands of several types. These represent a variety of plant and animal resources that may have been important to native Americans. In order to identify changes in the availability of resources through time, the developmental history of the wetlands is being determined through analysis of many cores in each mire system. The final result of this project will be a series of "time-slice" paleogeographic maps that show the approximate extent of the various types of wetlands and upland forests in relation to human settlements and travel routes.

WHAT DON'T WE KNOW ABOUT THE PRESETTLEMENT HISTORY OF FOREST STANDS IN MAINE?

Molly Schaufli - Department of Plant Biology and Pathology

Extensive logging of northern spruce and fir forests in Maine began in the late 1800's and led to major changes in the age-structure, species composition, and disturbance regimes of Maine forests. Yet little is known about these aspects of Maine forests on a stand scale (ca. 100 m²), in the centuries prior to European settlement. This

research proposal will outline an approach to answering related questions through analysis of the pollen record in peat and mor humus soils in small forest hollows.

THE ROLE OF FOREST REGENERATION MODELS IN PREDICTING RESPONSE OF FOREST VEGETATION TO GLOBAL CHANGE

Doug Maguire - Forest Biology

Early regeneration processes are potentially important in determining the ability of a plant species to colonize or persist under a given set of environmental conditions. These early regeneration processes are at best only implied in existing forest simulation models. A suggested general structure for simulating early regeneration includes the processes of seed production, germination, and survival.

PROGRESS REPORT ON MAINE GEOLOGICAL SURVEY INVESTIGATIONS OF LATE-GLACIAL STRATIGRAPHY AND DEGLACIATION CHRONOLOGY IN CENTRAL AND SOUTHERN MAINE DURING 1993.

Woodrow B. Thompson - Maine Geological Survey

Thomas K. Weddle - Maine Geological Survey

This report summarizes Maine Geological Survey (MGS) activities conducted under funding from the EPSCoR program, and related work included in the MGS surficial geologic mapping program.

MGS contracted with Christopher Dorion to locate exposures of fossiliferous glaciomarine sediments in eastern Maine, collect fossils for radiocarbon dating, and core lake bottoms for sampling and dating of basal organic-bearing sediments. This work was very successful, yielding several dates that closely constrain the time of deglaciation. Thomas Lowell was contracted to compile a series of 7.5-minute quadrangle maps showing ice-marginal deposits in northeastern Maine; he also participated in the lake coring work with other UM investigators. Bjorn Andersen investigated ice-marginal deposits and fossiliferous marine sediments in eight 7.5-minute quadrangles in the Penobscot lowland between Old Town and Lincoln. In spite of poor exposure, Andersen's work documented numerous possible end moraines, several fossil localities, and ice-marginal deposits within the esker systems. His report is available from MGS and UM-Quaternary Studies.

MGS surficial mapping in the Steep Falls Quadrangle by John Gosse and W. Thompson (for the STATEMAP co-op with USGS) provided data on the deglaciation sequence for incorporation in the EPSCoR map. Thesis work by Robert Johnston (MGS) led a field trip in southwestern coastal Maine for the national GSA meeting in Boston, in which MGS/USGS investigators showed evidence of the mode of ice recession and sea-level change.

THE EFFECTS OF ISLANDS ON THE RECESSION OF THE LAURENTIDE ICE SHEET IN THE GULF OF MAINE

Jennie E. Donner - Department of Geological Sciences

The hills to the west of Camden would have formed islands beneath the retreating ice sheet. The question is whether the ice melted over the islands first or whether it got caught up on the highlands while retreating rapidly in the marine embayment, possibly leaving remnant ice caps on the islands. This research is to investigate the shape of the ice margin and possible ablation mechanisms.

