Interreg POCTEFA

Cofinanciado por la UNIÓN EUROPEA
Cofinancé par l'UNION EUROPÉENNE

# PERMAPYRENEES

IGEOTEST

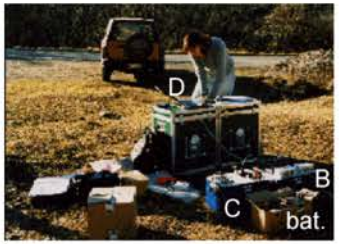
Marcel Chevalier Foundation

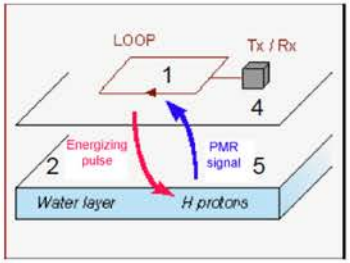
Principality of Andorra

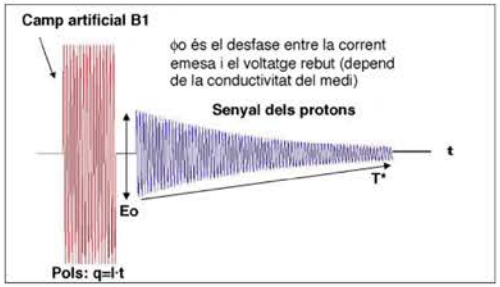
(Valenti Turu)

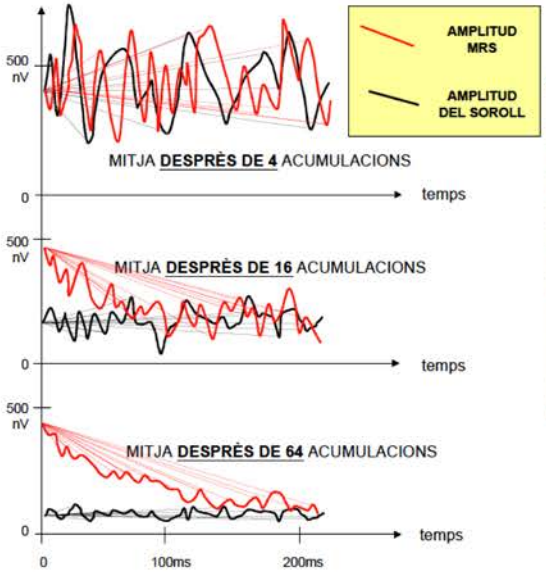
*21th century geophysics*

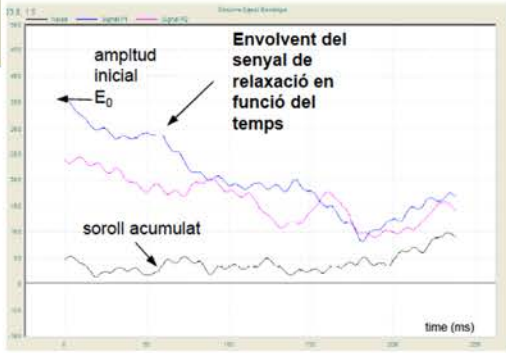
# NMR geophysics



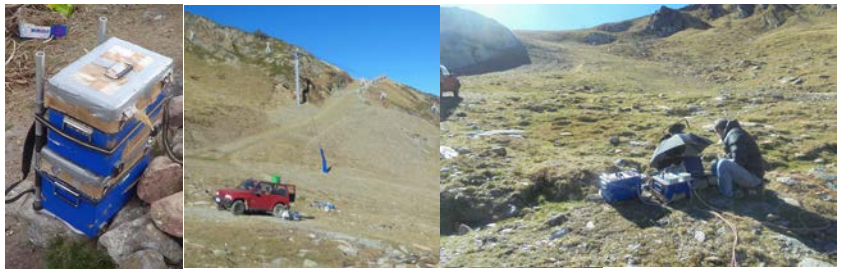



# Easy to implant but half a day for a single sounding



Groundwater surveying (Andorra 2018)

Sierra de Gredos (UCLM 2017)

Sierra de Gredos (2017 – 2020)

