Workshop on Aquifers as Archives of Paleoclimate

Martin Stute, martins@ldeo.columbia.edu
10/31/07

Background

The isotopic and elemental compositions of groundwater are influenced by climatic conditions at the time of recharge and are therefore indicators of climate change. Since the 1970s, numerous researchers have identified aquifer systems all over the world that contain groundwater of Pleistocene and Holocene origin. They have used the concentrations of the dissolved noble gases, as well as its chemical (e.g. Cl) and stable isotopic (^{18}O, ^{2}H) composition, and groundwater radiocarbon dates to reconstruct paleoclimate records. While groundwater is a low pass filter and does not allow for high temporal, e.g. millennial scale reconstructions, the climate proxies are very directly linked to climate variables. Temperatures derived from the dissolved gases, for example, have an uncertainty of $\pm 0.5^{o}C$, and the isotopic composition of groundwater is generally a direct sample of precipitation at the time.

These data sets have played an important role in glacial paleoclimate reconstructions. Noble gas paleotemperature records have been reviewed the last time about 7 year sago [*Farrera et al.*, 1999; *Stute and Schlosser*, 2000]. There has never been a comprehensive review of stable isotope groundwater data on the glacial/interglacial time scale. Progress in the interpretation of these proxies [*Aeschbach-Hertig et al.*, 1999; *Ballentine and Hall*, 1999] requires a systematic re-analysis of the existing data. The recent development of coupled ocean/atmosphere climate models that include water isotopes (LeGrande, Schmidt, GISS) have sparked a renewed interest in ^{18}O and ^{2}H records in all paleoclimate archives, including aquifers. Unfortunately, the data sets are widely scattered in the literature, some are unpublished, and the raw data are interpreted by various models, some of which are now obsolete. There is a need to revisit these data sets and interpretative models for aquifer archives and create an internally consistent comprehensive review, which will then serve as interface with the paleoclimate and climate modeling community.

Proposal

I propose to bring together a group of key specialists to re-analyze existing data and produce a paper that reviews the differences in noble gas temperature and stable isotopic composition between the last glacial period and the Holocene. I anticipate that with proper preparation and cooperation among the participants we will be able to accomplish most of this task in a period of 2 days at LDEO. The meeting is planned for March/April of 2008, when airfares are reasonable.

Meeting Agenda

Day 1 will be dedicated to a review of existing data, with every participant responsible for their own work plus assigned studies/data of authors who are deceased, or not longer

working in this field. The first half of day 2 will focus on building a consensus on how to evaluate all groundwater paleoclimate records in a uniform framework. The second half of day 2 will be dedicated to a discussion on future research directions that will push this field forward and of the logistics of publishing the review.

Participants

1. Werner Aeschbach-Hertig, University of Heidelberg, Germany
2. Jordan Clark, UCSB, Santa Barbara,CA
3. Daniele Pinti. Université du Québec à Montréal, Montréal, Canada
4. Chris Hall, University of Michigan, Ann Arbor, MI
5. David Hilton, Scripps, La Jolla, CA
6. Roland Purtschert, University of Bern, Bern, Switzerland
7. Rolf Kipfer, ETH Zürich, Zürich, Switzerland
8. Kazimierz Rozanski, University of Technology Kraków, Kraków, Poland
9. Kip Solomon, University of Utah, Salt Lake City, UT
10. Zoltan Szabo, USGS, Trenton, NJ
11. Niel Plummer, USGS, Reston, VA
12. Peter Schlosser, LDEO
13. Martin Stute, LDEO

Budget

I anticipate that I do not need to cover all expenses for the participants. For a two day meeting I anticipate the following expenses to partially cover air fare and accommodation and food for the participants:

	each	total
4 European participants	600	2400
7 US/CA participants	400	2800
2 local participants	0	0
coffee breaks, 1 dinner		800
Total		6000

References

Aeschbach-Hertig, W., et al. (1999), Interpretation of dissolved atmospheric noble gases in natural waters, *Water Resour. Res.*, *35*(9), 2779-2792.

Ballentine, C. J., and C. M. Hall (1999), Determining paleotemperature and other variables by using an error-weighted, nonlinear inversion of noble gas concentrations in water, *Geochim. Cosmochim. Acta*, *63*(16), 2315-2336.

Farrera, I., et al. (1999), Tropical climates at the Last Glacial Maximum: a new synthesis of terrestrial palaeoclimate data. I. Vegetation, lake levels and geochemistry, *Clim. Dyn.*, *15*(11), 823-856.

Stute, M., and P. Schlosser (2000), Atmospheric noble gases, in *Environmental tracers in subsurface hydrology*, edited by P. G. Cook and A. L. Herczeg, pp. 349-377, Kluwer, Boston.