E028 RESISTIVITY SURVEYS – EFFECTIVE METHOD FOR INTEGRATED GEOELECTRICAL EXPLORATION IN ALBANIA

HOMAGE TO THE C. SCHLUMBERGER

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Fifty years ago for me, an 18 years old electric technician, started work in Well-Logging Service of Albanian Oil and Gas Industry, the Schlumberger brothers name has been equivalent to the geophysics one. Today, after a half of century experience for the geoelectrical exploration and forming of the geophysical engineers, I'm concluded that resistivity method, proposed by C. Schlumberger many tens of years before, has demonstrated high effectiveness in the different exploration domains, and always is in the front of geoelectrical surveys. Analyse of the geoelectrical surveys results by resistivity method in Albania is presented in the paper.

DIRECTION OF THE RESISITIVITY METHOD APPLICATIONS IN ALBANIA

Apparent resistivity method, for half a century, is an important element of the integrated geophysical surveys, with high accuracy and discrimination capabilities:

- **Borehole logging**: for oil and gas deep wells and shallow boreholes for coil exploration.

There are used gradient arrays B0.1A0.5M; B0.1A0.45M, B0.1A0.95M, B0.2A1.9M, B0.4A3.3M and B0.7A7.65M and potential arrays M0.25A2B, M4A40B, M8A40B, which from 1952 are represented the base arrays and important elements for electrical borehole logging in oil and gas industry. B0.2B1.9M and M0.25A2B represent standard normal arrays. Particularly, by all these arrays were realised lateral electrical soundings. Arrays B0.1A1.95M and M1.95A0.1B are used for coal boreholes logging.

- **Geoelectrical surveys**: In Albania, the electrical soundings and profiling by Schlumberger array AMNB, were successfully used for solving of following geological problems:

1) Marine Electrical Soundings, with depth of investigation about 2500 m and depth of influence 3500 m, by current electrode spacing up to 16 km, in the Albanian Adriatic Shelf:

- Exploration of shallow oil and gas bearing molasses structures in the Albanian Adriatic Shelf, having geoelectrical markers as top of Pliocene clay and Tortonian and Serravalian sandstone pack.
- Mapping of eroded fold flanks covered by loose Quaternary marine deposits or sea waters.
- Exploration of littoral heavy minerals placers.
- Mapping of loose Quaternary deposits.

2) Onshore Electrical Soundings, for:

- Method in the integrated oil and gas exploration, for lithological identification of seismic reflectors from carbonate anticline tops, and for the sandstone packs of the Neogene's molasses structures mapping.

- Engineering investigations of construction areas, raw materials dams, slope stability and landslides, traces of the highways, railways, tunnels and main irrigation channels.
- Hydrogeological Exploration.
- Karst zones and cavities investigations.
- Environmental investigations: Underground waters aquifer and soil pollutions.
- Solid mineral exploration: copper minerals deposits, high, rare and precious placers, coal basin tectonics, bauxites etc.

3) Electrical profiling:

Marine profiling: For Quaternary loose sediments and outcrops of the Neogene's molasses sea bottom mapping. Profiling was carried out by differential array MAN, $B \to \infty$, axial dipole array ABMN, and pole-dipole array AMN, $B \to \infty$, with a spacing 100-400 m.

Onshore profiling: with Schlumberger multiple arrays $A_1A_2MNB_2B_1$ for geoelectrical mapping of the contacts between volcanic and sedimentary rocks in Lower-Middle Triassic volcanic sedimentary pack, last ones with Upper Triassic limestone, tectonic faults etc. Pole-dipole array for combined profiling AMNB, $C \to \infty$ was used for massive structure of copper minerals bodies exploration.

Results of the electrical soundings and profiling by Schlumberger array in Albania, in the paper are analysed.

RESULTS AND DISSCUSIONS

Marine electrical soundings and profiling, as a part of integrated marine geological-geophysical oil and gas exploration, along Albanian Adriatic Shelf from Vlora Bay at the south to Shengjini Bay at the north, were used for mapping, within a distance of 10 km from the coastline, where the sea depth reaches about 50 m. Averagely, sea depth was 10-20 m. of the this marine space.