Journal of Applied Geophysics 195 (2021) 104478

Contents lists available at ScienceDirect

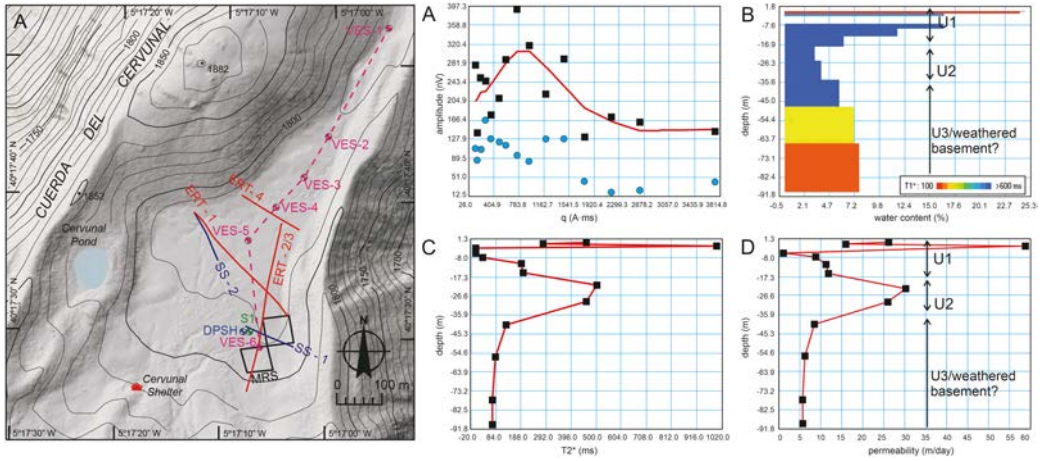
Journal of Applied Geophysics

journal homepage: www.elsevier.com/locate/jappgeo

# Geophysical characterization of the El Cervunal kame complex (Sierra de Gredos, Iberian Central System): Insight of infill geometry and reconstruction of former glacial formations

José Luis Granja-Bruña [a,*], Valentí Turu [b,c], Rosa M. Carrasco [c], Alfonso Muñoz-Martín [a,d], Xavier Ros [b], Javier Fernández-Lozano [e], Rodrigo L. Soteres [f,g], Theodoros Karampaglidis [h], José Antonio López-Sáez [i], Javier Pedraza [a]

[a] Department of Geodynamics, Stratigraphy and Paleontology, Complutense University, C/José Antonio Novais 12, 28040 Madrid, Spain
[b] Fundacio Marcel Chevallier, Edifici Socio-Cultural la Llacuna, AD500 Andorra la Vella, Andorra
[c] Department of Geological and Mining Engineering, Castilla-La Mancha University, Avda. Carlos III, s/n, 45071 Toledo, Spain
[d] Instituto de Geociencias – IGEO (UCM, CSIC), C/José Antonio Novais 12, 28040 Madrid, Spain
[e] Higher Technical School of Mining Engineering, Campus de Vegazana s/n, 24071 León, Spain
[f] Instituto de Geografía, Pontificia Universidad Católica de Chile, Avda. Vicuña Mackenna, 4860 Santiago, Chile
[g] Millennium Nucleus Paleoclimate, ANID Millennium Science Initiative, Santiago, Chile
[h] MONREPOS, Archaeological Research Centre and Museum for Human Behavioural Evolution, Schloss Monrepos, 56567 Neuwied, Germany
[i] Environmental Archaeology Research Group, Institute of History, CSIC, Albasanz 26-28, 28037 Madrid, Spain




Geomorphology 315 (2018) 1–16

Contents lists available at ScienceDirect

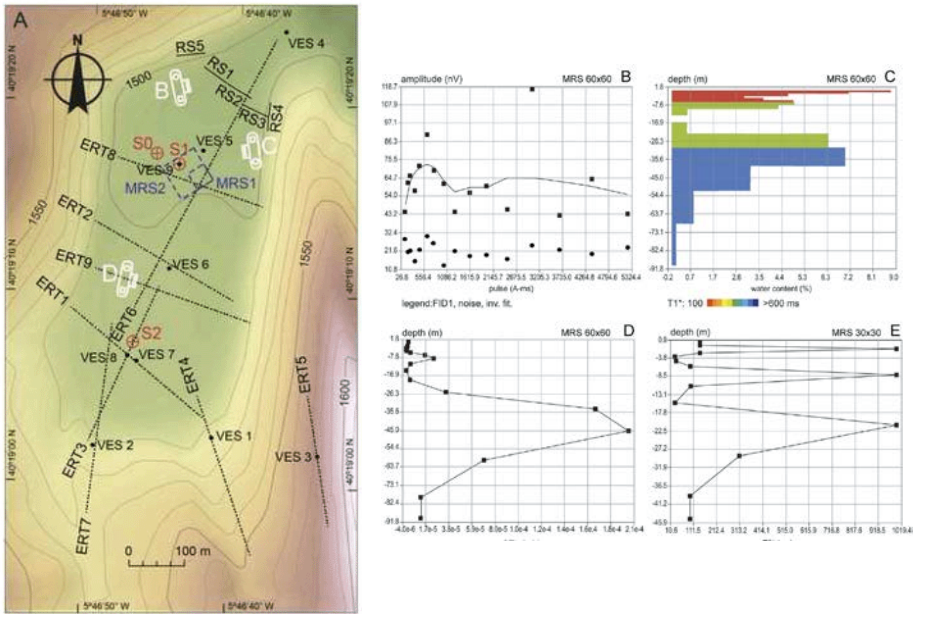
Geomorphology

journal homepage: www.elsevier.com/locate/geomorph

# Near surface geophysical analysis of the Navamuño depression (Sierra de Béjar, Iberian Central System): Geometry, sedimentary infill and genetic implications of tectonic and glacial footprint

