

UNUSUAL FLOOD EVENT IN THE SOUTH MARGIN AT PERITO MORENO GLACIER IN 2004

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Abstract

An unusually large water stream flowing from under the south margin of Perito Moreno Glacier was observed in 2004. Comparison with the typical situation in 2003 indicates that this flood event was unusual. It was shown that this event connected with a long-term migration of the intraglacial water channels to the glacier surface. We suppose that such events are periodical or irregular, i.e. should have taken place in the past and should repeat in the future.

Необычный паводок на южной окраине ледника Перито Морено в 2004 г.

Необычно большой водный поток, текущий из-под южного края ледника Perito Moreno наблюдался в 2004. Сравнение с типичной ситуацией в 2003 указывает, что этот случай наводнения был необычен. Показано, что этот случай, связанный с долгопериодным перемещением внутрiledниковых водных каналов к поверхности ледника. Мы предполагаем, что такие события периодические или нерегулярные, то есть должны были иметь место в прошлом и должны повториться в будущем.

Introduction

Melt water that exists in the ablation area of glaciers during the melting season flows down on the glacier surface, in the ice, or on the bedrock, making complicated systems of drainage channels. These channels, as well as glaciers, are very changeable. They can form and disappear during one melting season or can exist for many years under specific conditions (Isenko, 2005). Ice deformation, glacier movement, freezing and melting processes influence on the position and form of channels. The amount and distribution of water in glaciers also change in time that reveals in various phenomena, such as glacier lake outbursts, flooding and disappearing of water in moulins and channels, water level and pressure oscillations and so on. There is also opinion that a change in the drainage system of a glacier can trigger a glacier surge. In this work we described and tried to explain the unusual flood event in the south margin of Perito Moreno Glacier (Fig. 1), observed in 2004.

Glacier Perito Moreno

Glacier Perito Moreno is an eastward outlet of Hielo Patagónico Sur, the largest one of the two icefields in southern South America (Skvarca et al., 2004). The total length of the glacier is 25 km, and the ablation area is a valley-type glacier with about 15 km in length and 4 km in width. Perito Moreno Glacier is extremely active, because of very high precipitation in the upper reaches, and very high rates of melting (up to 13 m per year) in the ablation area. As a consequence, the huge amount of melt water produces large water channels and shafts in the glacier, which are very good subjects for glacio-speleological expeditions (Badino, 1999). There are also a lot of lakes, both marginal and surface, which exist only for a short

time or appear irregularly. Typically, all meltwater discharges into Brazo Lake, surrounding the glacier terminus, through underwater springs.

Observations and discussion

First time we visited Perito Moreno in November-December 2003. We observed two oscillating marginal lakes along the south margin on the way upstream the glacier (about 1 km from Brazo Lake). When the lakes were empty, entrances to subglacial caves were visible there. In addition, we observed a river (about 3 m³/s), flowing out from the lowest cave. This river existed during two days, and probably formed due to temporary clogging or closing of the inner marginal channel, causing water level rising up to 15 m (Fig. 2). According to these indirect observations, we made an assumption that there was a large tunnel in the ice near the margin, where water discharge was at least 3 m³/s.

The situation in 2004 was quite different from what we observed in 2003 (Fig. 3). First of all, the marginal area just near the Brazo Lake was flooded with water rushing down from the cliff, making tremendous waterfall. The maximum water flow discharge was estimated approximately as 15 m³/s. This time we counted six cave entrances on the 1 km way upstream that is three times more comparing to the previous year. Moreover, we found one small cave near the glacier surface (Fig. 4) that was supposed to be a part of an old drainage channel.

Although, there is possibility that this unusually large water flow appeared due to the outburst of some glacial lake upstream the glacier, diurnal oscillations of water discharge in it (up to complete absence of water) make this assumption to be doubtful. Therefore, we will try to explain this phenomenon by another way.



