tion, oxygen isotopic composition of precipitation, volume of glacial meltwater input, and oxygen isotopic composition of meltwaters as inputs to the model. Output from the model include the volume and isotopic composition of the outflow from each lake basin. We have used the published isotopic composition of the melt waters from glacial Lake Agassiz as input to the model and have adjusted the volume of melt waters passing through the Great Lakes basins to match both the known drainage pathways and the isotopic composition of the lake waters derived from oxygen isotope studies of cores from the lake basins.

Estimates of outflow from the Great Lakes system are highest during the early history of the lakes and during lowstands of the lakes when oxygen isotopic composition of the lake waters are the most negative. The maximum values during these intervals are slightly less than 0.03 Sverdrups. This rate of outflow through the St. Lawrence seaway, by itself, does not appear to be sufficient to provide the fresh water 'cap' on the North Atlantic as estimated by published models of thermo-haline circulation. Additional input from the marine and southeastern-most portions of the Laurentide Ice Sheet, as well as the Scandinavian Ice Sheet, are needed to provide enough fresh water to shut off the formation of North Atlantic Deep Water.

BTH 89 Rea, David K.

ANNUAL AND SEASONAL CLIMATIC VARIABILITY IN THE NORTH AMERICAN MID CONTINENT DURING THE YOUNGER DRYAS: A STUDY OF LAKE HURON VARVED SEDIMENTS

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A sequence of varved sediments of early Holocene age was recovered in a large-diameter piston core raised from 123 meters depth in northwestern Lake Huron. The upper portion of this core includes 264 red/gray couplets. The lower red layer is characterized by springtime pollen and the overlying gray layer of each is characterized by late summer and fall pollen. The contact between the red and gray layer is gradational, and between the gray and over lying red horizon is sharp. The varves are commonly 1 to 2 cm thick; 25 thicker varves divide the sequence into upper and lower sections. We interpret the thickness of the varve layers as reflecting runoff and sediment input to the lake, and the red/gray coloring allows us to examine seasonal differences as well as annual variability. Image analysis was used to enumerate red and gray layer thickness, and these data were subject to spectral analysis by both the Blackman-Tukey autocorrelation technique and the multi-taper method. Results show significant variability at periods of 2.3-2.6 years associated with the Quasi-Biennial Oscillation, 3.4-3.8 years associated with ENSO, a peak at 7.3 years similar to that of the North Atlantic Oscillation, and a longer period of about 15 years. Evolutionary spectra 'maps' for the varves show three periods of climatic stability separated by 10-20 year transition intervals, one of which is associated with the thick varves. The older part of the sequence displays more variability in the red layers associated with spring melting and runoff. In the younger part of the sequence the variability is dominated by variation in the late summer and fall part of the seasonal cycle.

BTH 90 Lini, Andrea

THE BIRTH OF POST-GLACIAL LAKES: A TALE OF STABLE ISOTOPES

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Carbon and nitrogen stable isotope and C/N ratio analyses performed on bulk organic matter from cores recovered from the depocenters of two Holocene post-glacial lakes in northern Vermont provide significant insights into the response of lacustrine ecosystems to past environmental and climatic changes. The two lakes have contrasting sedimentation histories reflecting differences in the geomorphology and hydrology of their watersheds. The contrasting sedimentation histories are also reflected in the isotopic records of the two lakes. Both the carbon and nitrogen isotopic signature and the C/N ratios of the sedimentary organic matter have been used to time the onset of lacustrine primary productivity and examine fluctuations in the relative contributions of terrigenous and aquatic organic matter to the sediments through time. Furthermore, the combined use of isotopic and C/N data allow us to distinguish between macrophyte and algal organic matter in the sediment. The isotopic data show that in the studied lakes aquatic communities were not fully established until about 500 to 3000 years after the glaciers left, thus providing valuable indications about the time necessary for lacustrine biota to recover from extreme climatic events. In particular, the isotopic records indicate that the response of land vegetation and lake biota to deglaciation was more immediate in the lower altitude lake (Ritterbush Pond, 317m asl). In the higher altitude lake (Sterling Pond, 1000 m asl), it took about 3,000 years longer for aquatic primary producers to become a significant source of sedimentary organic matter. The difference between the two records reflects different revegetation patterns and the delay in the establishment of aquatic productivity in the alpine zone, where the higher altitude lake is located.

BTH 91 Gregoret, Amy

CARBON CYCLE GEOLOGY OF GREEN AND SPECTACLE LAKES, MINNESOTA, AS A GENERAL MODEL

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Although lakes are small features on the landscape, they represent a significant sink for organic and inorganic carbon. In Minnesota lakes, documented Holocene shifts in the magnitude and style of carbon accumulation are linked to regional climate history. The sedimentary records of two small lakes less than 1 km apart in east-central Minnesota show divergent carbon accumulation histories related to Holocene climatic, hydrologic, and landscape changes. Green Lake, an open basin, has sediments rich in authigenic carbonate until the cultural horizon, when organic content increases. Spectacle Lake, a closed basin, shows an abrupt Mid-Holocene switch from carbonate- to organic carbon-rich sediment, whereafter sediments consist primarily of algal organic matter. In order to understand the factors forcing these and more subtle shifts in lake carbon storage, a flux-reservoir model of aquatic carbon cycling is developed which includes biotic, chemical, physical, and hydrologic controls on the system, as well as the isotopic signatures of C, H, O, and N constituents. Because all lakes share characteristic components of the carbon cycle, a process model of carbon dynamics is broadly applicable to lake systems throughout the world.