Rosa M. Carrasco [a,*], Valentí Turu [b], Javier Pedraza [c], Alfonso Muñoz-Martín [c,g], Xavier Ros [b], Jesús Sánchez [a], Blanca Ruiz-Zapata [d], Antonio J. Olaiz [e], Ramón Herrero-Simón [f]

[a] Dpt. of Geological and Mining Engineering, Univ. of Castilla-La Mancha, Avda. Carlos III, s/n, 45071 Toledo, Spain
[b] Fundacio Marcel Chevallier, Edifici Socio-Cultural de La Llacuna, AD500 Andorra la Vella, Andorra
[c] Dpt. of Geodynamic, Complutense University, C/ José Antonio Novais, 12, 28040 Madrid, Spain
[d] Dpt. of Geology, Alcalá University, Ctra. A-II km 33,600, 28871 Alcalá de Henares, Madrid, Spain
[e] Non Seismic Methods, Repsol Exploration, c/ Méndez Álvaro, 44, 28045, Madrid, Spain
[f] Dpt. de Física i Enginyeria Nuclear, Polytechnic University of Catalonia (UPC), Física Ed. TR1 (EET) C/Colom, 1, 08222 Terrassa, Spain
[g] Instituto de Geociencias – IGEO (UCM, CSIC), C/ José Antonio Novais, 12, 28040, Madrid, Spain



*Landform Analysis, Vol. 21, 57–74, 2012*

# Surface NMR survey on Hansbreen Glacier, Hornsund, SW Spitsbergen (Norway)

**Valenti Turu**

*Marcel Chevalier Earth Sciences Foundation, Andorra, e-mail: vturu@andorra.ad*

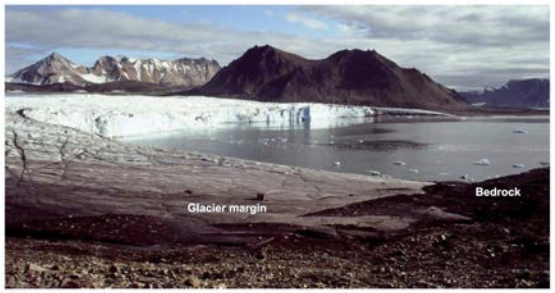
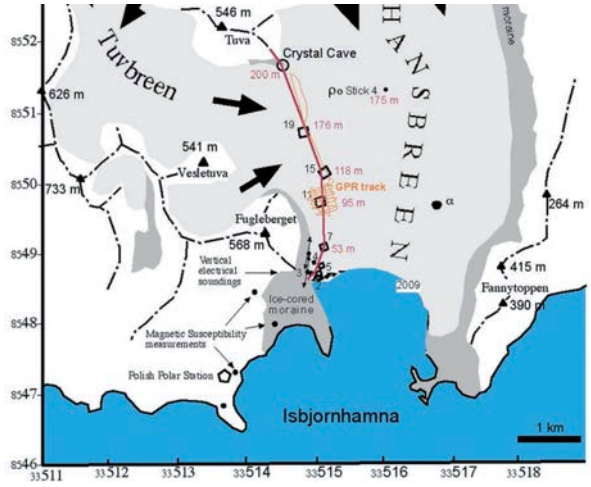



Fig. 1. Hansbreen calving ice-cliff, a tidewater grounding glacier at Siedleckivika bay on Hornsund fjord, September 2009



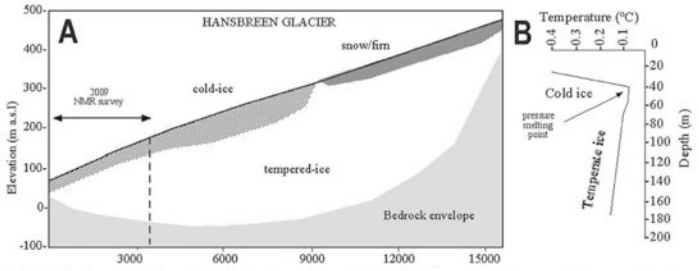




Fig. 3. A – Hansbreen polythermal-type glaciers have a layer of cold-ice in their accumulation zone and a temperate ice layer in their ablation zone (figure based on Moore et al. 1999). B – thermal profile after Jania et al. 1996

