Name of research institute or organization:

Eawag

Title of project:

^{7}Be and ^{10}Be in monthly precipitation

Project leader and team:

Prof. Jürg Beer, project leader
Dr. Jose Abreu, Dr. Friedhelm Steinhilber, Dr. Ulla Heikkilä

Project description:

^{7}Be (half-life: 53.2 days) and ^{10}Be (half-life: 1.4 million years) are contiunuously produced in the atmosphere by spallation reactions of cosmic ray particles with nitrogen and oxygen. Within a short time after production these radionuclides become attached to aerosols and follow their pathways. Ultimately they are removed from the atmosphere mainly by wet precipitation. Some are stored in natural archives such as glaciers, ice sheets, lake and sea sediments. Measuring ^{10}Be in ice cores reveals unique information about the long-term variability of the cosmic ray intensity for the past several hundred thousand years. However, the cosmic ray induced production signal is affected by the transport and scavenging processes from the atmopshere into the respective archive. ^{10}Be can be considered as a natural “neutron monitor” with a low temporal resolution, but with a very long operation period (Beer 2000). Therefore, a direct comparison and calibration with a man made monitor is important to make optimal use of its long record reaching back today about 10,000 years.

Continuous monthly samples from Jungfraujoch and Dübendorf allow us to monitor the production signal and to study transport effects. The ^{10}Be/^{7}Be ratio is especially well suited to investigate atmospheric mixing because the ratio is known as a function of altitude and latitude and increases with the travel time from the production to the deposition site.

Our record of monthly data covers the past 11 years and shows a clear seasonal signal with increased ^{7}Be and ^{10}Be fluxes and higher ^{10}Be/^{7}Be ratios during summer. These results point clearly to changes in the air exchange between stratosphere and troposphere. The basic feature can be reproduced with a simple atmopsheric 2-box model (Heikkila et al 2008). More realisitc modeling using the general circulation model ECHAM5-HAM shows that the stratosphere can be consdered as well mixed for ^{10}Be and that the production signal is becoming increasingly dominant on longer time scales (Heikkila et al 2009).

Key words:

Long-term cosmic ray record, ^{10}Be, atmospheric transport processes

Collaborating partners/networks:

J. Feichter, MPI Hamburg

Scientific publications and public outreach 2009:

Refereed journal articles and their internet access

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Theses

Heikkilä U, Modeling of the atmospheric transport of the cosmogenic radionuclides ^{10}Be and ^{7}Be using the ECHAM5-HAM general circulation model. ETH Zürich, Zürich, 2007.

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