The Durresi structure exploration represents a successfully example of marine resistivity sounding and profiling application. Based on this exploration have been drilled a deep well Du-16 which has been discovered a gas deposit; under the Adriatic Sea water structure (Fig. 1,2).

Durrës – Kepi Pallës area is characterized by a presence of Neogene's molasses formation: Tortonian clay-sandstone, Messinian clay, sandstone interbeds and lens, and gypsum debris and blocks stage and Pliocene clay deposits. Up to present, by deep wells, is known that 2975-3125 m is thickness of Neogene molasses. Marine Quaternary loose deposits have covered bedrocks of the neogene molasses. These deposits are extended in the shallow offshore in Durresi-Kepi Palles area, and are presented by loose sand in the coastal line and clay mud far from coastline. Marine deposit thickness in the offshore are is 10 m near of the coastline in the Kepi Palles sector, which increased up to 20-50 m at the west.

Durrës-Kepi Pallës anticline is asymmetric and structure top is extended about 1600 m at the west of the coastal line, under the Adriatic Sea waters (Fig. 1, 2). After Pliocene field extension, about 40 km is length of the structure, and 2 km width. The anticline amplitude is varies of 2000 up to 2500 m. Eastern flank is tectonically abrupt. Part of eastern limb of the structure has a dipping 45-55^o in the western location from tectonic line. At the depth, the dipping gradually is increased to 75-80^o up to overturned. At the surface, the tectonic line is outcropped at Kepi Pallës on shore. The tectonic line is located under Adriatic Sea waters toward the Porto Romano sector.

Tortonian sandstone packs of the eastern anticline flank, covered by marine Quaternary loose deposits, are mapped by electrical profiling (Fig. 2).

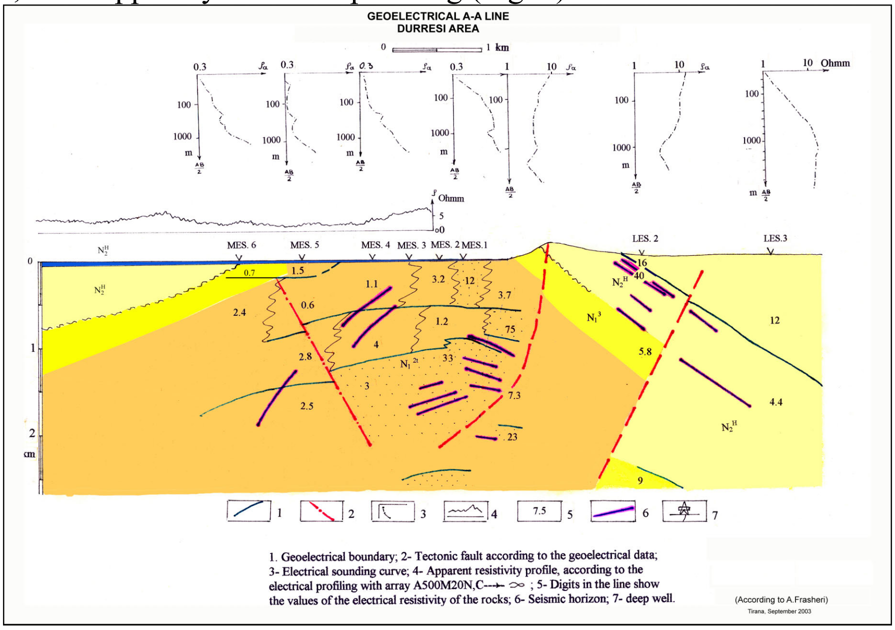

Fig. 1. Geological-geophysical profile, Durresi gas bearing structure.

