SOME FIELD MEASUREMENT RESULTS OF IP METHOD

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1. Introduction

This paper presents some interpretation results of induced polarization (IP) data using TAU-transformation of time-domain IP curves measured in the field [1]. Two methods for the estimation of type and level of soil contamination and of polarizable ore concentration have been introduced using time constant analysis.

The theoretical basis of TAU-transformation and the contamination estimation [2], [3] are presented in the current volume of this journal [4]. The TAU-transform method was applied first in a TEMPUS project [5] and it has also been tested above several contaminated areas within Hungary ([4], also Rudabánya – 2011, Felsőtelekes – 2011 and Ózd – 2012). This paper presents interpretation results from the Nagytétény, Tiszavasvári and Ózd areas.

2. Soil contamination interpretation results of IP data collected above Nagytétény waste site

IP time-domain data were measured in a Schlumberger electrode array above the Nagytétény communal waste site. At each IP sounding point 16 discrete current electrode spacing points were used, and the array parameters were MN = 1 m, AB_{min} = 3.2 m and AB_{max} = 100 m, where MN was the potential electrode spacing and AB was the current electrode spacing.

In Fig. 1 the vertical WAV (Weighted Amplitude Values) section of the first profile measured from IP data indicates a very high level of contamination [1]. Making a complex time-constant analysis [1], our results show that there is mainly metallic (Fig. 2) and redox (Fig. 3) polarization in the Nagytétény waste site. Where WA values are high there are redox (electrochemical) and metallic polarizations. Membrane polarization (Fig. 4) was correlated with a low contamination level appearing on the WAV section (Fig. 1).

The vertical section of corrected conductivity over Nagytétény is presented in Fig. 5, where the lighter contour lines show the corrected conductivity value of 50 milliSiemens/meter (mS/m), indicating a medium level of contamination.

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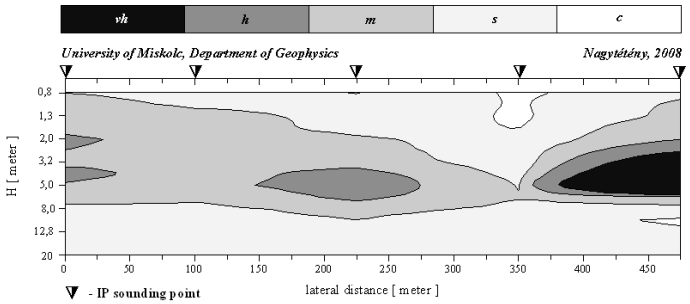

Figure 1. Vertical WAV section (WAV levels: > 0.2 – very high; 0.1-0.2 – high; 0.05-0.1 – medium; 0.02-0.05 – small; < 0.02 – clean)

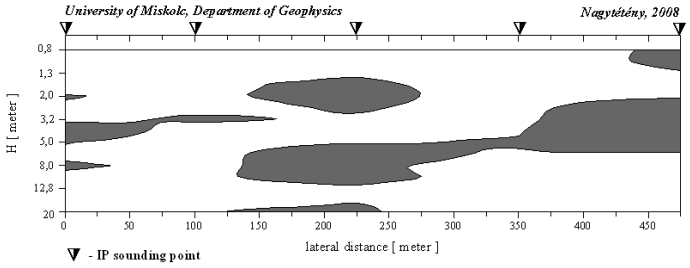

Figure 2. Vertical section of metallic effect (1 sec < τ)

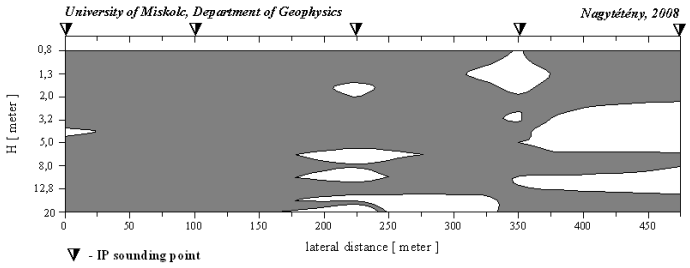

Figure 3. Vertical section of redox effect (0.6 sec< τ <1.2 sec)

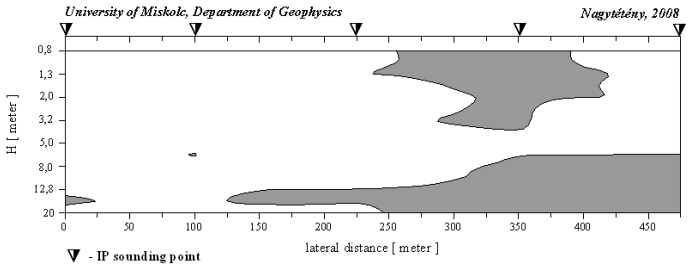

Figure 4. Vertical section of membrane effect (0.2 sec< τ <0.8 sec)

