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# Late Pleistocene and Holocene Climatic Variability in the Carpathian-Balkan Region

## ABSTRACTS VOLUME

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## Electrical resistivity tomography (ERT) surveys on glacial deposits in Romanian Carpathians

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The study presents preliminary results regarding the use of electrical resistivity surveys in the assessment of the internal structure of the glacial deposits from the Romanian Carpathians.

ERT is a geophysical method used to quantify changes in electrical resistivity of the ground towards passing electric current across an array of electrodes and simultaneous measurement of the induced potential gradient. Using specific software the measurements are further processed and correlated with the topography in order to obtain bedrock resistivity features. Therefore, the method is useful to evaluate the characteristics of geological strata and is widely used for mapping shallow subsurface geological structures. In the mountain regions ERT studies have been applied in different glacial and periglacial geomorphological studies - for permafrost detection (in Romanian Carpathians - Urdea et. al., 2008; Vespremeanu-Stroe et al., 2012), slope deformation analysis, the assessment of slip surface depths, sediment thickness, groundwater levels etc. One of the most commonly 2-D array used is the Wenner electrode configuration, which is moderately sensitive to both horizontal and vertical ground structures.

Due to their elevations and Pleistocene's climatic conditions, the Romanian Carpathians have been partially affected by Quaternary glaciations. The glaciers descended to about 1050-1200 m a.s.l. (Urdea and Reurther, 2009) in the Transylvanian Alps and Rodna Mountains (Eastern Carpathians) carving a large number of U-shaped valleys and glacial cirques (Mîndrescu, 2006) and forming accumulations of unconsolidated glacial debris (moraines). Our study areas are two sites located in the northern (Rodna Mts.) and southern (Iezer Păpuşa Mts.) part of the mountain range.

Two-dimensional resistivity surveys were carried out in June 2014 using a GeoTom (Geolog 2000) device connected to two multi-core cables, each allowing the use of 25 electrodes equally spaced at 2 meters. Electrode elevation change was determined using a Leica TC407 total station. When the length of the profile was greater than the length of the cables "roll along" sequences were used. Penetration depth achieved using Wenner electrode configuration was about 20 % of the total cable length (16 – 17 m). Once the readings were taken an inversion (interpolation) routine was run using Res2Dinv software. We evaluated several inversion algorithms and settings available in the software and the best results (2D sections) were achieved using the robust inversion.

First study site is located in the western part of Rodna Mountains (maximum elevation- 2303 m a.s.l. at Pietrosu), in the Gropile cirque area, where several well preserved morains and few rock basins on the cirque floor have been identified. One of the best preserved rock basins is Gropile peat bog ('peat bog with pool') located on the upper glacial step within the cirque at 1920 m a.s.l. We chose this latter place for electrical resistivity surveys. The ERT profile overlaps the young lateral moraines and rock basin filled now with peat deposits (fig.1,2 ).

GROPILE profile (fig.2), with a north-northeast to south-southwest direction and a length of 150 m has the highest resistivity values of 95.000Ωm on that two glacial deposits till 10 m. The lowest resistivity values (80-10.000Ωm) at maximum 17 m deep from surface indicate the presence of water within moraines**.** The profile shows the internal structure of moraines on both sides of Gropile peat bog and the presence of bedrock in the left corner. The lower values of electrical resistivity in the middle highlights a section with glacial boulders and gravel but also the presence of air pockets. The lateral glacial deposits are well defined. Bellow the rock basin (green color) the resistivity profile points towards the presence of an old ground moraine buried later on by younger ones.