ICE-MARGINAL PALEOCEANOGRAPHIC CONDITIONS DURING THE LATE WISCONSIN MARINE TRANSGRESSION IN MAINE

Karl J. Kreutz - Department of Geological Sciences

Stable isotopic analyses on marine molluscs from emerged ice-proximal sediments in eastern coastal Maine

are used to reconstruct ice-marginal hydrographic conditions during retreat of the Laurentide Ice Sheet ca. 14,000-12,400 BP. Three AMS dated ice-marginal positions (Dennison Point, Pond Ridge Moraine, and Carrying Place Bluffs) contain fauna whose average $\delta^{18}\text{O}$ are $3.88 \pm 0.20\text{‰}$, $2.92 \pm 1.25\text{‰}$, and $3.39 \pm 0.03\text{‰}$, respectively. This indicates ice-marginal fauna were living in cold (-2‰ to -2‰) water of normal to slightly reduced salinity (25-35‰). Therefore, meltwater emanating from the base of the ice sheet rose directly to the surface as a plume, similar to the model of Powell (1990).

THE DEGLACIATION OF SOUTHEASTERN COASTAL MAINE

Michael R. Kaplan - Department of Geological Sciences

A fluctuating internally active ice-margin retreated across the study area, a distance of $\approx 20\text{km}$., between 14,000 years B.P. and $>13,000$ years B.P. Generally, topography had a significant influence on the position of the grounding line. At lower elevations, between the Pond Ridge moraine and the Pineo Ridge moraine system, two small marine embayments existed. The dominant ostracode and foraminifera species living near the grounding line are presently found only in subarctic-arctic areas.

CHRONOLOGY, SEDIMENTOLOGY, AND FAUNAL ASSEMBLAGES OF GLACIOMARINE SEDIMENTS IN MAINE

Christopher C. Dorion - Department of Geological Sciences

Recession of the Laurentide Ice Sheet across Passamaquoddy Bay began at Pond Ridge Moraine at $13,180 \pm 90$ (*Nucula tenuis expansa*) and a West Quoddy Head at $13,800 \pm 80$ (*Nucula tenuis expansa*). By $13,425 \pm 75$ (*Portlandia arctica*) ice had withdrawn north of Mattaseunk Lake, near Millinocket, Maine. A retreat rate below the marine limit of 400 meters per year suggests rapid ablation by marine mechanisms. Ice lingered at the marine limit for 1,000 years in eastern Maine at Bear Pond, until $12,350 \pm 55$ (terrestrial vegetation). Concurrently, regression of the sea to the present coastline near Machias was complete by $12,425 \pm 110$ (*Mytilus edulis*). The marine inundation that accompanied ice recession was frigid polar sea ($-2^\circ < T < +2^\circ\text{C}$), persisting until after 13,000 years B.P. based on foraminifera, ostracode, and $\delta^{18}\text{O}$ values.

THE LATE QUATERNARY DEVELOPMENT OF THE LOWER PENOBSCOT RIVER VALLEY

Alice R. Kelley - Department of Geological Sciences

The lower Penobscot River Valley has a complex late Quaternary history. Overriding by the Laurentide Ice Sheet was followed by simultaneous deglaciation and marine inundation. Following the retreat of the ocean, the present day Penobscot River established its current drainage system. In some portions of the valley the river occupies what appears to be a pre-glacial valley, while in other areas, the drainage is deranged. A series of archaeological excavations related to dam relicensing and proposed construction affords an unparalleled opportunity to examine the stratigraphy of the late Quaternary development of the lower Penobscot Valley. This presentation summarizes the geological elements of that work, and focuses on future research problems.

THE LOWER CARRABASSETT RIVER VALLEY, MAINE A SOURCE OF THE EMBDEN FORMATION?

Matthew G. Jager - Department of Geological Sciences

Detailed surficial geologic mapping of the Embden Formation, a time transgressive, fine grained, glaciofluvial, pebbly sand deposit that conformably overlies fossiliferous marine mud of the Presumpscot Formation, is used to identify recessional ice-margin positions and source areas for the Embden Formation along the

Carrabassett river drainage in the Longfellow Mountains of west central Maine. Marine fossils from the Presumpscot Fm., if found, can yield an absolute chronology for the deposition of Embden Formation outwash, outwash heads and ice margin positions.

