

Antarctica 2000

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Abstract

During 2000 a first speleological expedition to Antarctica was organised by La Venta exploring team together with Etsim of Madrid Polytechnics and the Institute of Geography of the Russian Academy of Sciences. The aim of this expedition was to search for glacial karst phenomena, which resulted to exist even at a small scale due to the very scarce melting and high acclivity of the glaciers.

Keywords: Glaciokarst, Ice caves, King George Island

Introduction

In the last few years the “La Venta Exploring team” is carrying explorations in the largest glaciers of the world in order to characterise their glacial karst phenomena (Badino 1994, 1995, 1999; Badino & Piccini, 1995). Therefore La Venta members made expeditions to Central and Southern Asia, Patagonia, Iceland and Tierra del Fuego.

These explorations evidenced that just 2° southward were enough to transform the “glacial hypercast” found in Patagonia to a scarce “glacial karst” in the Tierra del Fuego. In fact the limit of the late summer snow, which is over 1500 m a.s.l. in the Hielo Continental Patagonico, is lowered to about 500 m a.s.l. in the Sierra Darwin of the Tierra del Fuego.

Therefore it was extremely important to see if any glacial karst still exists some 10° southward.

The map of the annual mean temperatures put in evidence that rather all Antarctica is far below 0°. The single area slightly over that temperature, which has proved to be the limit for glacial karst in the Alps, is the occidental part of the peninsula together with its archipelagos. Therefore this is the single region of Antarctica in which ice pits and caves should develop.

In order to organise the first true speleological expedition to Antarctica, La Venta joined the Etsim of the Polytechnic of Madrid and the Institute of Geography of the Russian Academy of Science: the selected area being King George island.

Previous Karst Observations in Antarctica

A long and hard bibliographical research allowed to discover that during expeditions with different targets someone went inside some Antarctic caves in the past.

The Rumanian Emile Racovitza, who is the founder of biospeleology, was the first caver reaching Antarctica in 1898 with the tragic Belgian expedition, world-wide renown due to the presence of Amunsen. Anyway in the long period spent there Racovitza made no one caving exploration.

The first news about a cave in Antarctica was found in the report of the Scott 1911 expedition: a photo with the title “The boat Terra Nova in the Ross sea”, now property of the Royal Geographical Society, was taken from the interior of an ice cave, which is reasonably to think as a sea cave on the border of a tabular iceberg. Now that photo has been chosen as the logos of the U.I.S. Commission on glaciokarst.

The first true cave exploration was made by Mr Werner during the scientific expedition lead by Tazieff on Mt Erebus, an active volcano not far from Mc Murdo base. Fumarolic vents melts the overlying ice thus allowing the evolution of rooms large enough to be explored between the rock and the ice. These cavities, which are well known and documented in Iceland, are called sub-glacial caves and in reality they cannot be considered true glacier caves.

Anyway practically nothing is known on this first cave exploration in Antarctica: in fact, in his "Erebus", Tazieff printed just a photo of scarce quality together with the following caption "*Werner avait exploré un système de grottes*".

During the '80, a true glacial karst (developed by the water action over ice) has been observed by East Germany scientists inside a dry valley in the part of Antarctica facing the Indian Ocean, close to the important Russian base of Novolazarevskaya. They reported (AA.VV. 1993) that during summer a rather large river springs from the glacier and gave the photos of the cave entrances but no further speleological details are supplied because they were not cavers.

A further speleological exploration was carried out by an Italian team on Melbourne Mt, a volcano close to the Terranova base. In 1985, during the first PMRA expedition M. Spezzotti became the first Italian caver in Antarctica exploring a fumarole vent on top of the volcano. Five years later the same exploration was made for a second time in order to do volcanological observations (gas analyses).

Glacial mills have been seen by helicopters flying over the glaciers of the peninsula and in the King George island. Anyway the scarcity in the information (glaciologists have no real interest in ablation zones) was perhaps the main reason for organising this speleological expedition.

The Expedition

The meeting point with the other members of the "Antarctica 2000" expedition (Dominguez and Eraso from Etsim of Madrid and Moskalevsky from IG of Moscow) was in Punta Arenas in the extreme South of Chile from where the King George island was reached by plane.

The two Spanish cavers started their research in a different area, while the members of La Venta with the aid of a small track reached the Collins glacier which covers rather all the 1300 km² of the island. The camp was settled up at 235 m a.s.l. where the Russian glaciologists detected the presence of liquid water some 50-80 m below the surface with aid of a radar. The area is completely covered by snow: it is not a usual ablation zone but an accumulation one without any water flow. The area corresponds to a wide crest protruding into the sea in which icebergs are present.

In the first days the research was directed toward the sea, looking for water flows. Moving was extremely hard and dangerous due to the presence of wide areas with crevasses, which were often evident but sometimes completely masked, being always covered by a thin layer of snow.

In the whole Antarctica the ice ablation is not controlled, as in the temperate zones, by its melting and consequent water flow, which may in turn give rise to karst phenomena if the environmental conditions are favourable. Here ablation is mainly induced to wind erosion and, at a smaller extent, to calving (ice breakdown into the sea from the final part of the glacier).