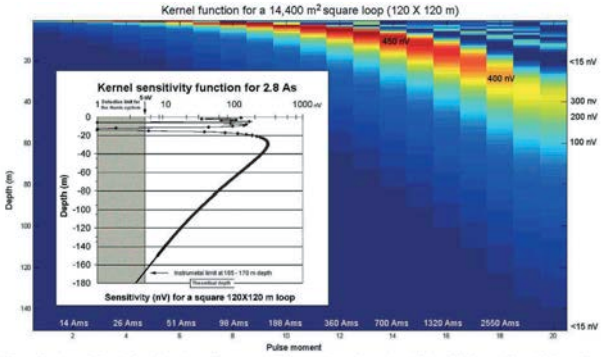



Fig. 4. Hansbreen Kernel function plotted for a 14,400 m² square loop in an ultra-high resistivity medium (2 Mega Ohms

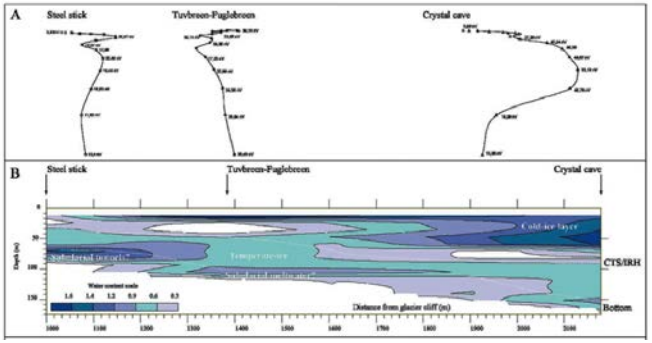





Fig. 5. Ice resistivity measurements (ABEM 4000 device) on stick number 4 at 175 m a.s.l. and image of the used device Numis Lite 005 at the glacier front (30 m a.s.l). Ice is a perfect electrical insulator so the maximum MRS depth is obtained by the loop size and configuration (Photo: O.Hengesch)

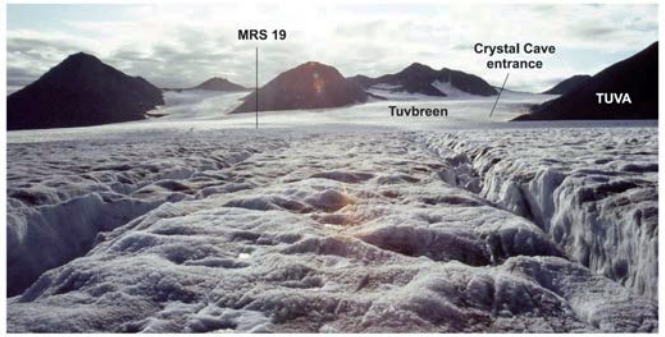
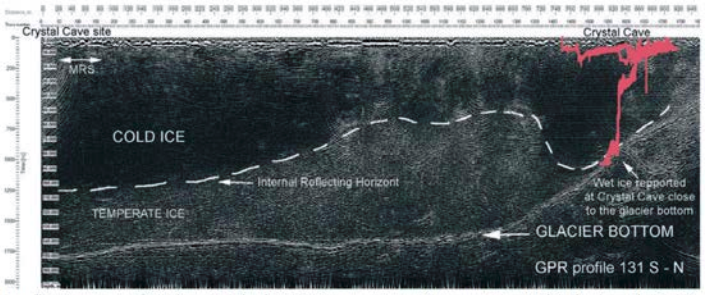
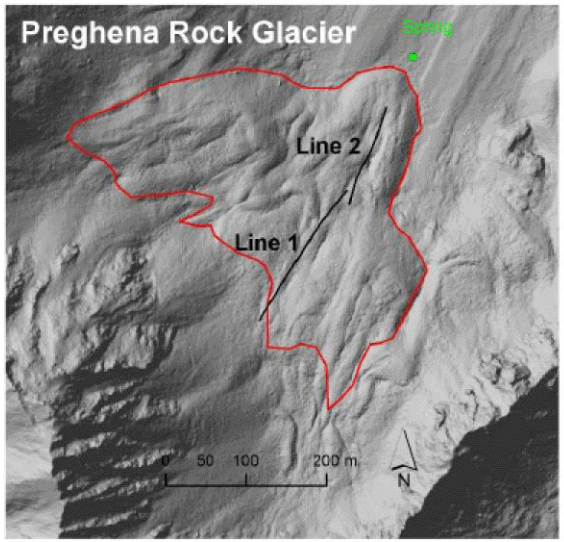



