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MASS MOVEMENT IN THE GREAT WALL STATION AREA, ANTARCTICA

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Abstract This paper deals with the mass movement processes on the Fildes Peninsula, King George Island. Based on numerous field investigation, the authors consider that the slope mass movement and periglacial form on the peninsula have an internal relationship in genesis, reflecting in there main aspects. 1, All patterns of mass movement are developed on the slope surface; 2, different—order mass movement and periglacial type show their space—time distribution rules (their development stages); 3, The slope mass movement are developed from the periglacio—geomorphic processes. More detailed works have been done, such as fixed reapeated surveying whose results are concord and with the typical characteristics above mentimed very well.
Key words Mass movement, Great Wall Station, Antarctica.

Topographically, the Fildes Peninsula is a hilly area, which is mainly charactericed by a slope type of periglacio — geomorphic development. Mass movement is an importment form through out the evolution of periglacial — forms on the whole slope. Mass movement is of many patterns, which are widely distributed and obviously creeping. Its developing level suggests that frost — thawing frequency is very high in the area, and it is a subcontinenptal or suboceanic periglacial feature. It is consistent with the above mentioned nivaton. Like that in the mountainous periglacial region of China (Cui Zhijiu & Zhu Cheng, 1988, 1989), the slope mass movement and periglacial forms on the Peninsula, have an internal relationship in genesis, reflecting in the following aspects:

1. All patterns of mass movements are developed on the slope surface. From the material source, all patterns of mass movements have experienced a primary stage of bedrock weathering. On lateral section, the material forms at higher level provides material basis for lower level forms and the lower forms inherit and develop higher forms. For example, the material of active talus and rockfall slope are the debris of weathered periglacial pillar and weathered bedrock slope at higher level. But the talus and rockfall slope experienced the processes of rolling, smashing, and bumping during the downslope movement. After long time weathering, the debris diameter gradually

reduced. Furthermore, after long time accumulation in gentle zone, .the debris also provides a coarse material base is for all kinds of frost—thawing sorting and nonsorting forms(i.e. sorted circle, debris flower, debris isle, stone pavement and nonsorting strip and nets). The evolutionary series which appears downslope reflects a formation model of the mass movement and the periglacial landforms from low grade(mainly by gravitation) to high grade (mainly by frost—thawing creep and frost heaving).

2. Different—order mass movement and periglacial types (i.e. steep slope/gentle slope, east slope/west slope, top of slope/foot of slope) only show their space—time distribution rules (their development stages). For instance, by effects of topography (slope degree), geology (lithologic occurrence) and space—time(development stages), the rock glacier only appears on the second—step terrace surface of Half Three Point in the southeastern study area.

3. The slope mass movement process and the periglacio—geomorphic form evolution show that one movement pattern disappears in a place, but it must appear at other place in another form during energy transfer process. It is a certain reflection of unlimited mass movement.

In order to understand periglacio — geomorphic processes and mass movement features on the Fileds Peninsula, we used Swiss DI—20 infrared range finder and WILD — T2 precision theodolite (gonimetric precision ± 1.8″, ranging precision 3mm + 1ppm) to survey the movement of rock glacier, stone circle and talus, which are located on Half Three Point, southern highland by the Yanou Lake and onshore cliff near Marsh Base where 27 surveying points were set by the Fourth Chinese Antarctic Expedition. The surveying methed is front intersection by fixed and repeated measurements. The surveying results are as follows:

1. Movement of talus

At the Chilian Marsh Base on the southeastern peninsula, we have twice taken the fixed and repeated measurements on a talus on December 5,1988 and February 18,1989. The talus debris consists of volcanic agglomerate, with its depositional dip of 25° NE, slope gradient of 38°, slant range of 45m, slope foot width of 40m and mid—slope width of 30m. Surveying point No.2 shows the fastest movement rate, it downslides 16.51m, the average downslide rate for 15 surveying points is 4.22m. It is 5 times faster than that of periglacial talus in Tianshan area of China. (Zhu Cheng, Cui Zhijiu, 1988) where annual movement rate is 0.8m. We consider that the phenomenon is related with excess high slope gradient of the talus and excess precipitation. For example, in Tianshan area rest angle of taluses is less than 35°, however, it reaches 38° in the study area. This is one of the reasons for unstable rockfall. Besides, the precipitation can reach 605mm in the region (but average is about 400mm in Tianshan area), the more melting snow water and rain water promote the debris to lubricate and to fall down. Moreover, when upper single block falls downslope, the block will often cause other blocks to move downslope. It is another reason for its high velocity.

2. *Features of rock glacier movement*

There is a lobate rock glacier (Fig. 1) on the second terrace on Half Three Point of Fildes Peninsula. It is 50m long, 80m wide, and flows in 93° SE direction. Its slope gradient is 22° at the top, 3°—5° at the adverse slope, and 41° at the front slope. On the rock glacier surface, we selected 28 large blocks (their diameters more than 1m) to use as surveying points for movement rate, and selected two reef bedrock on the front of the