CHRONOLOGY OF DEGLACIATION OF THE GULF OF MAINE AMS ¹⁴C AND AMINO ACID RACEMIZATION DATING IN PISTON CORES FROM OFFSHORE BASINS

Daniel F. Belknap - Department of Geological Sciences, Center for Marine Studies, Institute for Quaternary Studies and Department of Oceanography

Detmar Schnitker - Department of Oceanography, Center for Marine Studies, Institute for Quaternary Studies and Department of Geological Sciences

The stratigraphy of the deep basins and shallow rises in the Gulf of Maine was determined from seismic reflection profiling and long piston cores from NSF-funded cruises in 1990 and 1991. In the past year, we have obtained detailed chronology for seven cores using AMS radiocarbon dates, supplementing amino acid racemization stratigraphy. Deglaciation is tracked from 22 ka to 12 ka. Some reversals and anomalously old results are noted by comparing aminostratigraphy to AMS results.

THE ISOSTATIC COMPONENT OF POSTGLACIAL RELATIVE SEA-LEVEL CHANGE IN COASTAL MAINE, USA

Walter A. Barnhardt - Department of Geological Sciences

Daniel F. Belknap - Department of Geological Sciences, Center for Marine Studies, Institute for Quaternary Studies and Department of Oceanography

Joseph T. Kelley - Maine Geological Survey and Department of Geological Sciences, UM

Variable patterns of postglacial regression and transgression in the Gulf of Maine and Atlantic Canada are dominated by isostatic rebound, reflecting differences in ice loads and timing of deglaciation. Seismic-reflection profiles and vibracores from several submerged shorelines and river deltas on the inner continental shelf of Maine confirm previous estimates of the lowstand (approximately -55 m at 10.5 ka). Subsequently, a period of extremely rapid RSL rise occurred (35 m in 1,500 years). Subtraction of the "eustatic" component (Fairbanks, 1989) from the Maine RSL history argues strongly for complex isostatic motions, perhaps the passage of the glacial forebulge. These observations are empirically useful for testing glacial reconstructions and models of earth structure which, although commonly based on RSL, do not predict the RSL behavior observed in Maine.

REGIONAL TRENDS OF HOLOCENE SEA-LEVEL CHANGE IN THE NORTHERN GULF OF MAINE DETERMINED FROM FORAMINIFERAL ANALYSES AND PALEOTIDAL MODELING

Roland W. Gehrels - Department of Geological Sciences

Local Holocene sea-level studies in coastal Maine provide data that constrain theoretical models of global glaciation and earth rheology. This study establishes the most accurate Holocene sea-level chronology yet obtained for Wells, Phippsburg, Gouldsboro, and Machiasport. Assemblages of agglutinated benthic foraminifera occur in distinct zones on the surface of coastal marshes and serve as accurate sea-level indicators in peat cores. Additional tools are accelerator mass spectrometer ¹⁴C dating of individual plant fragments, precise surveying, and paleotidal modeling. Holocene long-term (10³ year) relative sea-level trends along the Maine coast are explained in terms of a collapsing glacial forebulge (all sites), late deglaciation in eastern Maine (Gouldsboro and Machiasport), and neotectonic crustal uplift (Machiasport).

FLUID-ESCAPE SEAFLOOR POCKMARKS: CATASTROPHIC OR CONTINUOUS

Joseph T. Kelley - Maine Geological Survey

Pockmarks are hemispherical depressions on the seafloor that have apparently formed through either the catastrophic or slow release of interstitial pore fluids. They range up to greater than 300 m in diameter and 30 meters deep. Sediment and gas escape has been observed from one in Belfast Bay, ME, and their steep internal slopes (>25 degrees) suggests they must all be active occasionally. Fields of hundreds of pockmarks are known from 5 bays in Maine, and more may exist. It remains unclear whether these features were initiated by a sudden event or whether they are the product of the gradual evolution of a bay.