Fig. 6. Image from stick 4 (meteorological station), long open and deep crevasses on the glacier surface. The MRS survey site and Crystal cave entrance at 200 m a.s.l are both located there. Tuvbreen ice stream is in front and intersects the Hansbreen ice stream at Crystal cave




GPR profiles (courtesy of Mariusz Grabiec in 2010) between Crystal cave and Steel Stick site (see Fig. 2). The

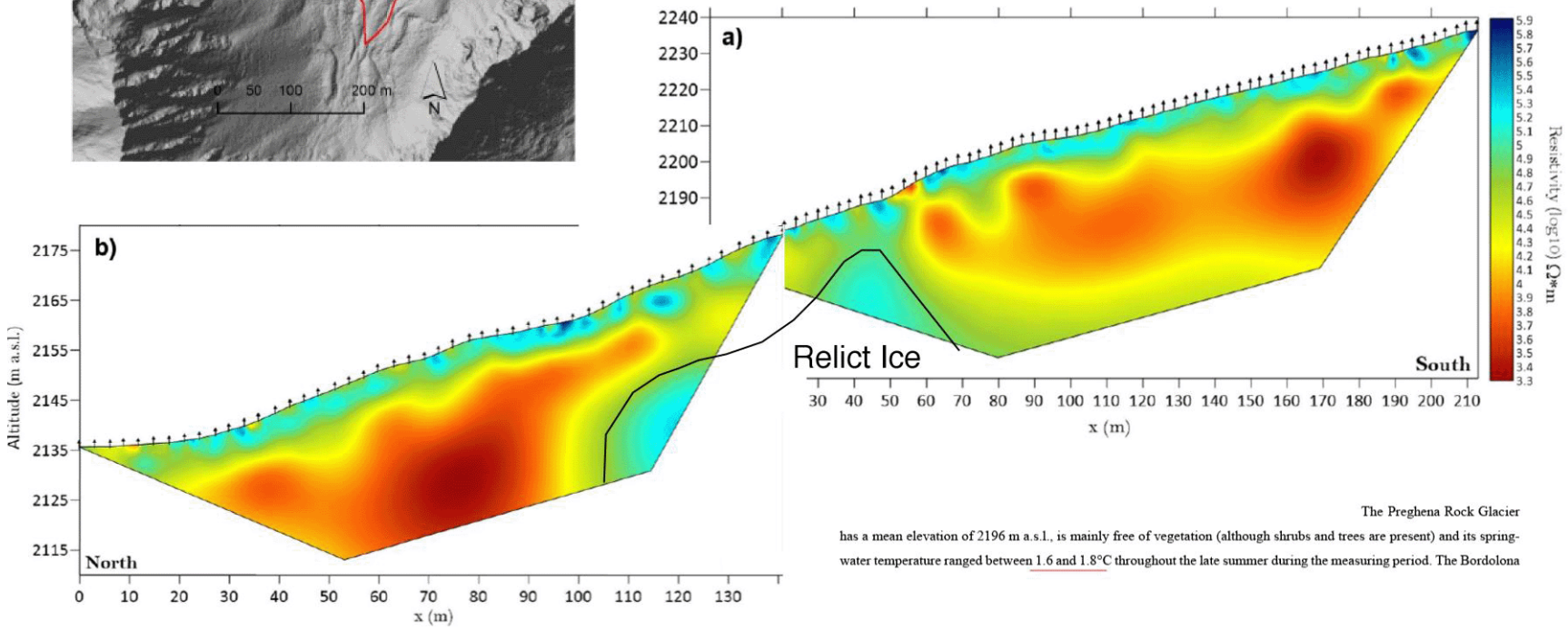
# Example of ice within rock glaciers




**Spring-water temperature suggests widespread occurrence of Alpine permafrost in pseudo-relict rock glaciers**

Luca Carturan[1], Giulia Zuecco[1,2], Angela Andreotti[1], Jacopo Boaga[3], Costanza Morino[1], Mirko Pavoni[3], Roberto Seppi[4], Monica Tolotti[5], Thomas Zanoner[4], Matteo Zumiani[6]

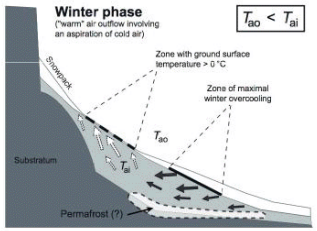
https://doi.org/10.5194/egusphere-2023-2689
Preprint. Discussion started: 5 February 2024




The Preghena Rock Glacier has a mean elevation of 2196 m a.s.l., is mainly free of vegetation (although shrubs and trees are present) and its spring-water temperature ranged between 1.6 and 1.8°C throughout the late summer during the measuring period. The Bordolona