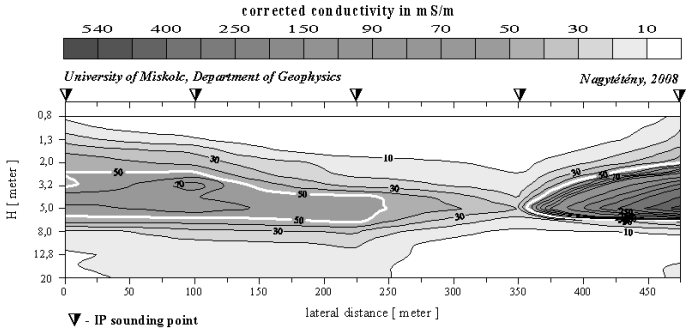

Figure 5. Vertical section of the corrected apparent conductivity

3. Time constant analysis of Time-Domain IP data measured over Tiszapalkonya ash slag

Figure 6 shows the vertical WAV section calculated over the Tiszapalkonya ash slag site. (Also in this measurement Schlumberger electrode array was used for IP soundings). As can be seen, there are only small and medium WA values, indicating some dangerous regions under the surface caused by redox (Fig. 7) and membrane polarization effects.

Sometimes the membrane effect appears with either low apparent resistivity (ρ_a) or high apparent polarizability, therefore let us determine the corrected conductivity (σ_{corr}) [1] section. The corrected conductivity vertical section is presented in Fig. 8. The lighter contour line shows the points of the section where the corrected conductivity value reaches the critical 100 mS/m.

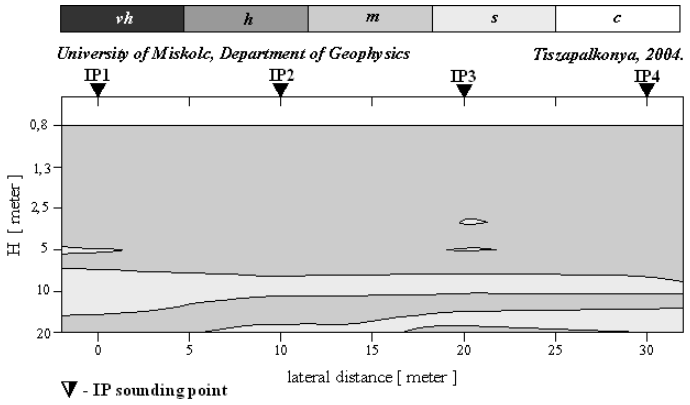

Figure 6. Vertical WAV section at Tiszapalkonya (WAV levels: > 0.2 – very high; 0.1-0.2 – high; 0.05-0.1 – medium; 0.02-0.05 – small; < 0.02 – clean)

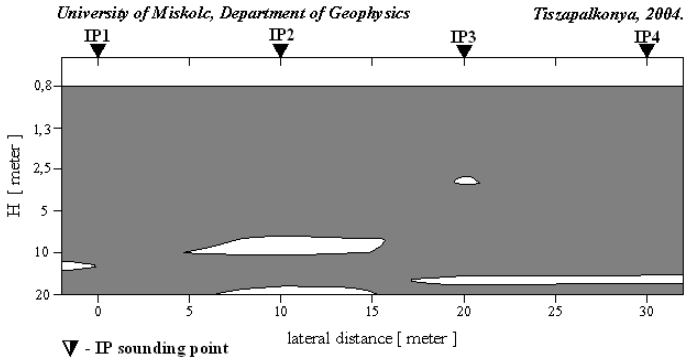

Figure 7. Vertical section of redox effect (0.6 sec< τ <1.2 sec)

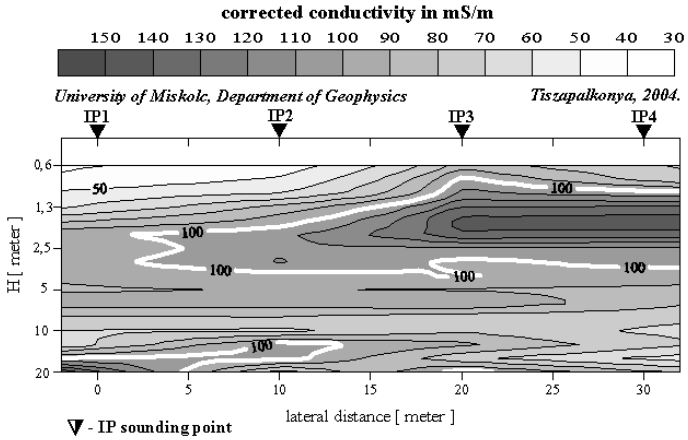

Figure 8. Vertical section of the corrected apparent conductivity

4. Soil contamination interpretation results above Ózd inert waste site

In 2012 the Háromkő Company measured IP data over the Ózd inert waste site. This section presents the calculated contamination levels of the inert waste site using the TAU transformation of IP curves. The following figures compare the two parameters (WAV and corrected apparent conductivity) introduced in [1] for the estimation of soil contamination levels on three reference depths.

Figures 9 and 10 show the WAV and corrected conductivity maps at a reference depth of 2 m. Only small soil contamination appears at this depth level on the northern part of the investigated area. It can be seen clearly that the lower boundary of the small contamination level correlates well with the thick black 50 mS/m contour line on Fig. 10.