PARTICULATE POC CYCLING, MARINE AGGREGATE DYNAMICS AND FUTURE (PENDING) RESEARCH IN THE GULF OF MAINE

Cynthia H. Pilskaln - Department of Oceanography

A summary of several years of studies off California examining biogeochemical particle fluxes and the role of marine aggregates in carbon regeneration and export will be presented. Additionally, proposals currently pending for similar studies in the Gulf of Maine and elsewhere will be outlined.

THE STATE OF THE UNIVERSITY OF MAINE STABLE ISOTOPE LABORATORY

Douglas S. Introne - Institute for Quaternary Studies

The University of Maine Stable Isotope Laboratory was built with University of Maine NSF-EPSCoR funds starting in 1990. The laboratory houses two high-precision gas mass spectrometers, a VG PRISM Series II and a Sira Series II, allowing automated analysis of a number of isotope ratios. Presently the machines are configured to measure $^{13}\text{C}/^{12}\text{C}$ and $^{18}\text{O}/^{16}\text{O}$ in carbonates (on the PRISM) and $^{18}\text{O}/^{16}\text{O}$ in water (on the Sira). In the past two years the laboratory has analyzed carbonates in foraminifera, corals, mollusks, and speleothems from a wide variety of settings. In addition, water samples from local streams and from a variety of ice cores have been completed. A videotape summary of laboratory operations will be shown to give a guided tour of the operations.

CORRELATION OF HEINRICH EVENTS IN THE NORTH ATLANTIC OCEAN WITH GLOBAL SIGNALS OF CLIMATE CHANGE

I. Marianne Lagerklint - Institute for Quaternary Studies

North Atlantic deep sea records and Greenland ice core records show evidence for step-wise cooling cycles followed by rapid shifts to warm periods during the last glacial cycle. Ice-rafting (Heinrich) events in the North Atlantic region and peaking *Pinus* abundances in Florida correlate with the maximum cold peaks immediately before the warmings. Recent findings in South America, New Zealand, and Europe indicate climatic changes that also correlate with these cold peaks. This suggests global climate change. Firm dating control must be obtained to determine the exact temporal relation between different signals. The lead and lag relationship should then provide clues to which parts of the climate system are responsible for the changes.

I am analyzing a core with high sedimentation rate, V29-191, from the eastern North Atlantic ocean. By methods of faunal analysis, lithic count, and isotope analysis, I will identify Heinrich events and temperature/salinity changes from ca. 21,000-9,000 ^{14}C years B.P. Radiocarbon dating at prominent changes and peaks in the records will pinpoint the timing for changes and the mid-points for certain climatic events. I can then compare and correlate the North Atlantic signals with those from other parts of the globe.

OCEANOGRAPHIC CONDITIONS IN THE NORTH ATLANTIC OCEAN DURING HEINRICH EVENTS

Peter L. French - Department of Geological Sciences

High relative abundance of the Radiolarian species *Cycladophora davisiana* occurred in the glacial North Atlantic Ocean at levels comparable to those in the modern Sea of Okhotsk. The modern Sea of Okhotsk, a suggested analogue for the glacial North Atlantic Ocean, is characterized by low-salinity surface conditions, density stratification of the water column and limited thermohaline circulation. The $\delta^{18}\text{O}$ record from deep-sea core DSDP-609 showed lighter $\delta^{18}\text{O}$ values attributed to fresh water input to the North Atlantic region during Heinrich events. Previous workers suggested that peaks in *C. davisiana* productivity during glacial periods were associated with ice-rafting in the North Atlantic region. I plan to conduct high-resolution analyses of *C. davisiana* abundance levels in deep-sea cores to test this link to ice-rafting events and determine the oceanographic conditions associated with Heinrich events.