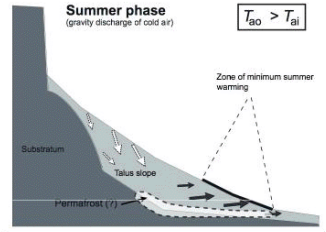
# Example of permafrost within rock glaciers

Schematic model of the winter ascending phase of the ventilation system

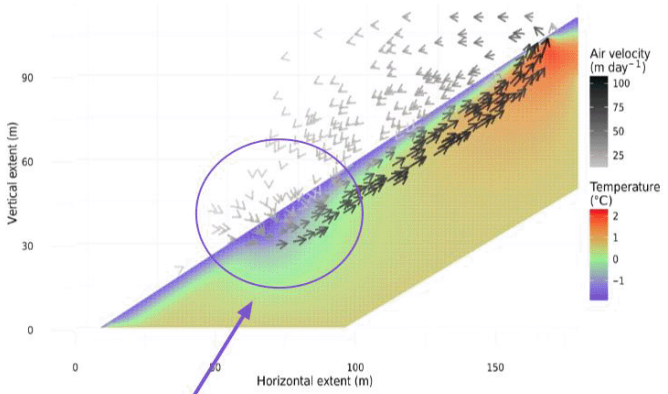


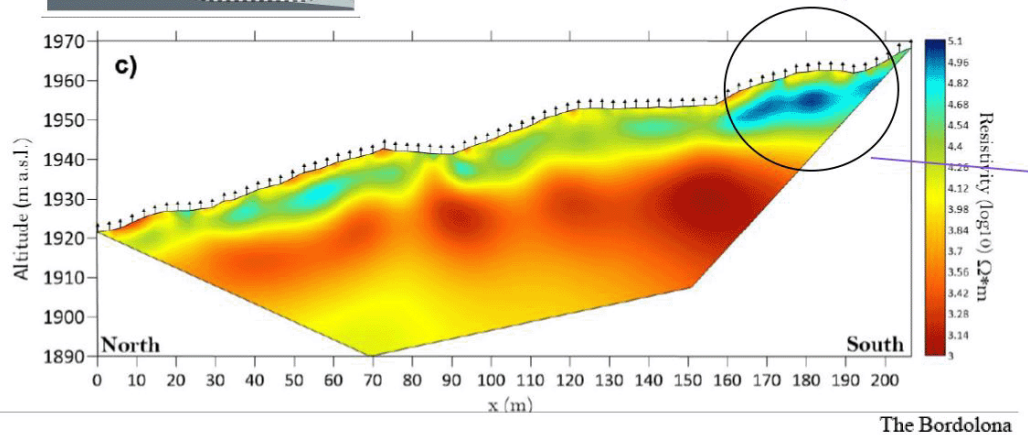

arrows represent warm (white) and cold (black) air

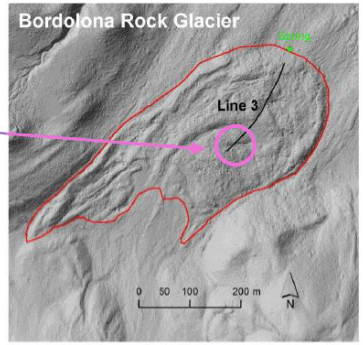
Schematic model of the summer descending phase of the ventilation system