In King George island the last process is by far the predominant: in fact the structure of the ice cap, steep in its external parts, hinders the rilling and therefore the possibility to drill caves.

The exploration in the surface was very long and dangerous but allowed to confirm that these conditions are efficient to avoid the evolution of glacio-karst forms. Moreover the ice temperature is always a few below 0°C and the snow cover ends about at 100 m a.s.l.: therefore the possibility to find a cave seems to be rather impossible.

Only during the third exploration day it was possible to detect that close to the main drains discharging into the sea along steep slopes some low activity areas develop in which small and short freshets exist. The gentle slope allows the evolution of a drainage network thus causing an increase of kinetic energy, and, in the mean time, avoids the sliding of the ice and, consequently, the karst systems may develop over the years (Fig. 1).

In one of these zones the La Venta team discovered and explored 4 caves from 15 to 55 m a.s.l.

It is an ablation area of about 400x200 m² with a regular dip of 16-18° toward East, developing from about 80 m a.s.l. and the seashore (Fig. 2).

The area is crossed by small freshets with main N-S direction in the upper part and along the maximum dip in the lower one. The whole drainage network consists of small water flows inside scarcely downcut "bediers", the characteristic flow of which is of few l/s.

The acclivity of the area is normally too high to allow the drilling of glacial mills (sinkholes) thus most of the freshets evolves into waterfalls reaching the beach and, after few meters, the sea.

The only exception is represented by 4 freshets which have the possibility to drill their mill just where the acclivity is a minimum (about 10°).

Following a tradition of the "La Venta" these first ice caves of Antarctica were named after famous Italian wines, which were chosen on the basis of origin of the different members of the team.

The Caves

the highest cave was named Brunello AN1 (Fig. 3-1): it has an entrance at 48 m a.s.l. and consists of a rather large pit 28 m high: a waterfall makes difficult its exploration from 10 m down. At the base of this pit the cave develops in fissure rather filled by the flowing water and too narrow to be explored. Most probably this sinkhole is directly linked to the wide spring-hole Frascati AN5 (Fig. 3-4), just below Brunello AN1, developing where the ice glacier enter the sea. This cave has a total length of 30 meters and shows the classical morphology of a subglacial cavity.

Cabernet AN2 (Fig. 3-2) is the deepest glacial cave of Antarctica (37 m). It is very close to AN1, the entrance of which is only 3 meters higher. The river sinking inside is smaller and consequently the cave size is lower: its structure consists of a sequence of two pits reaching the basement.

Barbera AN3 is a very small vertical cave, consisting of a pit of 13 m and a relatively large room inclined along the slope of the rock. All the cave is interested by a scarce water flow.

AN4, is close to Barbera and represents the active flow of the same system: the waterfall sinking inside avoided the possibility of its exploration and therefore no name was given to this cavity.

There is an aspect of these caves that is really terrific: they are sufficiently wide and with an inlet pit of some tens of meters but this, except for the first cave, is perfectly masked by a thin layer of snow. The wind, powerful ally of fogs and of very wet snows, flattens all the surface.... Thus it is very difficult to detect the presence of a killer pit under a one of the very frequent spots of snow only due to the presence of a scarce water flow enters the snow but never exists. These caves are really far worse traps than the worst crevasse!

Final Remarks

The last day of the expedition was dedicated to the exploration of the crevasses as near as possible to the camp. The aim is to test the hypothesis of the existence of groundwater in the ice body: the results seem to confirm the absence of such a water level.

The following few days were used to make a preliminary survey in another area of lateral flow, in order to improve the knowledge on the karst phenomena of this strange site.

In conclusion, even if it is evident that this expedition, due to its shortness, had not the possibility to allow a detailed observation of the karst phenomena of the King George island, was useful to put in evidence that even at this low latitude glacial karst systems may be hydrologically active.

