ENVIRONMENTAL GEOPHYSICAL DIAGNOSIS OF A CONTAMINATED AREA BY HYDROCARBONS USING GEOELECTRICAL DETECTION IN THE VICINITY OF NAVODARI REFINERY-ROMANIA

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Abstract

The hydrocarbon contamination of the environment (aquifers and shallow sediments) with oil contaminants resulted during more then five decades in areas of the refinerie located near Navodari city, Romania. Geoelectrical resistivity method (VES) performed on perimeters located in the vicinity of Petromidia refinerie proved to be the most effective in locating the underground contamination by high resistivity anomalies.

The oil-contaminated plumes associated with high resistivity anomalies are characterised by variations in intensity and also locally interrupted. These aspects are interpreted to be associated with inhomogeneities in compaction of the geological formations that host the floating oil contaminant and the aquifer. All changes in the near surface geological structure affect the level of underground contamination and induce many difficulties in the interpretation of geoelectric investigations results.

Introduction

We utilized an integrated geophysical tool that includes geoelectric and GPR investigations to detect the oil-contaminated plume in different hydrogeological and geological conditions.

The contamination of the environment (aquifers and shallow sediments) with oil and processing products, during more than five decades in the area of refinerie located on the outskirts of Navodari city, Romania, is the subject of a scientific project.

In all studied perimeters, the highest thickness of the contaminant reached a few meters outside the refinery, and decreased gradually toward south-east, the flow direction of the local aquifer.

The geoelectrical resistivity methods (VES) represent the most effective methods in locating the underground contamination by low conductivity anomalies, in areas located near refinerie, the hydrocarbon plume being displaced on top of the phreatic waters, at depths ranging from 0,5 to 1 m, due to specific seasonal climatic variations or geological structures.

Geoelectrical data acquisition and data proccesing

The Vertical Electrical Sounding (VES) measurements (VES and ERT) selected to be presented here have been performed in the vicinity of the Petromidia refinery, along profiles crossing the south-west trending of the contaminated areas (Figure.1). The instrument employed for the geophysical measurements were AGI- MiniSting.

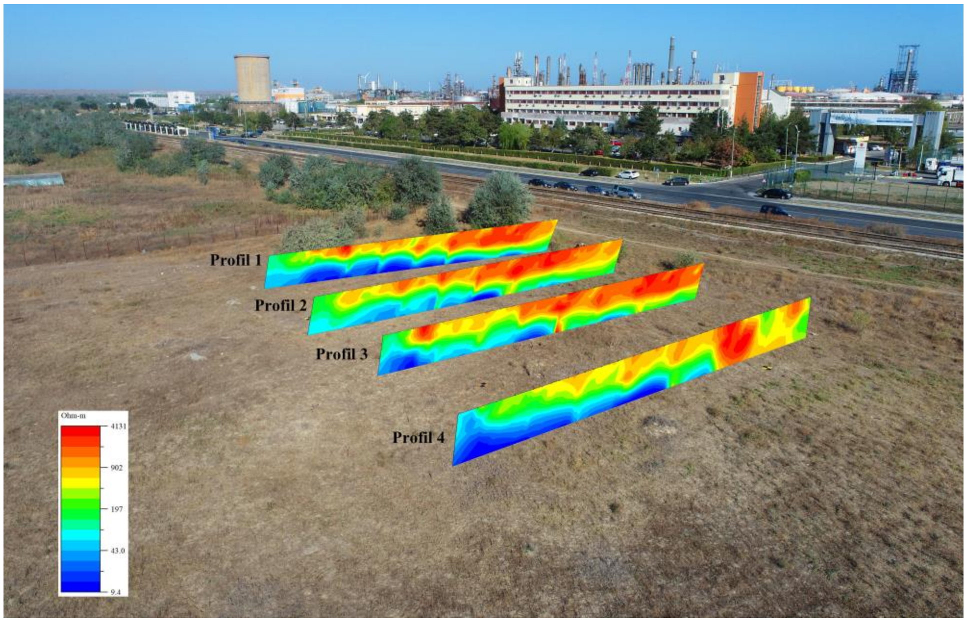

Figure. 1 – Location of geoelectrical profiles in the Petromidia hydrocarbon contaminated areas – perimeter I.

