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Study of a Dung Heap Impact on Electrical Properties of a Subsurface Zone - Geoelectrical Research

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SUMMARY

On the meadow located at the toe of a flood bank, the dung was accumulated. After a few months, the heap was removed. In order to monitor probable leakages causing change in the subsurface zone geoelectrical survey line was conducted. Geoelectrical studies in the case include two methods: Electrical Resistivity Tomography (ERT) and Penetrometer-Based Resistivity Profiling (PBRP). In the inversion results, clear resistivity decrease is observable in the parts where the dung was accumulated. Also, probable leakage zones are present.

Introduction

The presented results of geoelectrical research from Czernichow village near Cracow, Poland, form an introduction to monitoring of geoelectrical properties changes in the subsurface zone. Those changes are caused by presence of dung heap, being the main study object. The leakage from the dung heap causes a chemical changes in an aquifer. This may have an effect on resistivity changes in a centre. Additional factors which may influence the changes are, among others, variation of the neighbouring Vistula's water level, precipitations or other changes in vadose and saturation zone (Barker & Moore 1998).

Method

On the meadow located at the toe of a flood bank, the dung was accumulated (Fig 1d). The covered area was 9 ares large and the dung thickness reached about 1.3 m. After a few months, the heap was used to fertilize surrounding fields. The dung heap residue is shown in the Fig. 1c.

Fig. 1 presents the study area and survey line localization. The profile runs from NW to SE and is 83 m long. Geoelectrical studies in this case include two methods: Electrical Resistivity Tomography (ERT) (Dahlin 1996) and Penetrometer-Based Resistivity Profiling (PBRP) (Fejes & Josa 1990).

Figure 1 a, b – localization of the study area; c, d – photographs of study area from different dates.

controlled conditions (Mościcki 1998). Measurements for 10, 18, 23, 28, 34, 73 survey line metres were made on 2nd October. Remaining profilings were conducted on 28th October.

Additionally, on the second measurement day, 2 soil samples were collected for chemical analysis. The first sample was taken from 28th survey line meter and the second one from some distance to the profile (background).

The ERT and PBRP results are shown in the Fig. 2.

The ERT measurements were conducted along the earlier chosen profile. First measurement was carried out on 2nd October and the second one 26 days later. The beginning of the survey line is at the NW side. The surveys were carried out with basic electrode spacing $a = 1$ m, 8 Wenner array spacings $1a, 2a, 3a, 4a, 5a, 6a, 8a, 10a$. The ERT data was inverted with Res2dinv software (Loke 2003). The time-lapse inversion option was applied.

For conducting the PBRP, one-electrode probe with the second additional electrode on the surface was used. Measured value is the total grounding resistance, then recalculated into resistivity with the use of k coefficient. The k parameter is determined by calibration in

Figure 2 a, b - ERT data inversion results; c - resistivity section obtained from the *Penetrometer-Based Resistivity Profiling; d - percent resistivity change between the inversion results from 2nd and 28th October 2013.

Conclusions

The inversion results (Fig 2a and b) from two different time periods are similar at the first sight. In both cases clear resistivity decrease is observable in the parts where the dung was accumulated. Between 10 and 15, 50 and 62 m probable zones where leakages migrate to the deeper parts of the centre are visible. Differences between the both resistivity sections are shown in the Fig. 2d. Generally, the 2 m deep zone is dominated by the resistivity drop zones with exceptions between 18 and 26 m. Between the PBRP (Fig. 2c) and ERT (Fig. 2a and b) results, a correlation is noticeable.

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