CIBICIDOIDES WUELLERSTORFI (SCHWAGER) - TRACER OF DEEP PALEOCURRENTS DURING THE GLACIAL TO POST GLACIAL TRANSITION IN THE NORTH ATLANTIC

Detmar Schnitker - Department of Oceanography, Center for Marine Studies, Institute for Quaternary Studies and Department of Geological Sciences

This study searches for evidence of change in the dynamics of the North Atlantic thermohaline circulation at the moment of rapid transition from glacial to postglacial climatic conditions. The results of this study allow a three-dimensional view of the reinitiation of the North Atlantic deep circulation. The great climatic changes of the last glacial-interglacial cycle involved the surface waters of the North Atlantic ocean as an active participant. Microfaunal and geochemical evidence strongly suggests that the deep circulation of the oceans was also greatly modified in this glacial/interglacial contrast. Several new climate models are ascribing an active, even leading role to the deep water circulation in the transitions from glacial to interglacial climatic state. The significance of the three-dimensional ocean circulation to the global distribution of thermal energy, of nutrients and dissolved gases, and the ocean-atmosphere geochemistry makes it imperative that we understand the mechanisms of changes in the deep ocean circulation in the context of climatic change. One benthic foraminiferal species, *Cibicidoides wuellerstorfi* (Schwager), traces the presence and intensity of bottom currents and thus can probably serve as paleo-current meter with which to measure the timing and the areal and depth occurrence of the resumed flow of the Western Boundary Under Current at the end of the last glaciation.

STABLE ISOTOPE AND PLANKTONIC FORAMINIFERAL RESULTS FROM MULTI-SPECIES ANALYSIS OF NORTH ATLANTIC CORE V27-114: PRELIMINARY CONCLUSIONS AND PROBLEMS

Thomas B. Kellogg - Department of Geological Sciences and Institute for Quaternary Studies

High-resolution analyses of planktonic foraminifera, and of stable C and O isotopes of *N. pachyderma* (s and d) and *G. bulloides* document changes in oceanographic conditions in the North Atlantic from about 50 Kyr to 5 Kyr. Preliminary conclusions include: (1) Heinrich Events are present in this core located north of the primary zone of Heinrich Layer deposition; (2) Deglacial warming/ice retreat is apparently recorded at ~16 Kyr in this central North Atlantic location, some 2 Kyr earlier than in most other regions; (3) Multi-species stable isotope data may record fluctuations in upper water-column stability, and hence bear on deep and intermediate water formation. One of the biggest problems with these interpretations is the incorrect perception that data from the UMaine Stable Isotope Laboratory is flawed.

SILICIOUS MICROFOSSILS IN NORTH ATLANTIC CORE V27-114 AS INDICATORS OF GLACIAL MELTWATER

David Kellogg - Institute for Quaternary Studies

Diatoms

Diatom abundances in North Atlantic core V27-114 vary from high to very low prior to the LGM, and uniformly very low during the LGM and up to 11,500 B.P. The Younger Dryas event is marked by a diatom abundance peak. Abundances increase in a stepwise manner after 8,700 B.P. Four taxa out of the >50 encountered dominate nearly all samples. These taxa are known indicators of upwelling, productivity, winnowing, and summer pack ice, all of which vary with influx of meltwater from glaciers.

Radiolaria

A proposal to investigate changes in abundance of the radiolarian species *Cycladorphora davisiana* as an indicator of changes in salinity in the same core is in preparation.