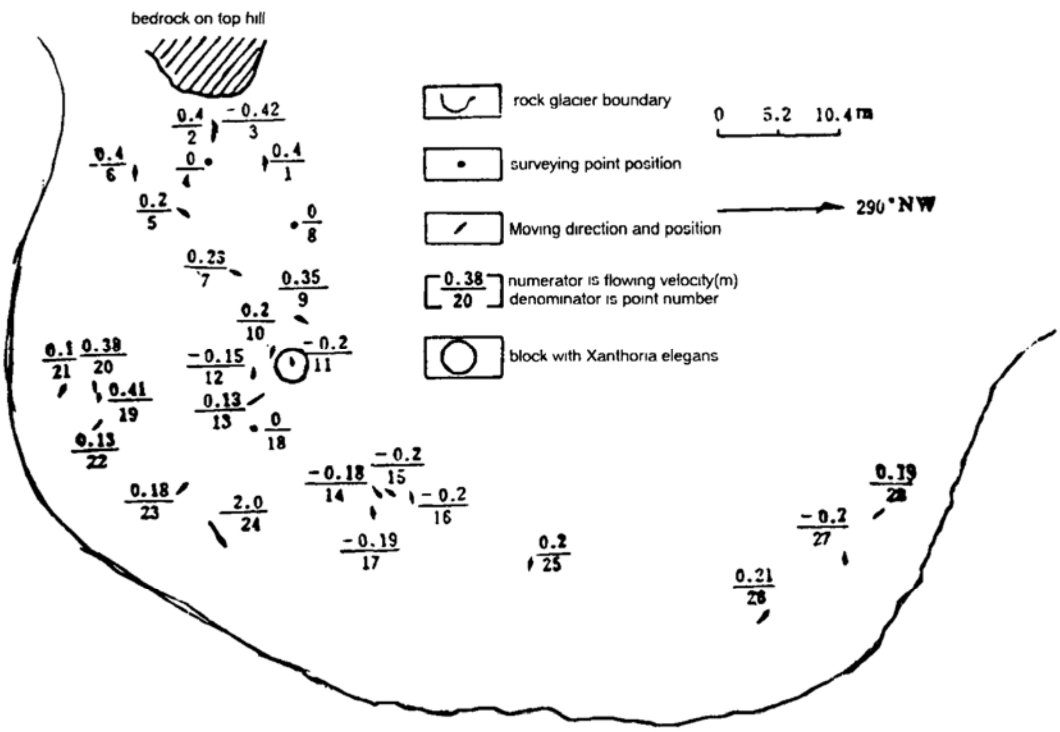

Fig. 1. Movement direction and velocity of rock glacier on Half Three Point during the period from Dec. 3, 1988 to March 5, 1989.

rock glacier to set theodolite. From the surveying results during the period from Dec. 3, 1988 to March 5, 1989, we found that 17 surveying points among 28 points have moved downslope to different extent, the maximum displacement is 2.0m for point No. 24. But 8 points have retrograding phenomena (it is just the special behaviour of surface movement of the rock glacier), their maximal displacement is 0.42m. Meantime, 3 points did not show obvious displacement. The average displacement value for the whole rock glacier is about 0.156m (Fig. 1). It is inferred that the movement rate of the rock glacier is about 0.62m/a. The value is higher than that of Tianshan lobate rock glaciers by 13cm (Zhu Cheng, 1989), which have maximum movement rate of 0.49m/a, as observed in the recent years, but the value corresponds to that of the rock glaciers on the Central Alaska Mountain (White, 1971) and the Alps (Haeberli, 1985), which have flow velocity from 0.5 to 1 m/a. The above phenomena show that a difference exists between continental and oceanic rock glaciers. For the Tianshan rock glaciers, due to a relatively dry continantal climate (i.e. annual mean precipitation of 430mm, annual average air—temperature of −5.4℃ in summer at campsite of Tianshan Glacial Station) and higher elevation (above 3500m a.s.l.), coarser sediments (mostly hard metamorphic rock debris and filling gravel soil), and lack of slide at frozen bottem, they contain less ice and have lower frost — thawing frequency, and slow movement velocity. On the contrary, although the Fildes Peninsula belongs to polar region in a broad sense, it has colder and moister oceanic climate by the influence of ocean (both annual mean air—temperature and precipitation are higher than in Tianshan periglacial area). Moreover, the volcanic rock here easy to be subject weathering produces finer — grained sediments (in addition to gravel and debris, they are mainly fine — grained debris soil with gravel and sandy or subsandy soil), plentiful melting snow water and summer rain make that liquidoid — flowing striated soil can be seen everywhere, therefore, all the above mentioned factors make the lower frozen — creeping layer to be a delivered belt to intensively draw upper rock glacier debris (Zhu Cheng and Cui Zhijiu, 1991).

References

Cui Zhijiu, Zhu Cheng (1988): Rock glaciers in the source region of Urumqi River, Middle Tianshan, China, Fifth Int. Conf. on Permafrost Trondheim, Norway, Proceedings, Vol. I, 724—727.

Cui Zhijiu, Zhu cheng (1989): The structural type and temperature and mechamism of movement of rock glacier at the head of " Urumqi River", Tianshan Mountains, Vol. 34, No. 5, 1286—1291.

Zhu Cheng (1989): The characteristics of surface movement of the lobate—shape rock glacier from the debris fabric, Tianshan, China, *Jour of Glac. and Geocr.* Vol. 11, No. 1. 83—87.

Zhu Cheng, Cui Zhijiu (1988): A superficial discussion of talus at the head of Urumqi River, *Tianshan Mountain Research*, Vol. 6, No. 4. 203—209 (English abstract).

Zhu Cheng, Cui Zhijiu and Xiong Heigang (1991): Characteristics of the active layers on Fildes Peninsula of King George Island, Antarctica. *Antarctic Research (English edition)*, Vol. 2, No. 2. 24—37.

Whiee, S. E. (1971): *Arctic and Alpine Research*, 3, 01: 43—64.

Haeberli, W. (1985): Creep of Mountain Permafrost, Nr. 77. Mittei Lungen der Versuchson Stalt fur Wasserbass, hydrologie und glazioloie, Zurich, 24—105.