Fig. 1. Map of the Perito Moreno Glacier area. The south margin, where large outflow was observed, is indicated by the arrow

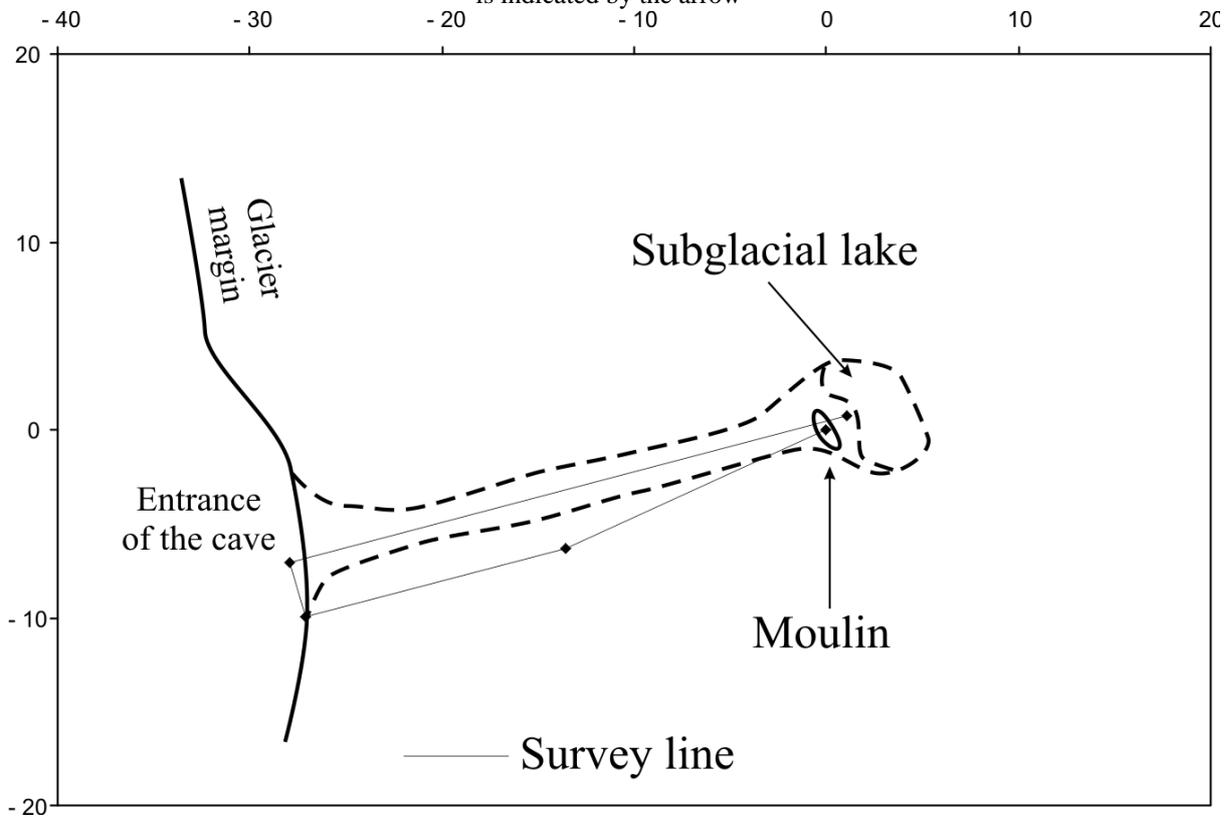


Fig. 2a. The map of the subglacial marginal cave, existed both in 2003 and 2004

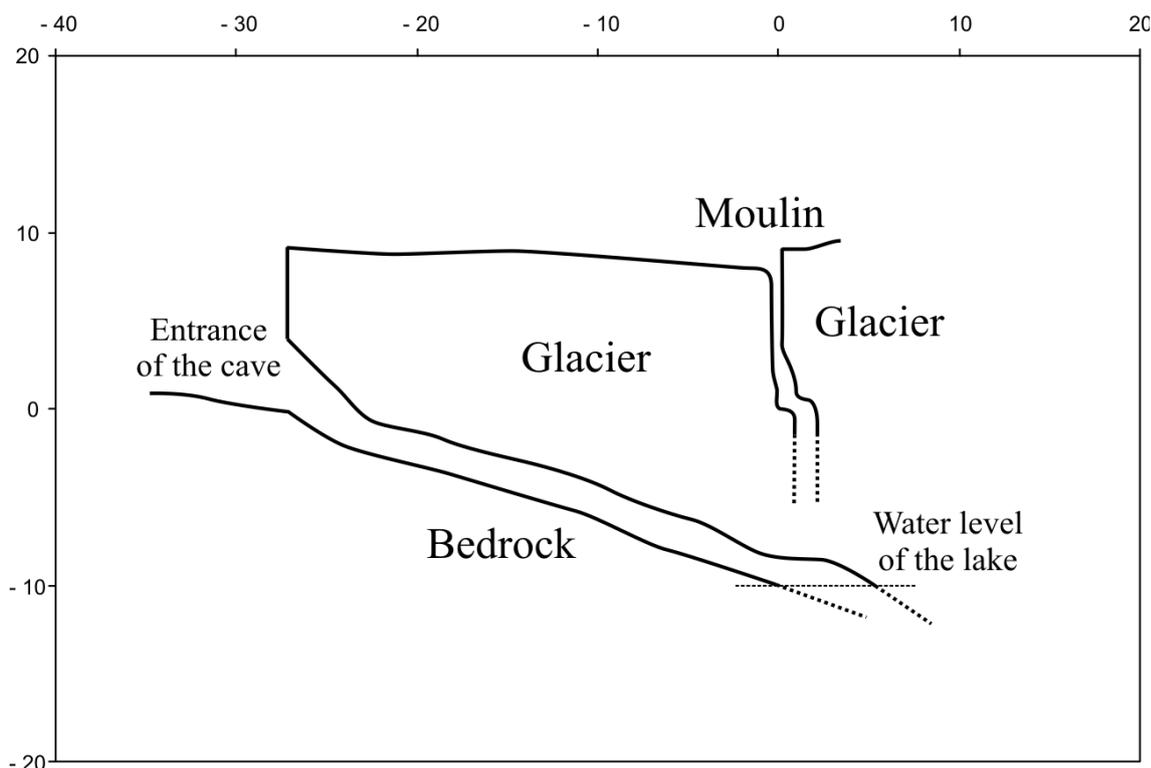


Fig. 2b. The vertical cross-section of the subglacial marginal cave, existed both in 2003 and 2004

In spite of extremely high melting rates of the glacier surface (up to 13 m near the margin), its position and elevation remain almost the same. That means that the vertical component of the ice movement is about 13 m per year, and the horizontal one, directed perpendicular to the margin, is much higher (~28 m per year), because of gentle slope of the bedrock in this place (about 25°) (see Fig. 2). Typical melting rates in the surface water streams on glaciers are 6-10 cm/day (Isenko, et al., 2002). In the absence of the solar radiation and the heat exchange with the air, that takes place in intraglacial channels, melting rates are usually lower because of lower water temperatures (Isenko, et al., 2005). Consequently, the channel melts down at most 10 m per year that do not compensate the vertical movement of the ice, not speaking about the horizontal velocity component. Thus, all channels inside the glacier, except probably the largest ones, will migrate to the glacier surface, but much more to the margin. Indeed, we observed a lot of tube-like short passages near the margin that are supposed to be old water passages (see Fig. 4).

As a channel migrates closer to the margin, the water come out from under the ice turning into a marginal river, unless a new channel formed somewhere in the ice. That is why there were a lot of water and cave entrances near the margin in 2004: the marginal channel just came too close to the glacier margin. This situation, obviously, will not last long. When a new channel in the ice will be formed, the water will disappear from the surface. This process can be periodical or irregular, depending on the

conditions. In any way, more field observations are needed to clarify this problem.

