bility and of the sensitivity of aquatic ecosystems to such variability. Since both natural variability, including extreme events, and anthropogenic forcing will contribute interactively and in as yet unknown proportions to future climate changes, it is important to understand the links between natural climate variability and aquatic ecosystem response. For this, a longer time scale than the last 200 years will be needed. Case studies spanning the last 1000 to 6000 years are therefore envisaged and these will also have the advantage of including the time frame of direct interest to the PAGES Focus 3 initiative on the Human Impact on Fluvial Systems since the beginning of Agriculture (LUCIFS – see PAGES Newsletter 98–1). The information generated by these studies will provide a more realistic view of pre-industrial base-line conditions and of the sensitivity of aquatic systems to the temporal pattern of natural variability.

High resolution, near-shore marine sediments with a major terrigenous component can provide paleorecords broadly comparable to those available through lake sediment studies. In addition, they can be used to document the impact of changing sediment and biogeochemical fluxes on marine and coastal ecosystems.

Ground Water, Mountains and Wetlands

Ground water forms a major human resource. Under favorable conditions, ground waters (unsaturated zone as well as saturated zone environments) may also act as an archive of climatic and environmental change. This information is obtained from conservative chemical species, noble gas ratios and isotopic signatures. This archive is the only other indicator, apart form ice cores, which may store water directly from former times. The ground water archive not only helps to quantify source contributions, ground water age, recharge rates and the future consequences of abstractions, but also human impacts from diffuse and point source contamination. Currently available research methods include the tools for understanding the fluxes of nutrients and contaminants between surface and ground waters, the role of ground waters as both sources and sinks and the future consequences of present and projected levels of exploitation.

In many upland areas and in regions dependent on the capacity of the world's mountains to store and deliver water for human use, glaciers and snow fields form an important part of the aquatic system. The response of these to recent climate change and their vulnerability under conditions of predicted global warming is a further area of concern into which paleodata can shed light.

Wetlands also contain paleo-records from which their role as biogeochemical sinks and sources, both of nutrients and trace gases can be reconstructed. Growing acknowledgment of the importance of wetlands in geochemical cycling and environmental management points to the need to exploit these systems as archives of recent changes in nutrient flux and sequestration rates.

Summary

In summary, sedimentary and other paleorecords can help to quantify the role of natural variability and human impacts on biogeochemical cycling in the continental aquatic component of the earth system, on a catchment, regional and, potentially, a global scale. They can provide information on base-line conditions and realistic management targets in amelioration programs. In addition, they can put present day observations, data sets and experiments in a realistic, dynamic context that acknowledges the role of changing forcing mechanisms in the fluxes, stocks and concentrations of at least some nutrients. In so doing, paleo-research also provides an essential tool in model development and validation.

The PAGES SSC has approved in principle the establishment of a new Activity within 'Focus 3' (Human Interactions in Past Environmental Changes). This Activity, to be led by Rick Battarbee, University College London, has been entitled "human impact on lake ecosystems and the role of palaeolimnology" (LIMPACS). One of the tasks for LIMPACS will be to link with and contribute to the IGBP-wide 'Water' initiative and thereby ensure that it serves the needs of both PAGES and the IGBP community as a whole.

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The above report is a modified extract from the IGBP briefing document on "Continental Aquatic Systems".

PEP I

New Leader

Geoff Seltzer, professor of Quaternary Geology and Geomorphology, Dept. of Earth Sciences, Syracuse University, has taken over the leadership of the PEP I transect from Vera Markgraf. Geoff's research focuses on the glacial and climatic history of the Andes of Ecuador, Peru, and Bolivia. Specifically, he is developing high resolution (centennial to millennial scale) records of climate change for the late Quaternary (last 20,000 years). The development of such proxy records provides the primary means by which hypotheses are generated and tested regarding the patterns and mechanisms for global climate change during the Quaternary. Recent research projects that Geoff has been involved with include: the history and climatic interpretation of glaciation in the Bolivian Andes, the pollen stratigraphy of lake cores and its relevance to changes in vegetation and climate, the physical sedimentology of glacial lakes in the central Andes, relict ice deposits in saline lakes of southwestern Bolivia and their relevance to issues of regional climate change and the Holocene record of lake level change in the Bolivian cordillera from cores of lacustrine sediments. His future research projects in the Andes include: high resolution glacial geologic and palynologic studies of the Ecuadorian and Peruvian Andes, the sedimentology of Lake Titicaca as a potential high-resolution and long-term climate record from the tropics, the use of cosmogenic isotopes in surface dating of moraines in the Bolivian Andes and stable isotope stratigraphy of marl-rich lakes in the Peruvian Andes. Geoff has an exciting set of plans building on the success of the recent PEP1 meeting on interhemispheric patterns of climate change in the Americas (Merida, March 1998) and complementing the ongoing PEP I synthesis project. His goals for PEP I will be the subject of a future PAGES newsletter report.

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