SUPPLEMENTARY MATERIAL TO:

Halamski, A. T., Baliński, A., Racki, G., Amler, M. R. W., Basse, M., Denayer, J., Dubicka, Z., Filipiak, P., Kondas, M., Krawczyński, W., Mieszkowski, R., Narkiewicz, K., Olempska, E., Wrzołek, T., Wyse Jackson, P. N., Zapalski, M. K., Zatoń, M. & Kozłowski, W., 2022. The pre-Taghanic (Givetian, Middle Devonian) ecosystems of Miłoszów (Holy Cross Mts, Poland). *Annales Societatis Geologorum Poloniae*, 92: 323–379. https://doi.org/10.14241/asgp.2022.19

METHODOLOGY OF THE GEOPHYSICAL SURVEY

by Radosław Mieszkowski

Description of the ERT survey.— The ERT method was worked out in the late 1990s and has been described in detail by Zhadov and Keller (1994), Loke and Barker (1996), Samouelian *et al.* (2005), Loke *et al.* (2015), and Loke (2016). In the ERT method, the distribution of electrical resistivity of the analysed medium is modelled by 2D clocks. Such modelling allows for determining the variable resistivity of the medium in vertical and horizontal directions along the measurement line. The range of electrical resistivity values of selected soils is presented in Table S3.

An essential element of ERT measurements was the installation of a large number of electrodes along the survey line. The electrodes were evenly spaced, connected with a multi-core cable to the instrument performing automatic data acquisition: electric current (I, mA) and potential difference (ΔV, mV); based on this the values of apparent resistivity (ρ, Ωm) were calculated. The software controlling the measurement device allowed to perform electrical resistivity measurements for a specific combination of several pairs of electrodes (AB-current and MN-measurement) among all electrodes connected to the multi-core cable. Measurement of apparent resistivity was made at a selected electrode combination, taking into account the type of measurement (gradient) and the array geometry.

The scheme of ERT surveys has been described for example by Vogelsang (1995) and Pacanowski *et al.* (2016) after Loke (2016).

After the measurement, an automatic selection of the next electrode combination is made (AB and MN) among all electrodes connected to the cable, based on the selected measurement protocol introduced to the device memory. The final effect of the measurement is the apparent resistivity distribution in the scale of apparent depth. The set of obtained results may then be visualised, processes and interpreted with regard to quality and quantity in order to recognise the lithological variability of the bedrock and tectonic contacts.

*Description of the SRT survey.—*SRT surveys are based on the fact that a seismic wave is dispersed spherically in the rock massif from the excitation point and then reaches the refraction boundary, on which it is diffracted and slides on its surface, and later reaches the surface of the area, where it is registered by geophones. The seismic apparatus automatically records the time of wave propagation from its excitation to its registry by the geophone. The fundamentals of SRT have been described in detail by Gurwicz (1958), Fajklewicz (1972), Telford *et al.* (1990), and Reynolds (2011). A demonstrative seismogram with points of first occurrence of direct waves and refraction waves is presented in Figure S1.

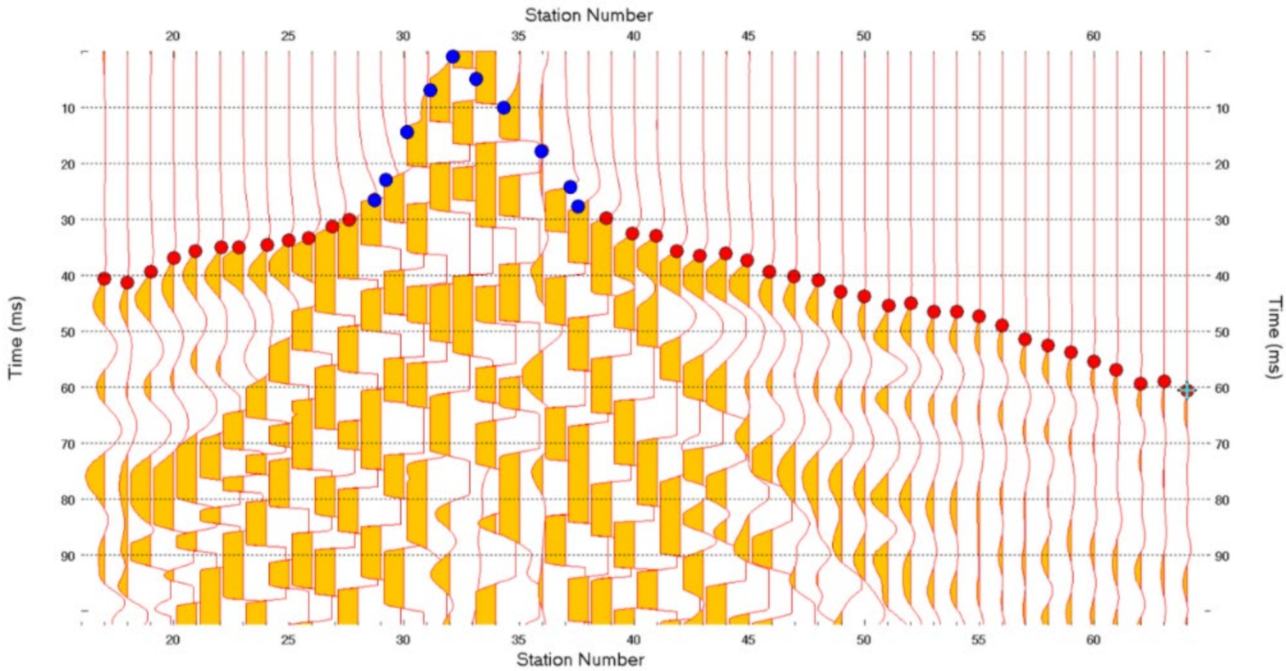

Fig. S1. Demonstrative seismogram with first occurrences of seismic waves. Geophone spacing at 2 m, 24 ch apparatus. Blue dots denote occurrences of direct waves. Red dots denote occurrences of refracted waves.

Table S1

Characteristics of geophysical measurements.

Geophysical method	Number of profiles	Measurement characteristics
SRT	2 profiles	Geophone spacing was accepted at 2 m (f = 10 Hz). The signal was generated by every second geophone. The instrument was Terralock 48 ch. by ANEM from Sweden. The vibration was generated by a 10 kg hammer. Topographic correction was taken into account.
ERT	2 profiles	Electrode spacing was accepted at 2 m. The instrument was Terrameter LS 8 ch. by ABEM, from Sweden. The gradient array was used at a 3 stack measurement. Topographic correction was taken into account.
Geodetic measurements		Geodetic measurement using Ruide6 linked to the local reference station. Resolution +/- 5–8 mm.

Table S2

Characteristics of field data processing.

Geophysical method	Software	Remarks
SRT	Reyfract	Timing of first occurrences of longitudinal waves (direct and refracted) was performed
ERT	RES2DInv	Settings for data inversion: Modeling method: finite element method Grid size: four nodes Finite element mesh maximally densified Number of iterations 5 Inversion type: standard least-squares, L2–norm method Inversion optimization: complete Gauss-Newton method

Table S3

Electrical resistivity values for different types of soils (Fajklewicz, 1972; Stenzel and Szymanko, 1973).

Type of soil	Range of electrical resistivity in Ωm
Clay deposits (clays, clayey loams)	< 25
Organic deposits (peats, alluvial muds)	10÷30
Loams (silty loams, glacial tills, sandy loams)	25÷70
Sands (loamy sands, fine sands, medium sands, coarse sands, gravels)	70÷1000
Sandstones	100–1000
Clay shales	20–70
Marls	10–100
Limestones	200–2000

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