Acknowledgments

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References

- Badino G.** (2002) The glacial karst. *Nimbus*, 23-24, 82-93.
- Isenko E.V.** (2005) *Development and evolution of water drainage channels in temperate and polar glaciers*. Ph. D. Dissertation, 47 p. Sapporo.
- Isenko E.V., Mavlyudov B.R.** (2002) On the intensity of ice melting in supraglacial and englacial channels. *Bulletin of Glaciological Research*, 19, 93-99.
- Isenko E.V., Naruse R., Mavlyudov B.R.** (2005) Water temperature in englacial and supraglacial channels: change along the flow and contribution to ice melting on the channel wall. *Cold Regions Science and Technology*, 42(1), 53-62.
- Skvarca P., Naruse R., Angelis H.** (2004) Recent thickening trend of Glacier Perito Moreno, southern Patagonia. *Bulletin of Glaciological Research*, 21, 45-48.

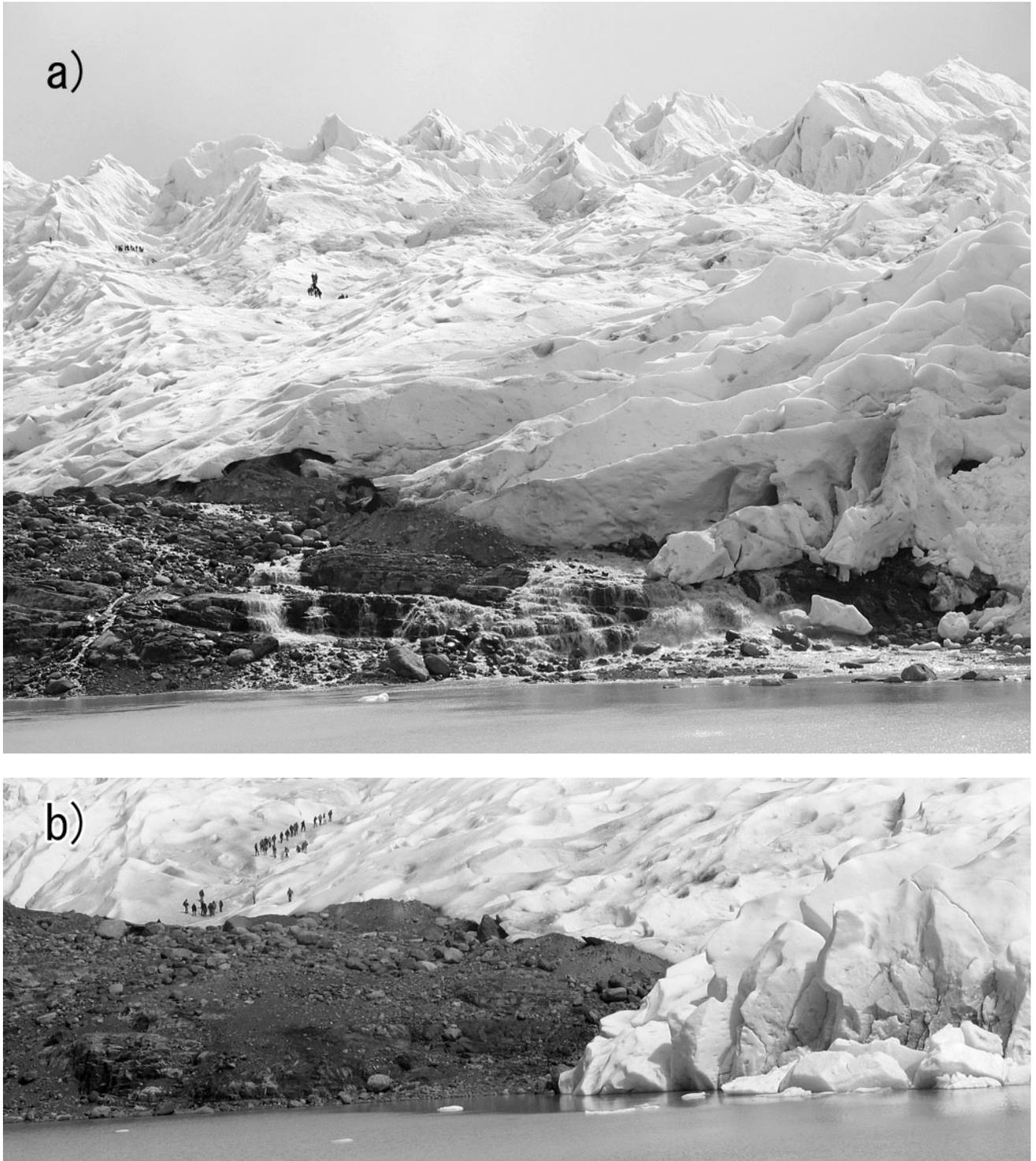


Fig. 3. The south margin: a) in 2004; b) in 2003



Fig. 4. a) A small subsurface cave was situated near the south margin. Both visible lakes are ephemeral. The length of the horizontal part of the cave is 18 m.

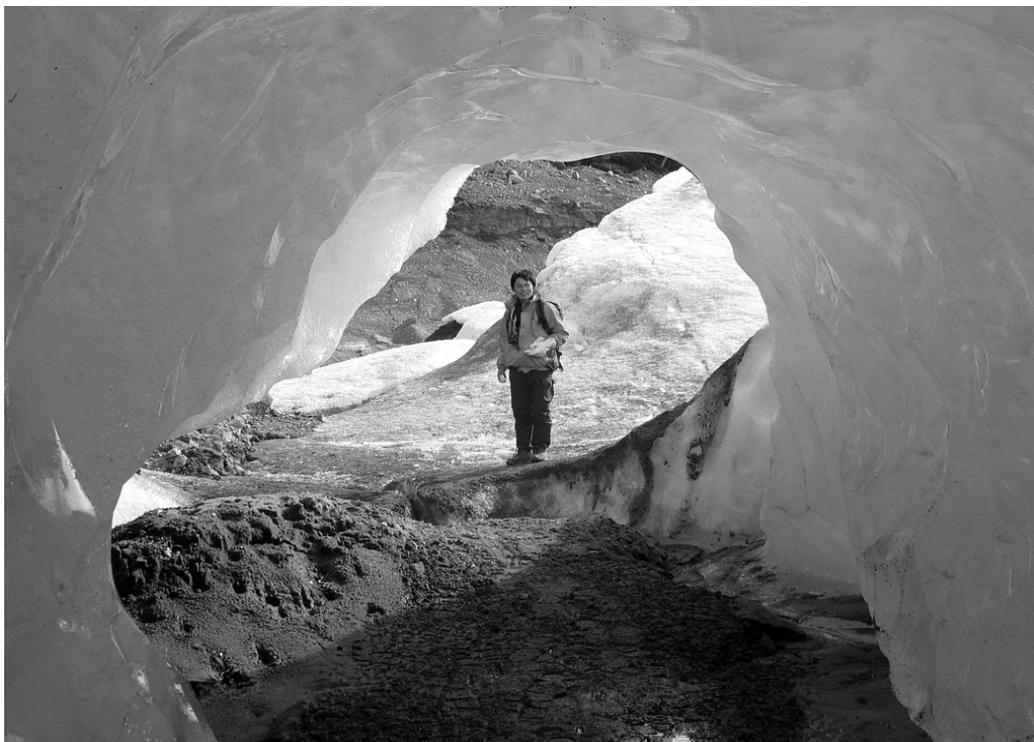


Fig. 4 b) Inside the cave. This cave is supposed to be a part of an old drainage channel

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