ENVIRONMENT AND ARCHAEOLOGY IN CUBA: RECENT AND PROPOSED RESEARCH

Daniel H. Sandweiss - Department of Anthropology and Institute for Quaternary Studies

Archaeological research on Cuban prehistory has been carried out since the last century, but coverage of areas and periods has tended to be sporadic. Unlike other parts of the New World (e.g., Mexico, Peru), a complete sequence from earliest occupation to the arrival of the Europeans has not been worked out for any single locale, to serve as a basis of comparison for understanding the isolated finds in other parts of the island. Furthermore, archaeological research in Cuba has not yet managed to integrate the paleoenvironmental studies which have proven essential in understanding human prehistory elsewhere. However, recent field work by the author and colleagues from the Carnegie Museum and Cuban institutions has shown the potential for such studies.

A team of archaeologists and Quaternary scientists from UMaine, the Carnegie Museum, and Cuban institutions are preparing a project to establish an integrated sequence of human occupations and associated paleoenvironments for a single area in Cuba, the Canimar Valley. This presentation reviews the work carried out previously and outlines the planned research.

ARCHAEOLOGICAL INVESTIGATIONS IN BIG BEND NATIONAL PARK

Kristin D. Sobolik - Department of Anthropology and Institute for Quaternary Studies

The Big Bend area is a unique resource for studying prehistoric desertic adaptations because of the diverse environments and ecotones provided by the presence of the Chisos Mountains and their biological divergence from the surrounding Chihuahuan Desert. Little archaeological and paleoenvironmental research has been conducted in this distinctive area lending such research importance for our understanding of this area specifically, but also adding to our knowledge of the importance of the environment and natural resources on population mobility and settlement organizations in general.

ANALYSIS OF LITHICS EXCAVATED FROM A LATE PREHISTORIC ROCK SHELTER AT BIG BEND NATIONAL PARK (SIDE BIBE 252) DURING THE 1993 SEASON

Bret A. Achorn - Institute for Quaternary Studies

This presentation will be a brief summation of the proposed research to be conducted on the lithics at a rock shelter site in south west Texas. Having only recently arrived at the University, my project is still being outlined at

this time and various research strategies are currently being appraised. The geology of Big Bend will be explored, as will the significant regional archaeology. IT is my plan to initiate an investigation into how the inhabitants of this area obtained their raw materials and what tools types were produced. It is possible that certain elements of style may become apparent within the lithic assemblage and if this is so, then an assessment of morphological variations can be explored.

**MAINE PEATLANDS: RELATIONSHIPS TO PRESENT, PAST
AND FUTURE ENVIRONMENTS**
Objectives and Approaches, and Progress and Preliminary Results in 1993-94

Ronald B. Davis - Department of Plant Biology and Pathology and Institute for Quaternary Studies
Dennis S. Anderson - Department of Plant Biology and Pathology
Melissa E. Perera - Department of Plant Biology and Pathology
Karen E. Bates - Department of Plant Biology and Pathology

Our objectives are to elucidate the present quantitative relationships of Maine peatlands and their components to climatic and other environmental conditions, and to reconstruct past and predict future responses of these ecosystems to changes in these conditions. Our approaches include the use of canonical correspondence analyses of modern biological, chemical, and physical data sets from >100 Maine peatlands to identify the strongest relationships between (1) biota that produce fossil remains and (2) environmental variables of paleoecological interest. These relationships are then incorporated into regression models for paleoecological interest. These relationships are then incorporated into regression models for paleoecological inference and forecasting. The data sets represent the full ranges of geographical and ecological variation of peatlands in the state. The calibrated models will be applied to peat contents (e.g., vascular plant, bryophyte, and testacean remains) in multiple peat cores from several peatlands. In addition, we are investigating several ancillary aspects of peatland paleoecology and paleogeography in Maine. Progress and results from our second year of participation in EPSCoR will be given in the following three presentations.