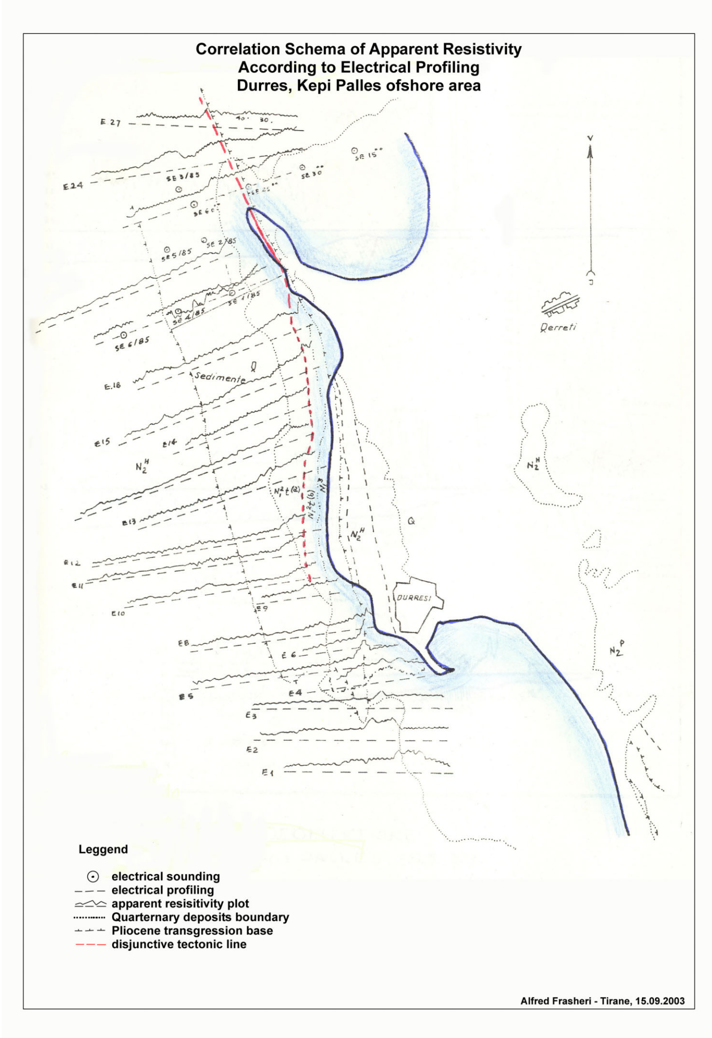

Fig. 2. Geoelectrical marine mapping of offshore eastern flank of Durredi anticline.

Slope stabilization and landslides investigations have been realized successfully by integrated geophysical methods, which electrical soundings present an important method (Fig. 3).

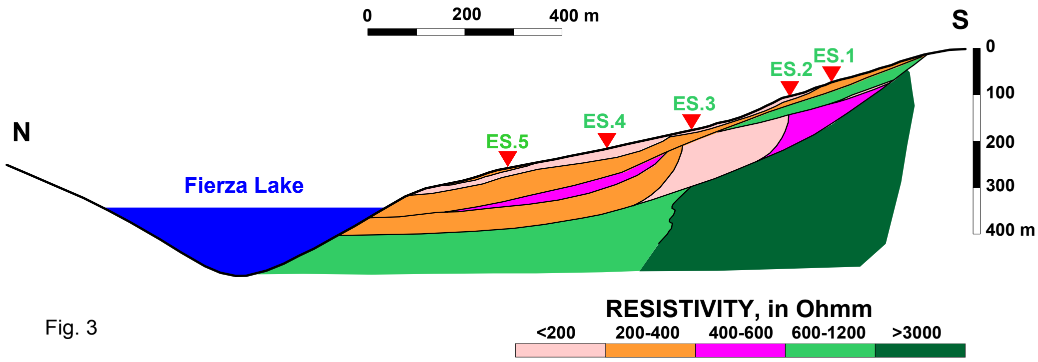

Fig. 3. Geoelectrical section of Porava landslide.

Porava landslide is located in the lakeshore of the Fierza hydropower plant lake. Fig. 3 shows presence of two categories of geoelectrical markers in the profile, which are determined full configuration of the sliding structure in the rocks of the volcanic sedimentary section. In the karstified zones , the geoelectrical section is KH type. Depending on the thickness of layers, A type geoelectrical section is also possible. Karstified surface forms, which are filled with residues of the altered material has a resistivity of first layer is smaller than that of the second layer, represented by karstified limestones with empty lattices. The third geoelectrical layer shows the resistivity is lower that of the second layer. This is because the less dense karst lattice is filled with water or clay. The fourth geoelectrical layer is represented by compact limestone, and consequently its resistivity is higher than that of all overlying layers.

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