

Cosmogenic radionuclide evidence for the limited extent of last glacial maximum glaciers in the Tanggula Shan of the central Tibetan Plateau

Patrick M. Colgan^{a,*}, Jeffrey S. Munroe^b, Zhou Shangzhe^c

^a Department of Geology, Grand Valley State University, 1 Campus Drive, Allendale, MI 49401, USA

^b Department of Geology, Middlebury College, Middlebury, VT 05753, USA

^c Department of Geography, South China Normal University, Guangzhou, PR China

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Abstract

Cosmogenic radionuclide (CRN) exposure ages provide evidence for the limited extent of last glacial maximum glaciers in the Tanggula Shan, central Tibetan Plateau. The most extensive advances occurred during or before marine oxygen isotope stage 6 (MIS-6) based on previous CRN exposure ages. The second most extensive advance occurred during or before MIS-4 based on previous ages and new ages of $41,400 \pm 4300$, and $66,800 \pm 7100$ ^{10}Be yr. A MIS-2 advance of less than 3 km occurred between $31,900 \pm 3400$ and $16,000 \pm 1700$ ^{10}Be yr. © 2005 University of Washington. All rights reserved.

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Introduction

The extent and timing of glaciations on the Tibetan Plateau have long been a subject of debate, yet today, a consensus is emerging that glaciers were limited in extent during the last glacial maximum (LGM) and reached their maximum extent well before then (Binyuan and Jijun, 1991; Derbyshire et al., 1991; Shi, 1992; Zheng and Rutter, 1998; Lehmkuhl and Owen, 2005; Owen et al., 2005). Cosmogenic radionuclide (CRN) exposure dating methods have begun to shed light on the timing of glaciations in the region, and they also have demonstrated that ice was not extensive during the LGM (Schäfer et al., 2002; Owen et al., 2003a,b, 2005; Finkel et al., 2003). Here, we provide new CRN ages that reinforce this view.

Schäfer et al. (2002) produced an age of $67,500 \pm 6000$ yr (mean of the three isotopes ^{10}Be , ^{26}Al , and ^{21}Ne) for a boulder on a moraine about 10 km from the present terminus of Tanggula glacier near Basicuo Lake. Three other ages of $83,400 \pm 7700$, $161,700 \pm 13,200$, and $169,300 \pm 15,100$ yr

(means of three isotopes each) were produced for moraines about 25 to 30 km south of Tanggula Pass. A more extensive set of ^{10}Be ages was obtained by Owen et al. (2005) and contains exposure ages that range from $33,850 \pm 1280$ to $215,000 \pm 2810$ ^{10}Be yr. Their ages for the Basicuo moraine varied from $46,420 \pm 1740$ to $79,280 \pm 4340$ ^{10}Be yr. Here, we discuss new ^{10}Be ages that suggest that Tanggula Glacier advanced less than 3 km during the LGM.

Methods

Moraines in the Tanggula Shan were mapped from topographic maps and satellite images. Fieldwork was carried out in 2002 near Tanggula Pass and Basicuo Lake, as well as the Longxiazai Valley (Fig. 1). Fifteen samples for CRN analysis were collected, and from these, four were prepared at the University of Vermont and then measured for ^{10}Be at Lawrence Livermore National Laboratory. Field and laboratory methods are described in Bierman et al. (2002) and Colgan et al. (2002).

Results

Mapping of moraines in the Tanggula Shan show that at least four phases of glaciation occurred (Fig. 1). The oldest,

* Corresponding author. Fax: +1 616 3313675.

E-mail addresses: colganp@gvsu.edu (P.M. Colgan), jmunroe@middlebury.edu (J.S. Munroe), zhzs@lzu.edu.cn (Z. Shangzhe).