**THE RELATIONSHIP BETWEEN TESTACEANS (PROTOZOA:RHIZOPODA)
AND ENVIRONMENTS IN MAINE PEATLANDS:
PRELIMINARY RESULTS AND FUTURE PLANS**

Melissa E. Perera - Department of Plant Biology and Pathology
Ronald B. Davis - Department of Plant Biology and Pathology and Institute for Quaternary Studies

The environments of testacean species must be understood to use their fossilized shells for inference of past hydrologic conditions in peatlands. The most common of the 70+ species at 20 peat surface microsites include Hyalosphenia subflava, H. elegans, Assulina muscorum, most Nebela spp., and Amphitrema flavum. Several species are good indicators of percent water in peat, most notably Bullinularia indica, Trinema lineare/Corythion dubium, Nebela carinata, and Trigonopyxis arcuata. The largest species (>125 μ m) are possibly more common in the extreme wettest and driest peat types. Initial results from a decomposition experiment rank H. subflava, A. flavum, and A. muscorum as most resistant to decay. Shell types in order of resistance to decay are: proteinaceous > siliceous \geq agglutinate >> calcareous. Plans for further investigation include the analysis of testacean assemblage responses to pH, cation concentrations, and bryophyte assemblages.

**NUMERICAL MODELS RELATING BRYOPHYTES AND LICHENS TO ENVIRONMENTAL
GRADIENTS OF MAINE PEATLANDS**

Dennis Anderson - Department of Plant Biology and Pathology
Ronald B. Davis - Department of Plant Biology and Pathology and Institute for Quaternary Studies

The objective of this research is to quantify and model the present relationships of peatland biota to chemical,

hydrologic, and climatic gradients, and to use these relationships to infer past environments from biotic remains. These numerical models can also be used to predict future responses of the peatlands to potential climate change. Bryophytes are good indicators of peatland environments, and bryophyte remains are an abundant component of peat cores. A database consisting of living bryophyte abundances and a wide range of chemical, physical, and climatic variables from 51 peatlands (289 relevés) was analyzed by principal components analysis and canonical correspondence analysis (CCA). A CCA with forward selection retained pH, concentrations of P, Fe, and Na in upper peat interstitial water, peat moisture content, shade, and a synthetic climate factor (heat/evapotranspiration) as the minimum number of variables that best account for the species variation. Calibrated regression models based on weighted averaging have been developed for inference of pH, moisture content, and the climate factor. The models have r^2 and RMSE of 0.81 and 0.42, 0.44 and 3.10, and 0.40 and 2.37, respectively.

CHARACTER AND CHRONOLOGY OF THE FIRST WETLAND COMMUNITIES IN EIGHT SHALLOW-BASIN FENS IN MAINE

Karen E. Bates - Department of Plant Biology and Pathology

Ronald B. Davis - Department of Plant Biology and Pathology and Institute for Quaternary Studies

In the summer of 1993 we cored eight geographically-separated, shallow fens to test the hypothesis that such peatlands originated during the cooling/moistening of the late-Holocene. Despite the shallow peat depths (0.8 to 1.4, 2.1 and 2.4 M), the first wetland communities began in the early-Holocene: 8880 +/- 90, 8500 +/- 70, 8340 +/- 70, 10,030 +/- 80, 10,082 +/- 120, and 10,570 +/- ^{14}C year B.P. Three were wet, graminoid meadows, four were graminoid, emergent wetlands and one was a semi-wooded, emergent wetland. There is no evidence of strictly terrestrial conditions preceding the wetland communities at any site.

CLIMATE TRANSITION IN THE MID-PLEISTOCENE: WAS THE ONSET OF THE 100-KYR CYCLE GRADUAL OR ABRUPT

Kirk A. Maasch - Department of Geological Sciences and Institute for Quaternary Studies

Todd K. Dupont - Department of Geological Sciences

We have investigated the rate of the increase in amplitude of the 100-kyr cycle at the mid-Pleistocene transition recorded in deep sea records using several recently developed techniques of time series analysis. Specifically, combining evolutive spectral, envelope, and wavelet analyses, we conclude that the onset of the dominant 100-kyr cycle was apparently rapid, perhaps occurring in less than 100 kyr.

