The Peace-Athabasca Delta (PAD), situated at the confluence of the Peace and Athabasca Rivers at the western end of Lake Athabasca, is one of the world’s largest freshwater deltas, containing a myriad of shallow lakes and wetlands, which support bountiful wildlife, including migratory waterfowl and a large population of North American bison. Although lying at boreal latitudes, the PAD constitutes a unique extra-limital prairie wetland complex ecologically, as well as being a key node in the Mackenzie River drainage system, the single largest source of freshwater discharge to the Arctic Ocean from continental North America. The PAD also has important indigenous and historical cultural significance and is recognized internationally as a UNESCO World Heritage Site.

Extensive multidisciplinary research efforts are being conducted to gain better understanding of the present and past ecohydrology of the PAD, with the aim of assessing the impact of both natural and anthropogenic factors, ranging from climatic variability and change to the influence of river flow regulation resulting from hydroelectric power generation at the headwaters of the Peace River (Prowse and Lalonde, 1996; Timoney et al., 1997; Cohen, 1997). The latter is of particular interest because of the possibility that alteration of the discharge characteristics of the Peace River may be affecting the frequency and magnitude of spring ice-jam flooding, which plays an important role in the water balance of many lakes and wetlands that are perched above the level of other, more frequent, high-water events (e.g., see Prowse and Conly, 1998, 2000).

This is an important consideration for effective long-term environmental stewardship of the PAD in the face of future climatic variability and change, as well as the likelihood of increasing demand for hydroelectric power and consumptive water use.

Our studies of the modern ecohydrology are spearheaded by utilization of the water isotope tracers $\delta^{18}O$ and $\delta^2H$ to assess instantaneous water balance in selected lakes and especially to detect events such as high-water flooding, which is difficult to monitor directly because of the remote setting and extremely subdued topography of the PAD. Information about the present hydrologic status and variability of lakes is crucial to the interpretation and calibration of other biological, physical and geochemical indicators (e.g., diatoms, plant macrofossils, pigments, C and N elemental and isotope data from aquatic cellulose to reconstruct the history of selected PAD lakes from sediment cores.

An impression of the dynamic and individualistic behaviour of lakes in the PAD can be gained from the $\delta^{18}O$ - $\delta^2H$ crossplots for sequential sampling of lakes PAD 5 and PAD 42 shown in Figure 1. PAD 5, a shallow (~1 m) perched lake in a forested part of the Peace sector that normally receives river water only in the event of major ice-jam floods, reveals significant changes in isotopic composition between sampling episodes in October 2000, June 2001 and August 2001. Slight depletion in heavy-isotope content between October 2000 and June 2001, attributable to dilution by local precipitation (mostly snowmelt), was followed by progressive evaporative enrichment over the summer captured by the sample obtained in August 2001. PAD 42, a lake of comparable size and depth in a sparsely forested area in the Athabasca sector having frequent river connection, on the other hand, behaved in a strongly contrasting manner, marked by pronounced heavy-isotope enrichment between October 2000 and June 2001 due to the overwhelming influence of evaporation on the water balance of the lake after ice-off in the spring, in spite of contributions from snowmelt runoff. This was followed by a profound shift to lower values by August 2001, obscuring the effects of seasonal evaporation, deriving from a mid-summer high-water event in
Lacustrine Oxygen Isotopic Records from Temperate Marl Lakes

RICHARD T. JONES¹ and JIM D. MARSHALL²

¹Hawes Water Research Group, Departments of Geography¹ and Earth Sciences², University of Liverpool, Liverpool, L69 3BX, UK.; rtjones@liv.ac.uk, isotopes@liv.ac.uk

Sediments from small, temperate, carbonate lakes can provide excellent archives for Late Glacial and Holocene paleo-environmental investigations. The rapid reaction of the local hydrological system to environmental change, coupled with relatively high sediment accumulation rates, facilitate high-resolution stratigraphic studies that can employ a wide range of lithological, chemical and biological proxies. Stable isotopic data can be collected relatively easily from authigenic carbonates, which precipitate in the water column, and from the calcareous skeletons of macro and micro-fossils. Ostracods that inhabit different lacustrine settings and which calcify at different times of the year potentially enable seasonal and depth variations to be determined. Carbonate oxygen isotopic data is particularly useful in that it can provide a record that can be linked to changes in temperature and meteoric precipitation on a scale that can be directly correlated with ice-core records. Because water residence times are short these isotopic records also can be used as a proxy for ‘instantaneous’ climate forcing – enabling the identification of lag effects and non-linear changes in other proxies which are controlled by processes acting within the lake catchment.

Sediments from several small hard-water lakes are the focus of current investigations funded by the Natural Environment Research Council. The sediment records are being calibrated by the investigation of carbonate precipitation and isotopic variation in the modern lakes (Fig. 1) and a multiproxy investigation in-