

## Rivers of North Rhine Westphalia – Revisited

A. STÖGBAUER<sup>1</sup>, H. STRAUSS<sup>1</sup>, J. ARNDT<sup>1</sup>, V. MAREK<sup>1</sup>,  
F. EINSIEDL<sup>2</sup> AND R. V. GELDERN<sup>3</sup>

<sup>1</sup>Geological and Palaeontological Institute, Westfälische  
Wilhelms-Universität Münster, Corrensstr. 24, 48149  
Münster, Germany; (astoeg@uni-muenster.de;  
hstrauss@uni-muenster.de)

<sup>2</sup>GSF-National Research Center for Environment and Health,  
Institute of Groundwater Ecology, Ingolstaedter Landstr.  
1, 85764 Neuherberg, Germany (einsiedl@gsf.de)

<sup>3</sup>Leibniz Institute for Applied Geosciences, Section3: Geo-  
chronology and Isotopehydrology, Stilleweg 2, 30655  
Hannover, Germany (r.geldern@gga-hannover.de)

In the early nineties of the last century rivers of North-Rhine Westphalia were examined by Veizer and members of his working group (Flintrop *et al.*, 1996). Their motivation for having a close look on these – and on other more eminent – rivers was primarily the search for the missing carbon-dioxide sink. In addition, they provided a documentation of the pollution situation. We revisited some of these rivers, looking for possible changes that occurred during the past 15 years, and visited additional rivers with the focus not on the carbon budget but more on the pollution state.

In order to isolate occurring in-river processes and to identify sources of river constituents we analysed the isotopic compositions of  $\delta^2\text{H}$  and  $\delta^{18}\text{O}$  of water,  $\delta^{13}\text{C}$  of dissolved inorganic carbon,  $\delta^{34}\text{S}$  and  $\delta^{18}\text{O}$  of sulphate, and  $\delta^{15}\text{N}$  and  $\delta^{18}\text{O}$  of nitrate. Isotopic work was supplemented with measurements of common physical parameters and concentrations of major anions and cations.

The different geographic settings of the rivers are mirrored by their isotopic composition of water. Respective regional trends are affected by processes as evaporation and mixing of different water masses. Compared to previous work, salt pollution (i.e. ions commonly attributed to an anthropogenic origin) has decreased. This holds true especially for potassium and nitrate, but also for sodium and chloride. The isotopic composition of nitrate in the river Ruhr identifies organic fertilizers and sewage as the main sources, with some evidence for denitrification processes. Compared to 1991, sulphate concentration has increased in the downstream part of the Lippe. Low  $\delta^{34}\text{S}$  values suggest a higher contribution from pyrite oxidation as the likely cause. This could indicate changes in mining activity and related groundwater hydrology. For dissolved inorganic carbon we found higher concentrations characterized by lower  $\delta^{13}\text{C}$ -values in all rivers compared to results from the early 1990s, caused by differing meteorological situations and in-river carbon cycling.

### Reference

Flintrop, C., Hohlmann, B., Jasper, T., Korte, C., Podlaha, E.G., Scheele, S., and Veizer, J. (1996), *American Journal of Science* **296** 58-98.

## Cosmogenic nuclide calibration – A progress report from the CRONUS project

JOHN STONE

Department of Earth and Space Sciences, University of  
Washington, Box 351310, Seattle, WA, 98195  
(stone@geology.washington.edu)

One goal of the overall CRONUS project (CRONUS-Earth, CRONUS-EU and contributors from countries outside the US and EU) is to derive cosmogenic nuclide production rates from well-characterised geologic sites. We aim to generate a network of natural calibration data that span a wide range of altitudes, latitudes and exposure periods, including as many nuclides and target minerals as possible at each site. This talk will provide a status report on geological calibration of  $^{10}\text{Be}$ ,  $^{26}\text{Al}$ ,  $^{36}\text{Cl}$  and  $^3\text{He}$  production rates, reviewing published data and presenting initial CRONUS results from sites in North America, Scotland and Antarctica.

The geological calibration effort is closely integrated with work on altitude-latitude scaling schemes, which provide the framework for comparing production rates between different latitudes, altitudes and exposure periods. All published scaling schemes can reconcile existing  $^{10}\text{Be}$  calibration data to within approximately 10% (1 sd). Assigning appropriate scaling errors is more complicated, however, because examination of the misfit between scaled production rate estimates and calibration data shows that there are systematic effects (biases in latitude and/or altitude) for all calibration schemes, as well as random error. The systematic component is minimal close to calibration sites, but may be large (and is unknown) at latitudes and altitudes far from calibration data. Additional calibration sites are needed to provide denser coverage, especially in latitude and exposure duration. Low latitudes are poorly represented in the data so far, and old sites are required to test the predictions of time-dependent scaling schemes which attempt to correct for paleomagnetic variations.