

Miaoergou Glaciers in the Kalik Mountains, western China: Report of a reconnaissance for future ice core drilling and biological study

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Abstract

Glaciological field studies on Miaoergou Glaciers in the Kalik Mountains, western China were carried out in 2003 and 2004 to investigate the possibility of future ice core drilling and biological observation. Two glaciers, which have dome-shaped accumulation areas at an elevation of approximately 4500 m a.s.l., were investigated. Radio-eco soundings showed that the ice thickness at the top of the two glaciers was 43.7 and 29.6 m, respectively. Snow-pit observations revealed that superimposed ice appeared at 20–50 cm below the surfaces at the top of both glaciers, indicating that significant melting had occurred during summer. Analyses of a 2-m-depth ice core drilled on one of the glaciers showed that it consisted mostly of continuously refrozen ice and that the $\delta^{18}\text{O}$ varied from -15.7‰ to -7.2‰ with a mean of -10.2‰ . In the ice core were three visible dust layers, one of which contained various microbes including cyanobacteria. Whereas the $\delta^{18}\text{O}$ record had proved rather unsatisfactory as an air temperature proxy due to melt water runoff, a reconstruction of dust deposition and biological activity on the glacier might be possible using an ice-core study.

1. Introduction

Several ice cores have been drilled on glaciers in high Asian mountains since the late 1980s. These cores have revealed environmental conditions dating back hundreds to thousands of years in this region and have significantly contributed to our understanding of the climate system in that region (*e.g.* Thompson *et al.*, 2006). These cores have also revealed geographical variations in the climate history of the Asian high plateau. For example, there have been antisynchronicities in stable isotopes between the eastern and western Tibetan Plateau (Lin *et al.*, 1995), as well as in accumulations between the eastern and western Himalayas (Kaspari *et al.*, 2008) for the last thousand years. In order to understand the spatial variations in former environments and climates in the Asian high plateau, more ice cores need to be recovered from new locations.

Geographical variations can also be made apparent by studying microbial communities living on those glaciers. Recent studies have revealed diverse biological communities on many glaciers across the

world (*e.g.* Kohshima, 1987). Such communities usually consist of snow algae, bacteria, micro animals, and insects. These are specialized species that have adapted to live on snow and ice environments. Community structure and biomass vary among glaciers in different geographical locations. For example, snow algal communities differ on glaciers from northern Asia (Altai), middle (Tibet), and southern Asia (Himalayas; Takeuchi *et al.*, 2006). The characteristics of organic matter derived from such biological activities also vary on different Asian glaciers (Takeuchi, 2002 b). The biogenic material is usually composed of a dark sediment called cryoconite (*e.g.* Takeuchi *et al.*, 2001a). These geographical variations in biological communities and biogenic materials may be due to differences in the physical and/or chemical conditions on glaciers, but they need to be better understood for future studies of glacial eco-systems and the usefulness of biogenic materials for ice core analysis.

The Kalik Mountains are located at the eastern boundary of the Tien Shan Mountains of western China at elevations up to approximately 4800 m a.s.l. There are more than 30 small glaciers in this mountain range, some of which appear promising sites for