^{14}C Age of Fossil Wood Remains Buried by an Inactive Rock Glacier, Upper Ticino Area (Southern Swiss Alps)

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Introduction

Within the framework of permafrost investigations in the Southern Swiss Alps of the Canton Ticino (see Scapozza & Reynard in press), eight fossil wood stem remains were found at a depth of 1 m below surface at the front of the Piancabella rock glacier (Fig. 1), situated in the Eastern part of the Blenio Valley (Lepontine Alps of the Ticino, Southern Switzerland).

Previously, ^{14}C datings of soils and moss buried by a rock glacier in the European Alps have been discussed, for example, by Mortara et al. (1992), Giraudi & Frezzotti (1997), Calderoni et al. (1998), Haeberli et al. (1999), and Dramis et al. (2003).

Site and Sampling

The Piancabella rock glacier (46°27′N, 9°01′E) has developed within a former east-facing glacial cirque from perennially frozen scree slopes at 2650–2460 m a.s.l. According to geomorphological observations and mapping, frequency-domain electromagnetic lateral mapping and 2D resistivity profiling (Geonics EM-16R and EM-31), direct current (DC) resistivity vertical soundings, thermal prospecting and space-borne radar interferometry analysis, Piancabella rock glacier is currently inactive (Scapozza 2008). The rock glacier surface is completely lacking of vascular plants.

Eight fossil wood stem remains were found beneath 1 m of coarse blocky sediments (Fig. 2). They were covered with sand and silt. The longest wood stem is 36 cm long and 6 cm large.

Radiocarbon Dating

Necessary preparation and pre-treatment of the sample material for radiocarbon dating was carried out by the ^{14}C laboratory of the Department of Geography at the University of Zurich (GIUZ). The dating itself was done by AMS (accelerator mass spectrometry) with the tandem accelerator of the Institute of Particle Physics at the Swiss Federal Institute of Technology Zurich (ETH).

Radiocarbon dating of the sample PIANCA2 gives a mean conventional ^{14}C age of 845 ± 50 y BP (UZ-5545/ETH-34417). Calibration of the radiocarbon dating, performed with the software OxCal 3.10 (Bronk Ramsey 2005) using the radiocarbon calibration curve IntCal04 (Reimer et al. 2004), gave, with statistical probability of 95.4%, an age of 1040–1280 cal AD (790 ± 120 cal BP).

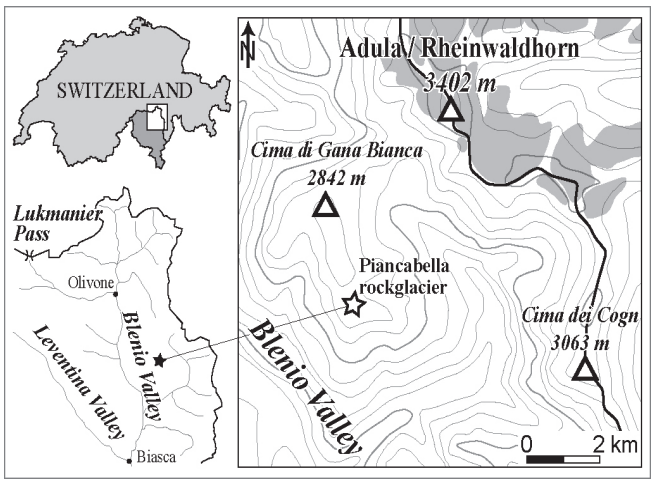

Figure 1. Geographical location of the Piancabella rock glacier.

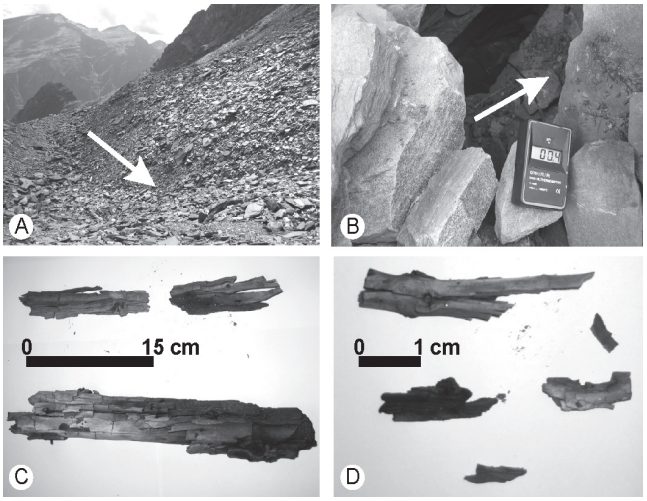

Figure 2. A–B: Sample site. C–D: Wood stem remains.

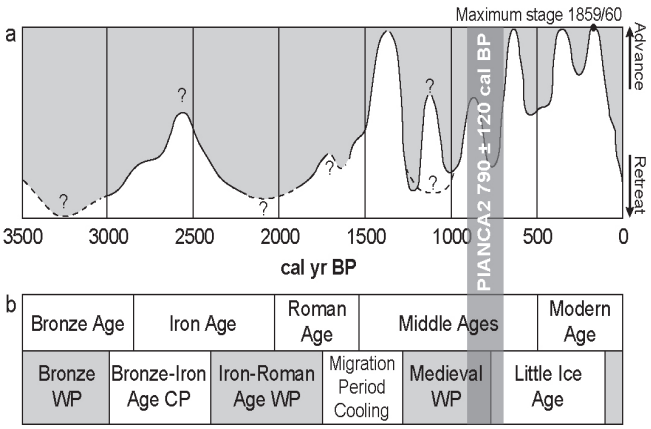

Figure 3. Comparison of the radiocarbon age of the sample PIANCA2 with (a) the Greater Aletsch glacier fluctuations in the last 3500 years, established by Holzhauser et al. (2005), and (b) the chronological and climatic framework of the Swiss Alps since the middle of the Bronze Age (Grosjean et al. 2007). WP: warm/dry; CP: cold/moist.

This age range corresponds to the end of the Medieval Climatic Optimum, a warm and dry period preceding the Little Ice Age cooling period (Grosjean et al. 2007). According to the Greater Aletsch glacier fluctuations established by Holzhauser et al. (2005), the period corresponds to a retreat phase of the alpine glaciers, with a front position similar to today (Fig. 3).

Discussion and Conclusions

Chronologic data suggest that the Piancabella rock glacier probably became inactive during the Medieval Climatic Optimum. The position of the wood remains at the front of the rock glacier confirms that it did not advance anymore after the Medieval Climatic Optimum. If we consider that climatic inactivation stops aggradation of ice in rock glacier permafrost, it confirms that ice within rock glaciers is probably several centuries old and by far predates recent climatic events such as the Little Ice Age, as it was pointed out by Haeberli et al. (1999).

Another hypothesis is possible. During the Medieval Climatic Optimum, the rock glacier front would have been several tens of meters higher in the slope. In this case, wood burial can be interpreted as the result of an advance or a reactivation of the Piancabella rock glacier during the Little Ice Age. Following these hypotheses, wood stems would have been exposed at the soil's surface for several decades before being buried.

The Piancabella rock glacier is currently situated close to the present regional lower limit of discontinuous permafrost (Scapozza 2008). It is, therefore, very difficult to determine which of the two hypotheses is likely realistic. Following the first hypothesis, ^{14}C dating of wood remains found at the front of the Piancabella inactive rock glacier could constitute the first absolute age determination of an alpine rock glacier inactivation.

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