**J. Wicky and C. Hauck: Numerical modelling of convective heat transport (2020) DOI: 10.3389/feart.2020.00335**



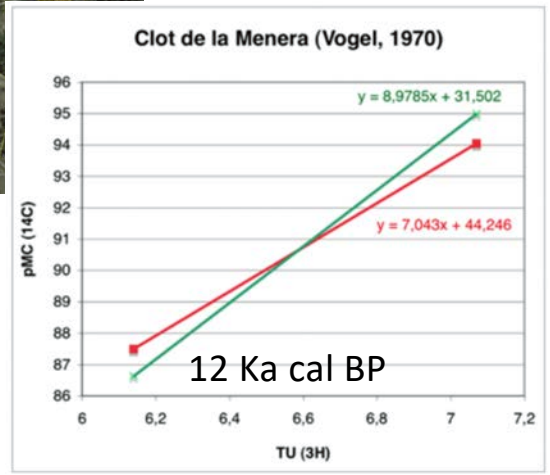



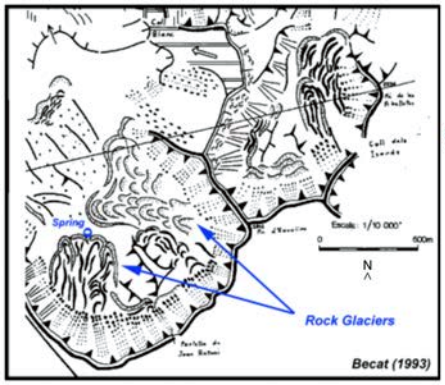



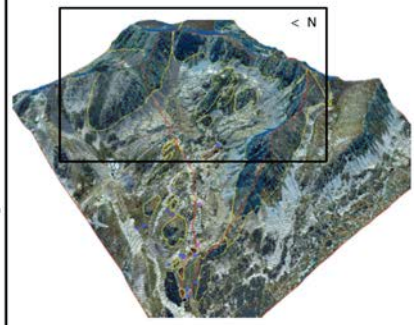

The Bordolona Rock Glacier has a mean elevation of 1967 m a.s.l., is completely covered by vegetation and its spring-water temperature ranged between 3.5 and 3.7°C in the late summer during the measuring period.

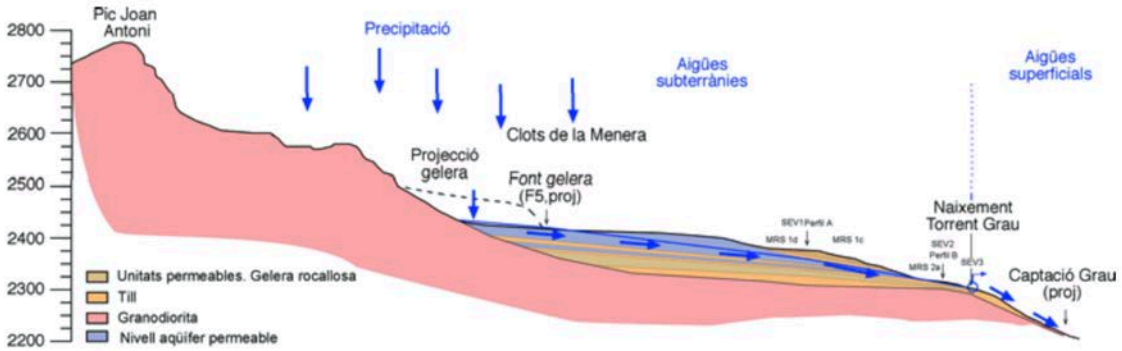
https://doi.org/10.5194/egusphere-2023-2689
Preprint. Discussion started: 5 February 2024

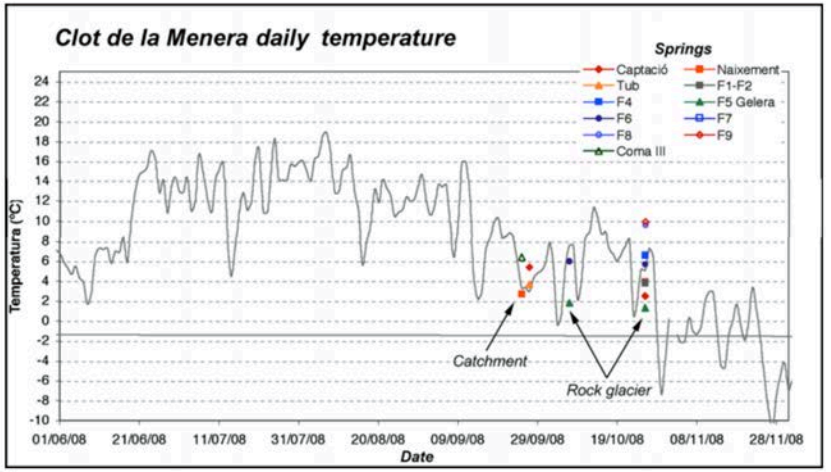
# The experiment *Clot de la Menera 2006-2023*