SURFICIAL STRATIGRAPHY AND GEOMORPHOLOGY OF CAPE BIRD, ROSS ISLAND, ANTARCTICA: IMPLICATIONS FOR LATE WISCONSIN GLACIATION IN THE ROSS SEA EMBAYMENT

Tina M. Dochat - Department of Geological Sciences

Antarctica contains 90% of the global ice budget. If completely melted, this ice would raise sea level 66 m. We do not yet understand how the Antarctic Ice Sheet responds to climatic change. The last sustained episode of climatic change was one of global cooling that occurred 24-12 ka ago. If the Antarctic Ice Sheet expanded during this time, then one key location to determine how expansive the ice sheet became is Cape Bird, Ross Island. Located in the Ross Embayment along a postulated ice-flow line, Cape Bird preserves a record of events from the last glacial maximum to the present. Drift with datable organics indicates that the ice reached an elevation of at least 549 m asl. Included marine shells and erratics indicate that the drift was deposited by a grounded marine ice sheet, a component of which originated in East Antarctica. A study of Cape Bird raised beaches suggests that raised beaches are not necessarily related to the time of deglaciation and, therefore, cannot be used reliably to determine ice extent in the Ross Sea as has been proposed by some researchers.

NEW EVIDENCE FOR ICE FLOW DIRECTIONS OVER COASTAL, WESTERN IRELAND

Harold W. Borns, Jr. - Department of Geological Sciences and Institute for Quaternary Studies

The formation and significance of glacier domes on continental shelves is a new and important problem for glaciology and global change studies. Recently found geological erosional and depositional evidence along the western coast of Ireland demonstrates that a marine-based ice sheet formed on the continental shelf and flowed eastward onto the western coastal zone during late Weichselian time.

MODELING THE TRANSIENT THERMAL DISTRIBUTION IN NON-STEADY STATE GLACIERS: AN OVERVIEW OF THE JUSTIFICATION AND APPROACH

Sathya Rajavelu - Department of Computer Science

For ice modeling studies, to accurately describe the physical processes that control an ice sheet, we need to conjunctively solve three basic conservation equations: 1) Conservation of mass, 2) Conservation of momentum, and 3) Conservation of energy. The inter-dependencies of the parameters involved in the solution of these equations increase the complexity of the model.

Results from a trial run of a 1D thermal model are discussed to highlight the need for a unified ice model. Specifically, with respect to the impact of temperature on the ice hardness parameter. The temperature component influences the mass component which in turn influences the momentum component. The temperature component is itself influenced by the momentum component. The results of the experiment reflect these inter-dependencies.

A top-down approach is adopted for development of the model. The stages in the development are presented.

RADIOCARBON CHRONOLOGY OF DRIFT IN THE CHILEAN LAKE DISTRICT AND THE SOUTHERN ALPS OF NEW ZEALAND

George H. Denton - Department of Geological Sciences and Institute for Quaternary Studies

The glacial chronology from the Andes and Southern Alps at 45°S latitude shows many elements of the North Atlantic record of abrupt climate changes. These include the Younger Dryas, the abrupt onset of the termination at 14,500 ¹⁴C years B.P., and advances at 14,800 (H-1); 17,500; 21,000 (H-2), and 27,400 (H-3) ¹⁴C years B.P. The implications are that these climatic events were global and must have had a source in the atmosphere. The cause of these climatic events remains a mystery.

CAN ICE SHEETS TRIGGER ABRUPT CLIMATIC CHANGE?

Terence J. Hughes - Department of Geological Sciences and Institute for Quaternary Studies

The life cycles of ice streams seem to result from a natural "breathing" of Northern Hemisphere ice sheets. The "breathing" turns major Laurentide ice streams on and off abruptly and almost synchronously around the entire ice-sheet perimeter, and may produce ice volume changes that are almost synchronous with the cycles of stadials and interstadials in ice-proxy stratigraphic records.