Two centuries of trace element deposition at the top of the Himalaya: natural background vs. anthropogenic pollution.

Anna Wegner1,3, Paolo Gabrielli 1,2, Joel D. Barker1, Roxana Sierra1, Emilie Beaudon1, Lonnie G. Thompson1,2

1 Byrd Polar Research Center, The Ohio State University, Columbus, OH, United States,

2 School of Earth Science,, The Ohio State University, Columbus, OH, United States

3 Alfred-Wegener-Institute Bremerhaven, Germany

South East Asia is one of the fastest developing regions on Earth and has experienced a recent large increase in atmospheric pollution. Glaciers of the nearby Himalayan mountains represent a unique archive that provides the potential to be used to determine the strength and timing of the onset of anthropogenic atmospheric pollution in the region.

Within the Third Pole Project several ice cores from the Tibetan Plateau and the Himalaya are analyzed for their trace element concentrations. Here we present results of a new trace element record from the Dasuopu ice core spanning 1790 - 1993 AD. The Dasuopu ice core was drilled in 1997 at 7200 m altitude in the Himalaya and provides the highest elevation ice core record ever obtained. Due to the high altitude this site has the potential to archive not only contamination records of regional significance, but possibly also long distant pollution from, for example, Europe and climatic signals influenced by the North Atlantic. This area is heavily influenced by the monsoon regime providing seasonally and highly variable snow accumulation rates.

The upper 50 m of the core covering the time interval from 1950 to 1997 consist of Firn and is sampled non-continuously in a resolution of approximately one sample/year. The time interval between 1790 and 1950 is presented by a continuous record in subannual resolution. Crustal enrichment factors are used to discriminate between the terrigenous and the anthropogenic contributions. In this study we focus two research topics: (1) determine the onset of the earliest anthropogenic contamination from trace elements at this elevation (7200 m) Himalayan site and (2) determine intra-annual variations of atmospheric trace elements, with a focus on discriminating between pre-monsoon season (when the aerosol input is governed by the high dust input in spring) and the monsoon and dry season.

We find trace element concentrations to be very low and very variable throughout the year with concentration changes of up to 2-3 orders of magnitude (e.g. Pb concentrations range from 0.1 ppt to 1000 ppt). Average concentration levels are comparable to those recorded at some polar sites. We find an increase in elements of crustal origin in the second half of the 20th century.