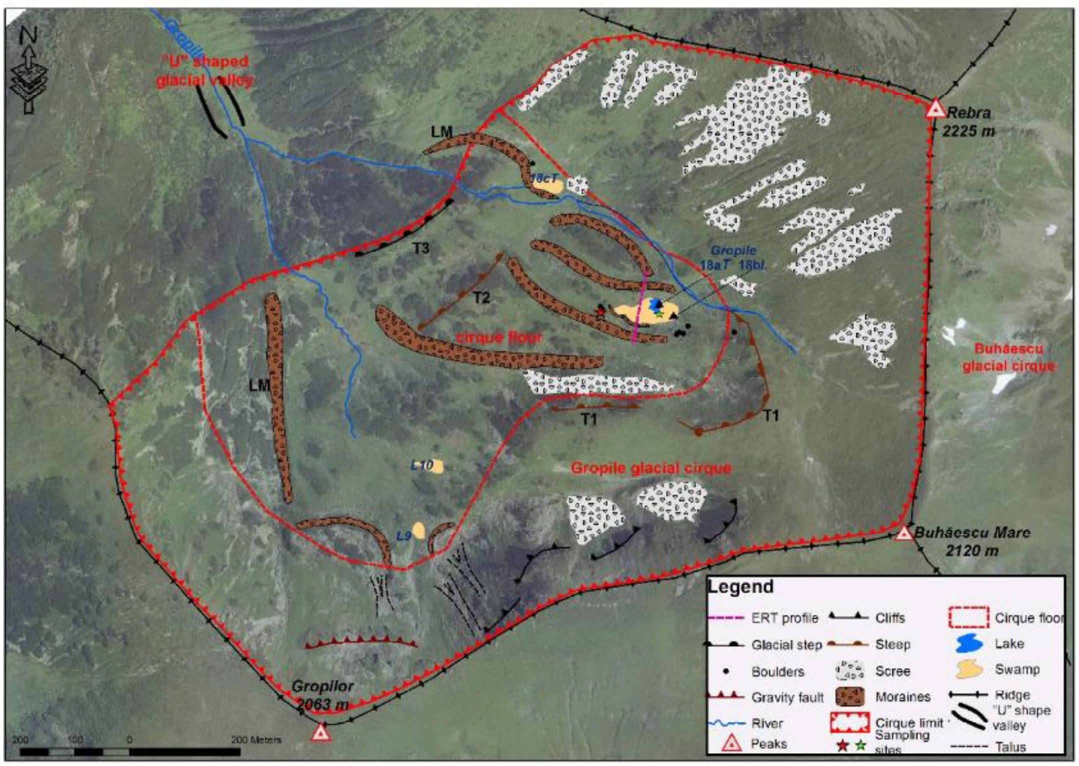


**Fig. 1** Gropile Glacial cirque.

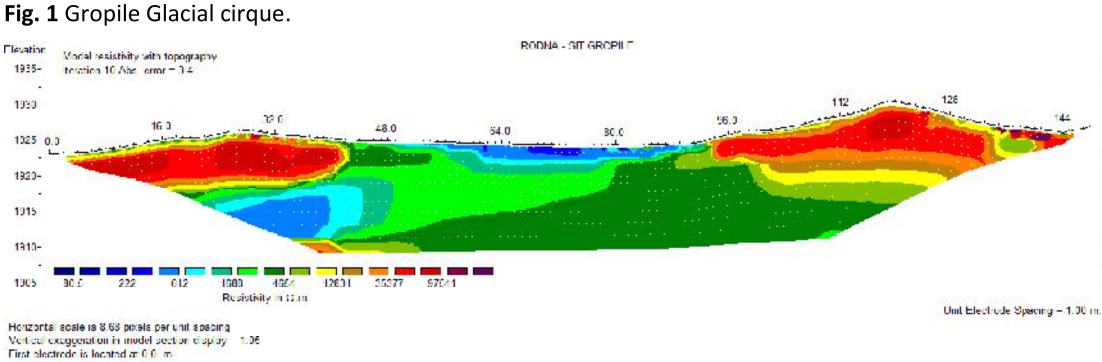


**Fig. 2** ERT profile Gropile.

The second survey was made in the eastern part of the Southern Carpathians, in the Iezer Păpușa Mountains (maximum elevation- 2470 m a.s.l. at Piscanu), namely in the Iezer glacial cirque. The cirque floor preserve less developed glacial deposits compared to Gropile (fig.3). On the right side of the cirque there is a huge rack basin occupied now by a deep water body (maximum depth-9 m). The electrical resistivity surveys start from the left bank of this lake towards the left side of the cirque along a series of moraine lineations.

The second profile (Fig.4), with a north-northeast to south-southwest direction was carried out over a moraine on left side of Iezer Păpuşa Lake. The electrical resistivity surveys from this moraine show likewise in Gropile, water infiltration in the lower parts. The other two profiles (ERT 1 and ERT 3) clearly show the internal structure of moraines with high resistivity values and highlights areas with high humidity.