The soil contamination level is the highest at the 4 m depth level (Fig. 11); however, it reaches only the medium value.

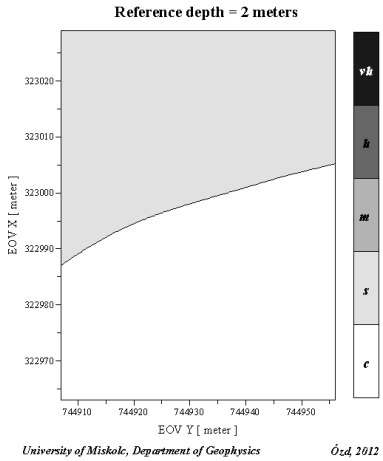

Figure 9. WAV map at 2 m depth

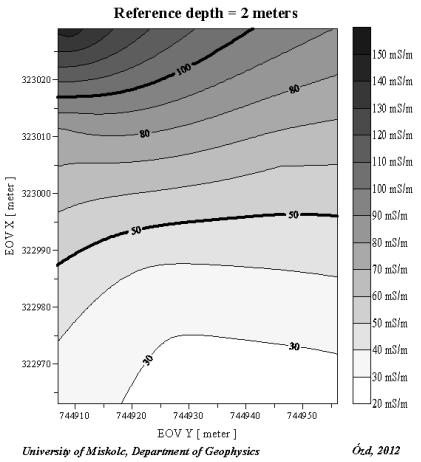

Figure 10. σ_{corr} map at 2 m depth

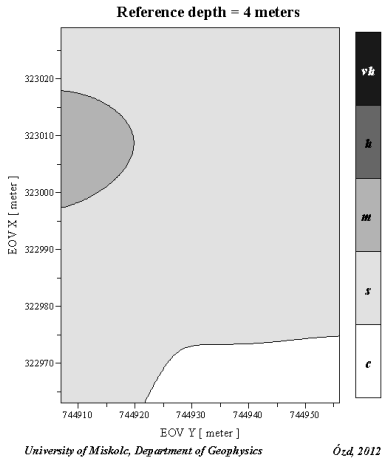

Figure 11. WAV map at 4 m depth

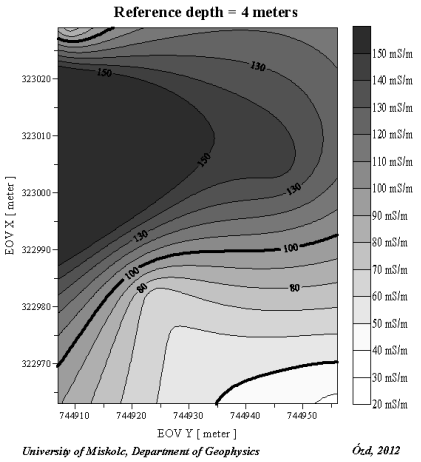

Figure 12. σ_{corr} map at 4 m depth

The soil contamination levels are low and medium on the western part of the area at a 10-metre depth (Fig. 13). It is clearly visible that on all three depth levels the thick black 50 mS/m valued corrected conductivity contour line (Fig. 10, Fig. 12 and Fig. 14) correlates with the lower limit of the low contamination very well.

Finally we can conclude that the Ózd inert waste site has no serious environmental problem, because mainly clean and low levels of contamination can be detected there.

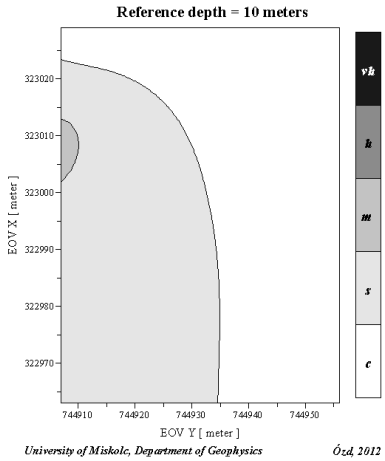

Figure 13. WAV map at 10 m depth

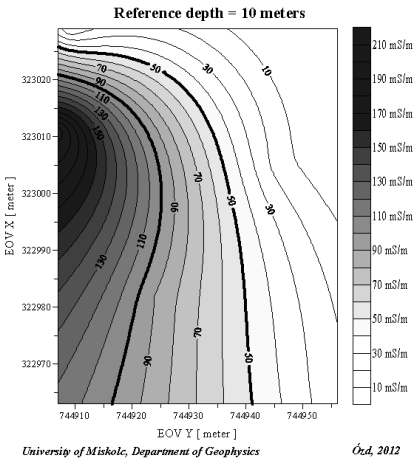

Figure 14. σ_{corr} map at 10 m depth

6. Conclusions

The time constant analysis [1] based on TAU transformation of IP data was applied successfully to all three presented exploration areas for the characterization of soil contamination. A strong correlation has been observed between the WAV and the corrected conductivity maps in all cases.

Acknowledgements

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