On ice and snow deposits in caves and their suitability to paleoenvironmental research

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Among the first written reports and observations about ice in caves dates back at least to Loomis de Viri, who visited the Grotte della Monocdeno ice cave (Genga, Lombaria). We performed a systematic and detailed study of this cave, and, with the recent finding of a AMS 14C datable insect, we will soon have a radiocarbon age of a known ice level.

Internal structure of the ice block and its interpolation

The P50 ice core is divided by an angular unconformity in an upper and a lower part. The ice strata above the unconformity are horizontally bedded, while the strata below it are tilled toward the underlying bedrock. Furthermore, the δ18O values of the interbedded ice-strata are generally near to the horizontal plane and the ice crystals show a preferential columnar growth parallel to the basal plane.

Polishing

Predominant results from pollen studies show that the ice core does not contain any pollen grains, down to complete absence in several of the 5 cm high sections. Further analyses are planned on a new, 4.6 m long ice core, to investigate the origin of these dusts.

The stratified clear ice deposit at the base of the P50 ice core formed in the Holocene, prior to the beginning of industrial input to the atmosphere, by superposition of several frozen shallow lakes

Local present-time climate: air temperatures and backward trajectories of the air masses

In order to be able to analyze the relationships among the epigean and hypogean climatic systems we have set up some dataloggers to record air temperatures at intervals of 3 hours. These low cost measuring proved it was well worth setting up. An additional long term datalogger (HOBO) capable of recording T, RH, incoming radiation, wind speed and direction, rock and ice temperatures at the surface and in several locations in the three shafts (see below).

In the year 1990 the local mean annual 0°C isotherm was estimated to be at an altitude of 1100 m a.s.l. This was not in agreement with the 1130 m a.s.l. estimated by previous authors. We have not have enough data yet to reliably update this estimation.

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Ice caves (karstic or volcanic caves hosting perennial ice deposits) represent a little known, generally neglected environment that in the very last years is receiving a remarkable fascination from scientific attention. The occurrence of ice caves is not uncommon in many mountain areas at mid-latitudes and until now, conditions they were found open at altitudes lower than 1000 m a.s.l. (e.g. the Dobroměřice ice cave in Slovakia), in the Alps, they are a very rare phenomenon in the high mountain karst in the Alps, but they are present from Sicily (Grotta della Gola, Enna, Sicily), the Canebianchi (Château de la Scaprona, Romania) to the Urals (Kungur ice cave, Russia) to the Caucasus. Large-scale investigations have been made on ice caves, but studies do exist on several ice caves in Mediterranean areas (e.g. the Grotta dei Grupi (Crema), Grotta Grotte di Castelvecchio (Verona) and the Grotta del gelo (Margareis karstic ice cave))

Location of the snow and ice deposits

There are two ice and one snow deposits in this cave:

- The P50 ice block is found at the bottom of the first shaft. It is formed by snow deposition and it shows internal stratigraphy variations in the order of several meters.

- P50 stratified clear ice deposit: this appears to be the largest ice deposit, with an altitude in excess of 12 m. It is located at the base of the second shaft and snowfall cannot reach it because of the cave roof. The ice core of this deposit is 1.2 m thick.

- P50 stratified clear ice deposit: it is found in the third shaft under a thin layer of clear ice. Its thickness is 1.0 m.

The present 0°C isotherm is located about 2000 m a.s.l. in the area during the whole LIA. The air masses responsible for meteoric precipitations are either atlantic or mediterranean.

What are these layers?

We hypothesize that all the ice cores are made of dusts and ice; this is based on our success in finding a larch tree cover during the whole Little Ice Age.

Ice stalagmites

We will soon look for deposits deep enough inside the cave so that snow can never reach the bottom of the ice core. We will use new, 4,6 m long ice cores, to investigate the origin of these dusts.