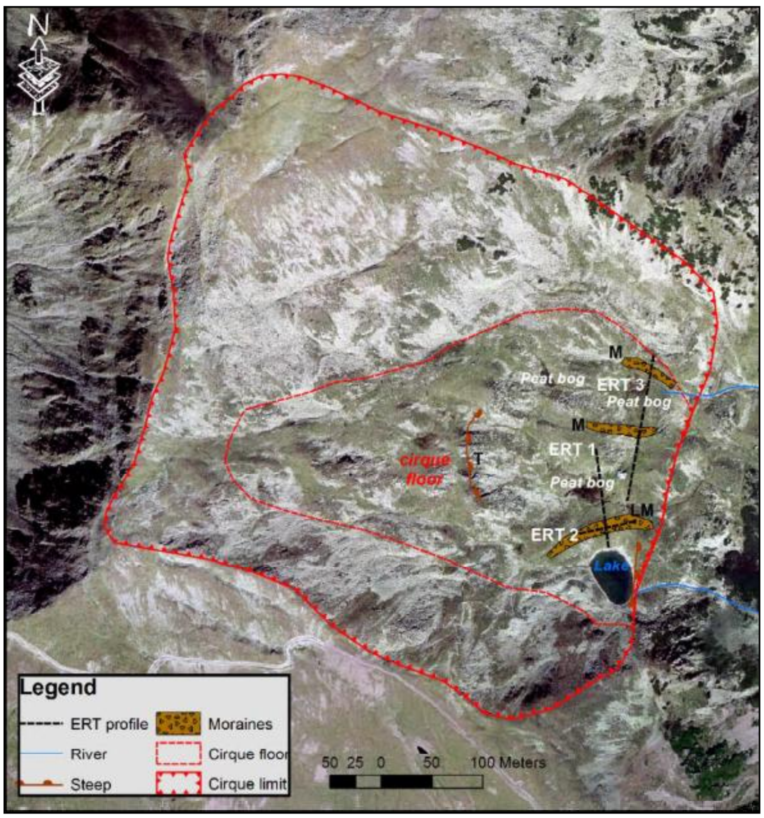


**Fig. 3** Iezer Păpuşa glacial cirque.

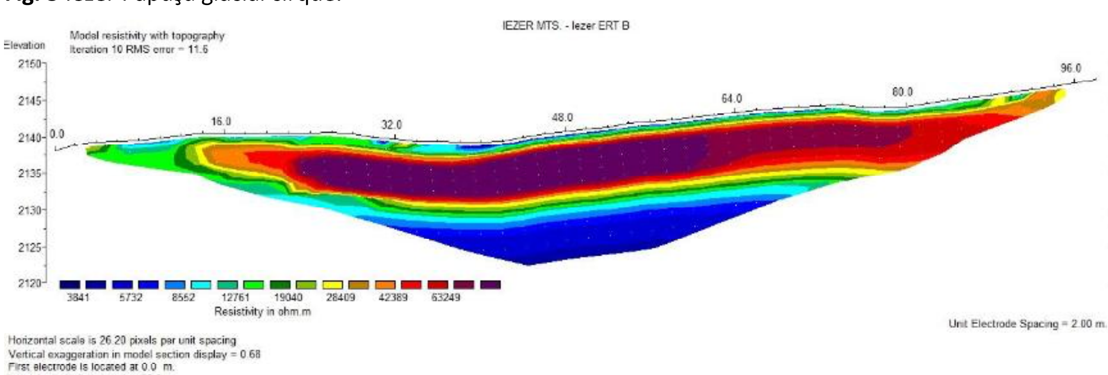

**Fig. 4** ERT profile Iezer Păpuşa (ERT 2).

Both ERT profiles over moraines in Iezer Păpuşa glacial cirque clearly show moraine ridges (*fig.4*) with a purple color showing a higher resistivity of the electric current passing through the rock material and a low resistivity (orange to blue) due to the infiltration of water in the rock material which has a lower resistivity, through which the electric current passes.

Through these ERT surveys we notice the depth of glacial deposits (moraines) have values of maximum 10 meters. High resistivity values of 30.000Ωm - 90.000 Ωm occurs within moraine deposits and lower values (100 – 30.000 Ωm) correspond to deposits with water located above the bedrock. For investigations of Gropile area near Gropile lake and Iezer Păpuşa, are highlighted post-glacial and glacial deposits. We can confirm that he use of Resistivity Imaging Method give a possibility to get the precise continuous model of the medium by the invasion-less way.


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