In the Petromidia refinery area two perimeters, aiming to investigate both transversally and longitudinally the underground hydrocarbon polluted area, have been prospected using vertical electric soundings (VES) measurements.

The investigation depth was 5m (AB/2=10m and MN =2m) and the length of profiles was 80m(distance into profiles-5 m). In the Petromidia refinery area, vertical electric soundings (VES) have been performed at 10m equidistance (perimeters I and II).

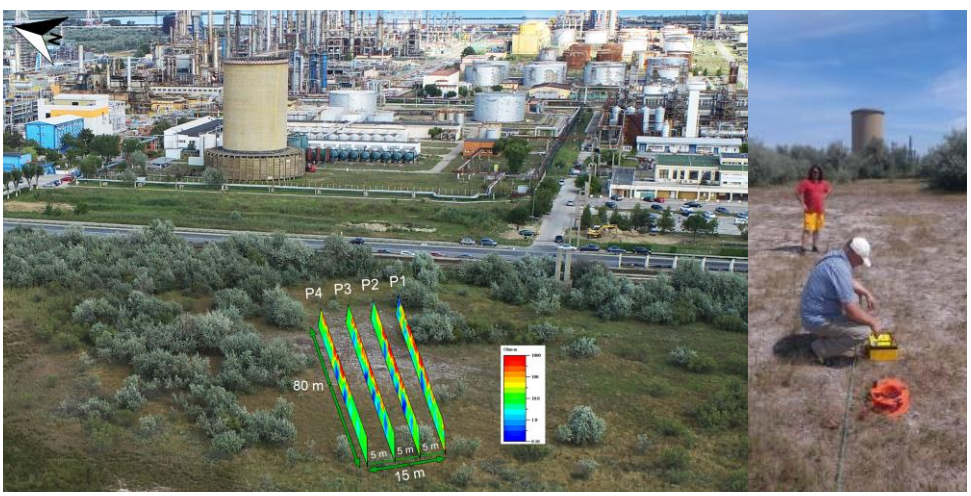

Figure. 2 – Location of geoelectrical profiles in the Petromidia hydrocarbon contaminated areas – perimeter II .

Geophysical data processing

The quantitative interpretation of VES data obtained on profiles I and K (Petrobrazi area) offered the resistivity sections are presented in figures 2 and 3.

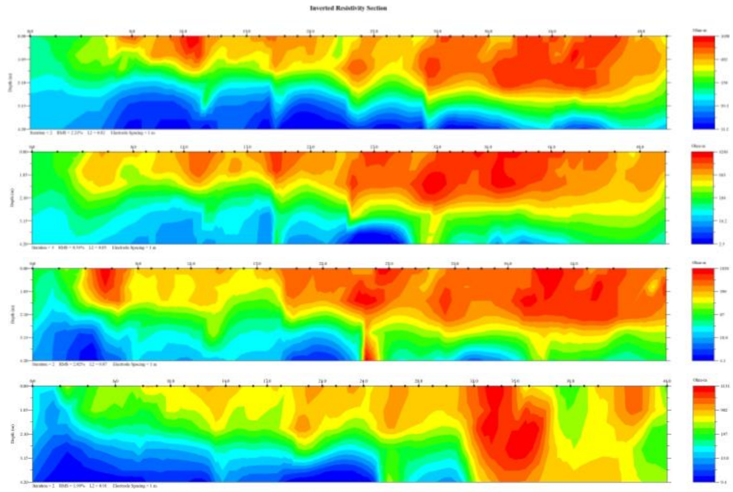

Figure.3 – Resistivity sections on the profile I-II-III and IV (Petromidia area – perimeter I).

