

# *Past Patterns of Precipitation and Earth Temperature*

**Wallace Broecker †**

**2008 Balzan Prize for Science of Climate Change**

**Balzan GPC Adviser:** Enric Banda

**Project Director and Researchers:** R. Lawrence Edwards (Supervisor); Irene Schimmelpfennig, Xianfeng Wang, Jimin Yu (Researchers)

**Affiliated Institution:** Comer Science and Education Foundation

**Period:** 2009-2013

Wallace Broecker was Newberry Professor of Earth and Environmental Sciences at Columbia University. He dedicated 90% of his Balzan Prize to his Research Project, which had the general aim of determining whether the paleoclimate record can support the prediction that precipitation will be more strongly focused on the Equator as the planet is warmed by fossil fuel CO<sub>2</sub>. Lacking an adequate warm analogue, a cold one – namely, the situation during the last glacial period – has been already used with encouraging results (i.e., less focusing of rainfall on the tropics during colder times). However, possible flaws in the cold analogue have yet to be evaluated. Research activities focused on data from different sources, including deep sea sediments and closed-lake basin size, cave deposits and ice core records.

Wallace Broecker supported three postdoctoral fellows. Jimin Yu (PhD, University of Cambridge) had demonstrated that the boron to calcium ratio in the CaCO<sub>3</sub> shells of bottom dwelling open ocean foraminifera are tightly correlated with the extent of carbonate ion undersaturation. At Lamont-Doherty Earth Observatory at Columbia University, he used this method to reconstruct the evolution of deep ocean carbonate ion concentration from the glacial maximum (~25 kyrs ago) to the present. His goal was to evaluate the role of deep ocean chemistry in the rise of atmospheric CO<sub>2</sub> content at the close of the last glacial period. Xianfeng Wang (PhD, University of Minnesota) had created an 18O record for stalagmites in Brazil and showed that millennial duration fluctuations in monsoon rainfall were exactly antiphased with

those in China. At Lamont-Doherty Earth Observatory, he continued this research, but also diversified his efforts by measuring the concentrations of  $^{234}\text{U}$ ,  $^{230}\text{Th}$ ,  $^{231}\text{Pa}$  and  $^{10}\text{Be}$  in sediments from the abyssal ocean. In so doing, he followed up on research done by Richard Ku in the 1970s with modern instrumentation. Irene Schimmelpfennig (PhD, France on the production rate of  $^{36}\text{Cl}$  in separated minerals) worked with Joerg Schaefer's group at Lamont-Doherty Earth Observatory to pursue the use of  $^{36}\text{Cl}$  and  $^{10}\text{Be}$  in what is termed "cosmic-ray exposure dating". During the last few years, working with Aaron Putnam and Yonathan Goldsmith, Broecker has used the paleo record to show that the preferential  $\text{CO}_2$  warming of the northern hemisphere will cause the planet's rainbelts to undergo a northward shift.

### **Publications**

The following article can be added to the 25-item bibliography in the previous editions of the *Overview*, which can be consulted at: <http://www.balzan.org/en/prizewinners/wallace-s--broecker/research-project-broecker>.

Broecker, W.S., and A. Putnam. 2013. Do the hydrologic impacts associated with shifts in the thermal equator offer insight into those to be produced by fossil fuel  $\text{CO}_2$ ? *PNAS*, 110, no. 42, 16710-16715.