Acknowledgement

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Figure Captions

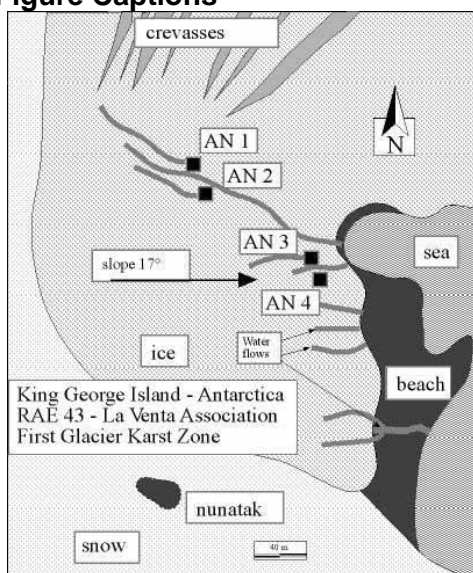


Fig.1 - Sketch of the explored area

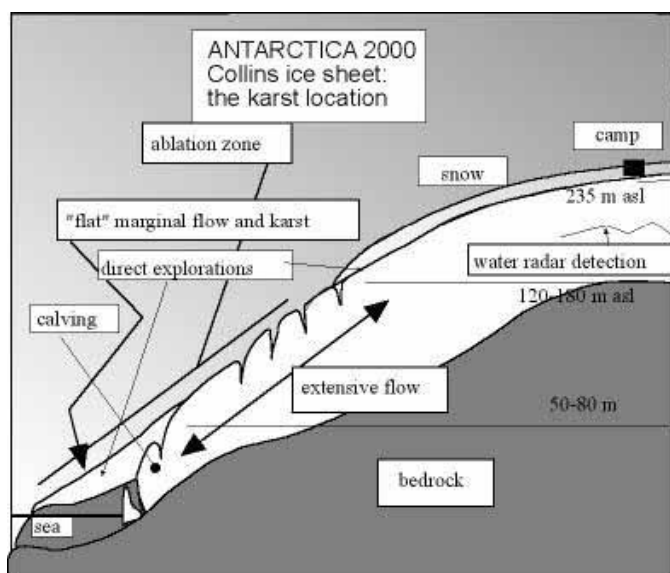


Fig.2 - Cross section of the explored area

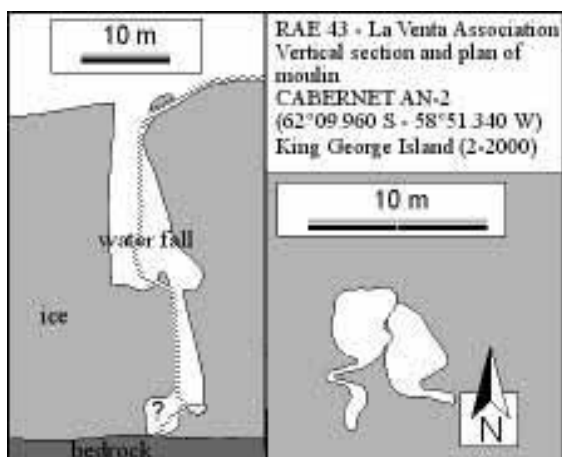


Fig. 3.1 - Map of the explored cave

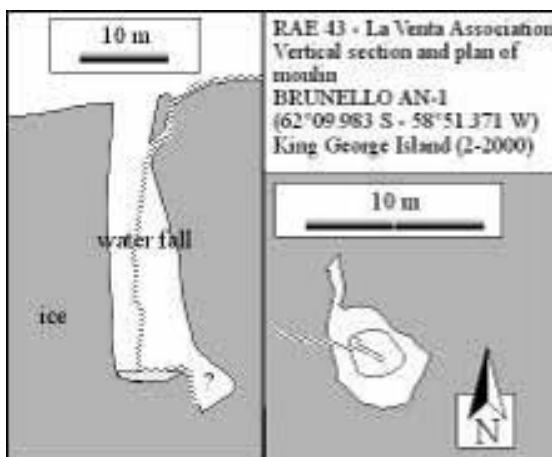


Fig. 3.2 - Map of the explored cave

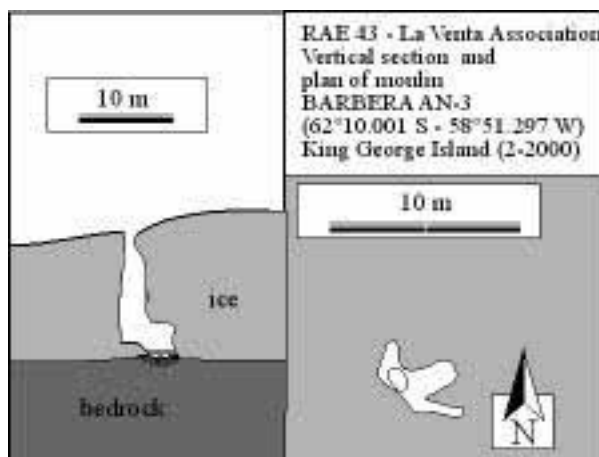


Fig. 3.3 - Map of the explored cave

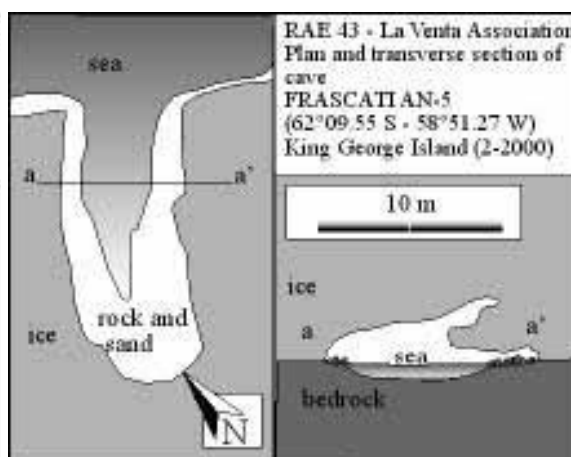


Fig. 3.4 - Map of the explored cave