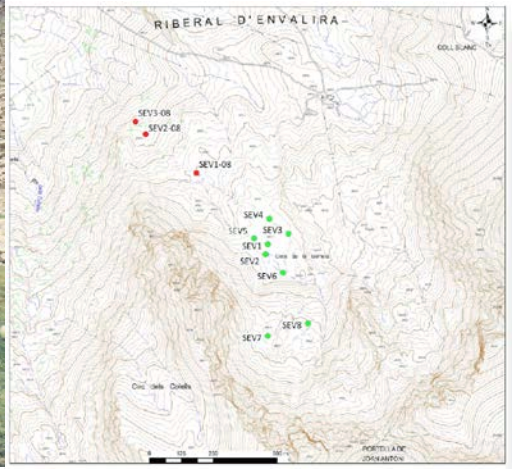



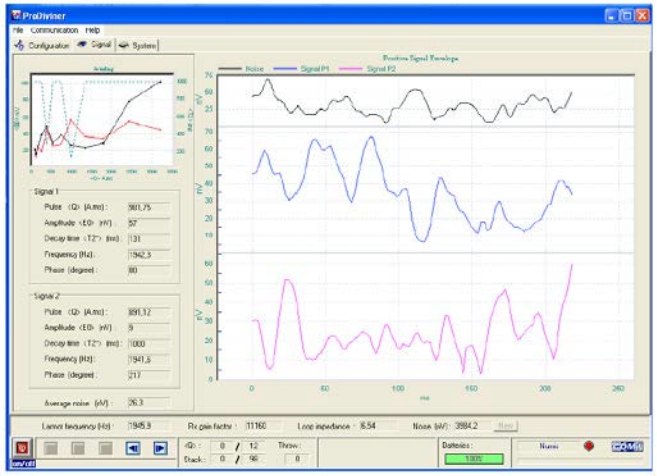



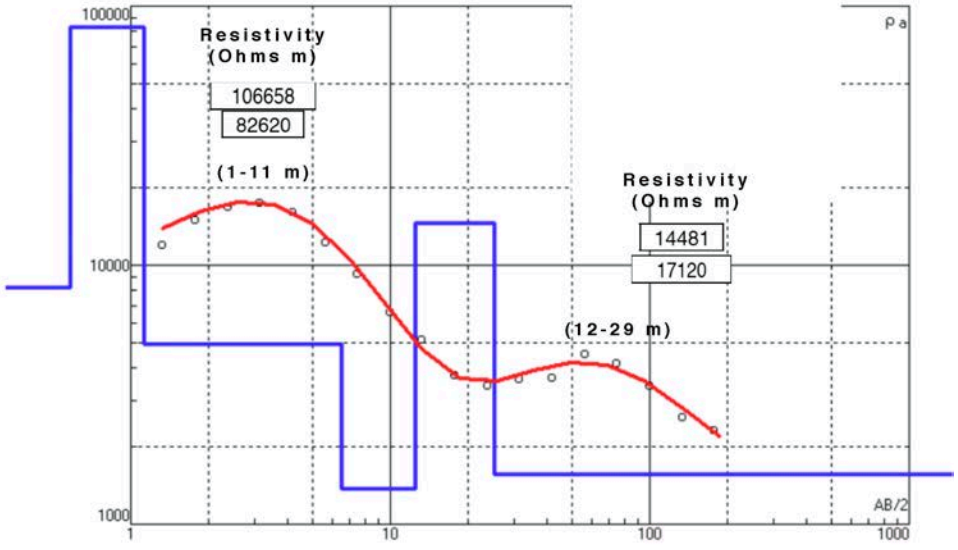



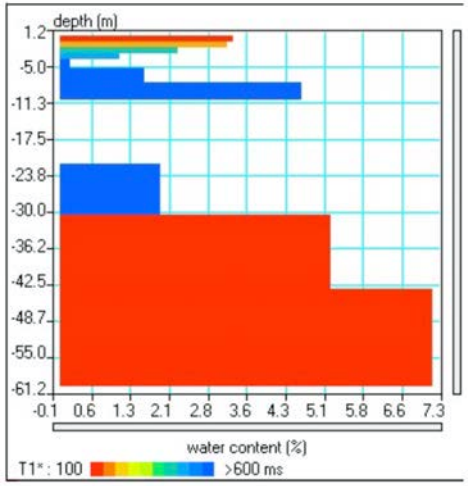



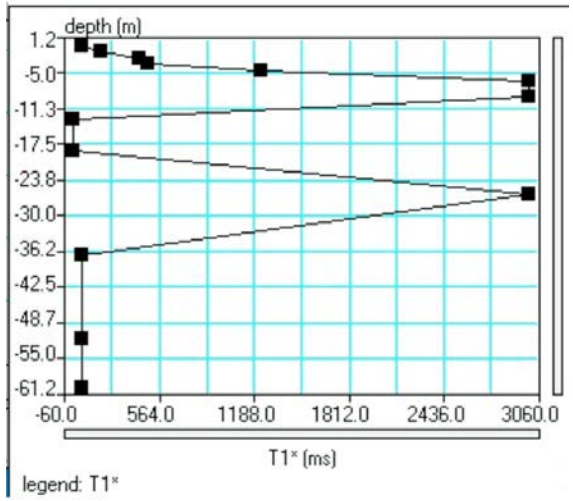



# The experiment 2006 and 2023




**Two layers of extremely high time decays (5 m an 25 m depth)**

# Conclusions

- If we are lucky, two thawing ice layers can be detected in a Rock Glacier (RG)
  - 1) The most superficial permafrost layer should be related with the air flux within the RG
  - 2) A second layer of fossil ice may in the core of the RG, feed the springs with cold water
- By using Magnetic Resonance Soundings we are able to detect the meltwater filling the empty spaces within the RG (large time decays), and thawing ice
- A couple of MRS could be possible to do in a single day on a RG