Glaciochemical study on the surface snow along the traverse route from Zhongshan Station towards Dome A in Antarctica: glaciochemical tracers of two climatic systems

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The Antarctic climate system plays a critical role in the global climate system through heat exchange, sea ice dynamics, global oceanic circulation, etc. The broad aim of the International Trans-Antarctic Scientific Expedition (ITASE) is to establish how the modern atmospheric environment is represented in the upper layers of the Antarctic ice sheet. China took charge of the fieldwork of the Zhongshan Station-Dome A traverse.

In the Antarctic summer of 1998/1999, the third Chinese Antarctic inland ice sheet expedition pushed forward successfully to Dome A area. The spatial distribution of chemical compositions along the route shows an obvious transition of variation in chemical concentrations in this profile, approximately to 76°11'S, 77°00'E with elevation of 2800 m and 780 km far away from Zhongshan Station which suggests two different types of climate system influence the average concentrations in the surface layers in the two sections. One is the oceanic climate, mainly affects Antarctic coastland, with the source derived from short-distance marine masses. Sea-salt ions (Na^+, Cl^-, Mg^{2+}) derived from sea spray, as well as MSA, SO_4^{2-} produced by marinetime, are characterized by relatively high concentrations with notable fluctuations in the coastal section. The major factors likely to influence concentrations are surface temperature of sea, altitude, the distance from the coast, surface topography, typical wind speeds. The climate information recorded in surface snow here probably represents local climatic change. The other is continental climate, mainly affects Antarctic inland ice sheet, with the source derived from upper atmosphere in which the compositions mainly come from the remote continent with long-distance transport. The concentrations of ions mainly derived from marine decrease remarkably and tend to a stable constant. While the concentration of the typical terrestrial ion, Ca^{2+} is much larger than that in the coastal section. The concentration of NO_3^-, probably derived from the stratosphere and from tropical lightning, is obviously higher than in coastal section. Then there is no or tiny effect of distance from the coast and altitude in concentrations in the Antarctic inland area, but the diversified physical and chemical processes in upper atmosphere. The abundant climate information preserved in Antarctic inland ice sheet is of global significance.