ANTARCTIC SNOW AND ICE: A NATURAL ARCHIVE OF ATMOSPHERIC CHEMICAL COMPOSITION

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ABSTRACT

Continuous accumulation of snow at the polar regions of the world records and preserves constituents of the atmosphere. Chronological proxy records of atmospheric chemical composition can be obtained from chemical analysis of snow samples and ice cores collected at judiciously selected sites on the Antarctica and Greenland ice sheets. The history of atmospheric chemistry contains important information on the global climate system, chemical evolution of the atmosphere, major volcanic eruptions affecting the global atmosphere, anthropogenic impact, and biogeochemical cycles.

Ice cores and snow samples from a number of locations in Antarctica were analyzed for their chemical composition. The ice core records date back a few hundred to a few thousand years, with annual time resolution in some cases. Comparison of the chemical composition of recent (during the past 100 years) snow with that of older snow indicates that large scale air pollution in Southern Hemisphere is relatively insignificant, in contrast with findings from Greenland ice cores that show unequivocal evidence of anthropogenic pollution of the atmosphere in the Northern Hemisphere since the mid-Nineteenth Century onset of the industrial revolution. Variations of the sulfuric acid concentration in snow through the past 4000 years suggest that major volcanic eruptions occur frequently, and that frequent explosive eruptions in the past may have had a significant impact on the global climate. Long and detailed records of explosive volcanism were constructed using the sulfuric acid concentrations in Antarctic ice cores.