BTH 92 Spooner, Ian S.

LATE-GLACIAL AND EARLY HOLOCENE STRATIGRAPHY AND PALEOECOLOGY OF TAYLOR LAKE, NOVA SCOTIA, CANADA

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Lake sediment, diatom, sponge spicule and pollen stratigraphy of sediments from Taylor Lake, eastern Nova Scotia reveal changes in vegetation, ecology and climate during the Late Glacial and Early Holocene. Though the Taylor Lake site was deglaciated in advance of Younger Dryas (YD) cooling the diatom and sponge spicule data indicate that a pre-YD warming trend was absent. The Younger Dryas inorganic marker horizon (YDimh) is coarse-grained, exhibits reduced pollen concentrations and contains no diatoms or sponge spicules. Complete ice-cover was thought to prevail during the YD and the development of aufeis and perennial snow cover was likely at this time. The YDimh was formed as a consequence of both increased sedimentation rates associated with landscape instability and reduced productivity.

Post YD aquatic conditions were acidic and possibly turbulent. Pollen and sedimentological data indicate the rapid establishment of a stable and productive landscape. An upper oscillation (UO) at about 7500 14C yr BP is the result of a cooling event indicated by both a decrease in LOI and a resurgence of alkaliphilic, benthic diatoms and cold-water-tolerant sponges. Image and grain size analysis of the bounding gyttja and the UO indicate that the these sediments differ primarily in their respective volumes of fine silt and clay; the maximum grain size of each unit remained unchanged. This would indicate that changes in sediment transfer mechanisms in response to cooling were subtle. The UO correlates with a regional cooling event that has been recognised in northwestern Europe.

BTH 93 Silis, Astride B.

OSTRACODES AS PALEOLIMNOLOGICAL INDICATORS AT THE BIGHEAD RIVER SITE NEAR MEAFORD, ONTARIO

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As the Laurentide Ice Sheet began its final retreat from southern Ontario, after the Port Huron stade, a series of glacial lakes formed in the present day Great Lakes basins. One of these lakes is the focus of this study. Glacial Lake Algonquin existed from 11300 to 10500 y BP in the present day Lake Huron and Georgian Bay basins. Limnological studies of this lake phase have been ongoing since 1891, when J.W. Spencer first named it. In several areas along the shore of Lake Algonquin lagoons formed in embayments and behind gravel bay mouth bars. Ostracode species that lived in these lagoons are still present in water bodies today. By analyzing the environmental conditions in which these ostracodes live a paleoenvironmental interpretation can be applied to fossil assemblages.

The Bighead River site near Meaford, Ontario is a 4.6 m Lake Algonquin section of laminated buff and gray sand to clayey silts. Sixteen fossil ostracode species were found upon sampling the section at 10 cm intervals. Four faunal zones were derived using the distribution of the species in the section. A paleoenvironmental interpretation of the freshwater habitat was also calculated. Faunal zone I was found from 4.6 to 3.0 m. The water habitat at this time was likely a mixture of littoral lake and pond with inflowing streams. This has been interpreted to be a deltaic habitat. Faunal zone IIa is found from 3.0 to 1.8 m in the section. The ostracodes in this section indicate that the water environment had deepened in the lower portion of the section to a lake habitat and then shallowed upsection to a mix of pond and streams. Faunal zone IIba stretches from 1.8 to 0.7m. This section is predominantly a littoral pond, similar to that seen at the top of the previous zone. Zone IIa and IIba indicate that as Lake Algonquin waters were rising there was a hiatus, in which the embayment environment shallowed. The final faunal zone is found from 0.7 to 0m and represents the Main Lake Algonquin phase, when water levels had reached their maximum height. The faunal zones found at the Bighead River section can be correlated regionally with other sites studied in Southwestern Ontario.

BTH 94 Sharpe, Saxon E.

HOW ACCURATELY DOES GASTROPOD SHELL DELTA 18-O RECORD HYDROLOGIC BALANCE?

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The hydrologic balance between sources of inflow and the nature of outflow in lakes and wetlands can be estimated with delta 18-O (water). A record of delta 18-O (water) can be produced when the aragonitic shells of aquatic gastropods calcify; these isotope values are often used to interpret paleohydrology and paleoclimate. This study compares the delta 18-O (water) values with those from gastropods in 1) a flowing spring to evaluate the relation in a relatively controlled natural setting and 2) a nearby welland to evaluate the potential for gastropod shell delta 18-O values to estimate seasonal change in delta 18-O (water).

Water and live aquatic gastropods were collected monthly over a 2 year period from Little Washoe Lake and a nearby spring approximately 27 km south of Reno, NV. Solute data were also collected monthly at Little Washoe Lake to further assess hydrologic balance. The delta 18-O (water) values from the spring were relatively constant throughout the year, although water temperature varied slightly. Evaporation, relative to inflow, was very high at Little Washoe Lake in the summer and fall, water and air temperature covaried, and delta 18-O (water) values varied widely.

Shell isotope values from Physella sp. were consistent (but not necessarily in isotopic equilibria) with the spring water, but those of Stagnicola sp. were often inconsistent by being very heavy. Isotopic values for adults and juveniles of both species were almost always heavier than isotopic equilibrium would predict. Highly variable Little Washoe Lake contained gastropods with shell delta 18-O reflecting the seasonality of this environment; shell values were highly variable, ranging between 20-34 per mil, throughout the year. Therefore, certain species represent the isotopic value of the water better than others, and delta 18-O values from some gastropod shells provide a delta 18-O record of hydrologic balance.