In this case, the high resistivity anomalies contoured at shallow depths (1-1.5 m -perimeter I - figure 3 and 1-4 m perimeter II-figure 4) on all profiles may be associated with the oil-contaminated plume, floating at the upper limit of the aquifer, a situation already observed on hydrogeological wells and deep anthropic trenches

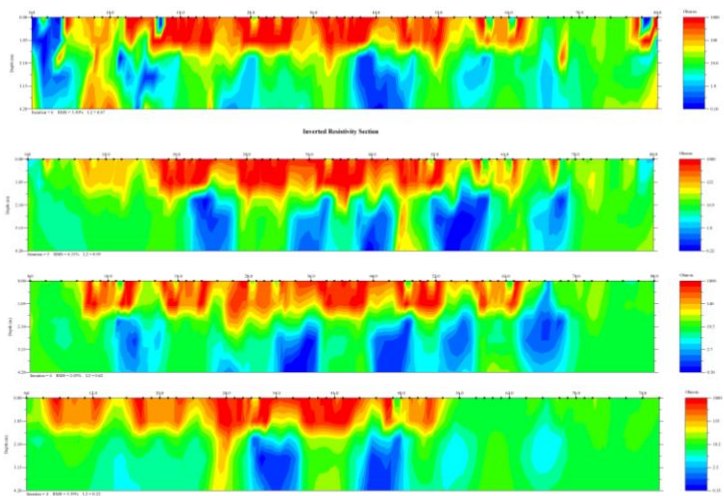

Figure.4 – Resistivity sections on the profile I-II-III and IV (Petromidia area – perimeter II).

In the first time, the geoelectric imagining of the high resistivity layer, especially on the perimeter I, suggests the presence of interrupted flow of the contaminant, due to differences in compaction within the gravels that are hosting the phreatic aquifer.

We remark on the continuity of the high resistivity anomalies, as well as their high intensity, and may represent the detection of a low compaction sector within the gravel formation, that favors the contaminant toflow toward the south-west.The resistivity anomalies located at the upper part of the geoelectric section are high in intensity, as compared to those detected in perimeter II.

The reason for the lower contamination of the geological formations and underground water is a particular feature of this area – the shallow geological structure includes a clay layer 5 m thick,

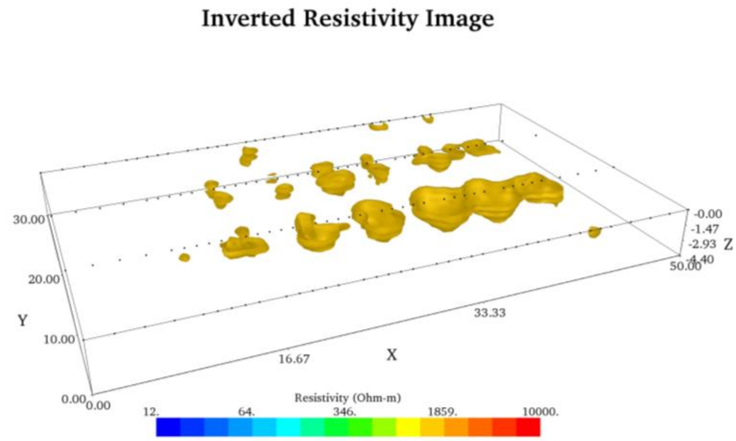

Figure 5 3D resistivity map – perimeter I

that partially prevented the oil contaminant from penetrating toward the phreatic aquifer. In conclusion, the shallow geologic structure of the underground contamination with oil pollutants in the neighborhood of Navodari city is nicely shown by the resistivity sections for perimeter I and II.

Conclusions

Related to the results of geoelectrical VES measurements performed in the vicinity of the refinery Petromidia (Navodari city, Romania) showed good possibilities for the detection of hydrocarbon contaminated plumes. Exist a good concordance into high-intensity resistivity anomalies which were contoured at depths where hydrogeological wells located the underground pollution.The resistivity anomalies are characterized by variations in intensity, and features interpreted to be associated with inhomogeneities in compaction of the geological formations that host the aquifer and the floating oil contaminant.The changes in the shallow geological structure may affect the degree of underground contamination, such as in the Petromidia area, and introduce supplementary opportunities in the interpretation of geoelectric results.

Acknowledgement

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