Satellite-Synchronized MT Network
3-D Applications

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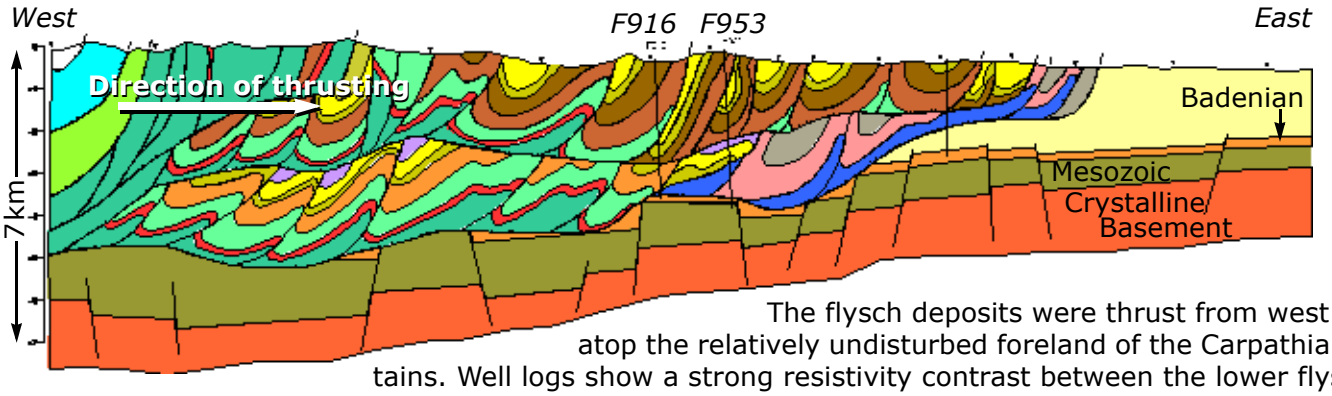
Deep Gas Discovery in Romania based on 3-D MT

Romgaz, the state-owned gas corporation in Romania, is systematically exploring the external flysch zone of the Eastern Carpathian Mountains. The topography is very rough, so the seismic technique is relatively costly; and due to the complicated geology, the seismic results are not very satisfactory. The geophysical techniques used therefore include gravity and magnetics, but are mainly based on MT.

Previous Methods Unreliable

Before the MT survey, the Frasin area was considered a single uplifted block. Some old deep wells here were drilled on geology alone, and many did not find hydrocarbon shows. But oil shows were noted in horst blocks, both in wells and in outcrop. Elsewhere, there are known gas deposits in the middle Miocene (Badenian, Sarmatian) units, which here are deeply buried beneath the thrust sheets.



The flysch deposits were thrust from west to east atop the relatively undisturbed foreland of the Carpathian Mountains. Well logs show a strong resistivity contrast between the lower flysch deposits and the older middle Miocene sediments atop the deeper faulted blocks, providing the basis for mapping with MT. Note Well number F953 in the cross-section above.

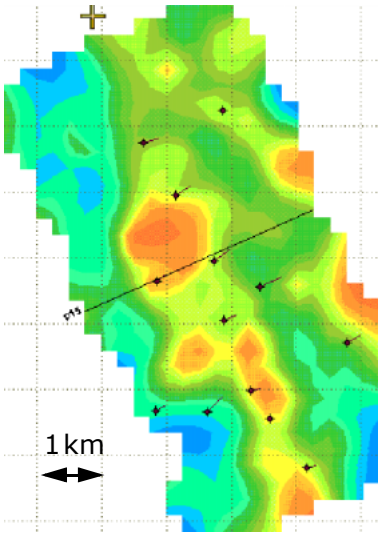
Regional MT Success Leads to Full-Scale 3-D Survey

More than 1500 regional MT soundings performed with older equipment in the years before 2001 showed NW–SE uplifted zones, transected by NE–SW strike-slip faults.

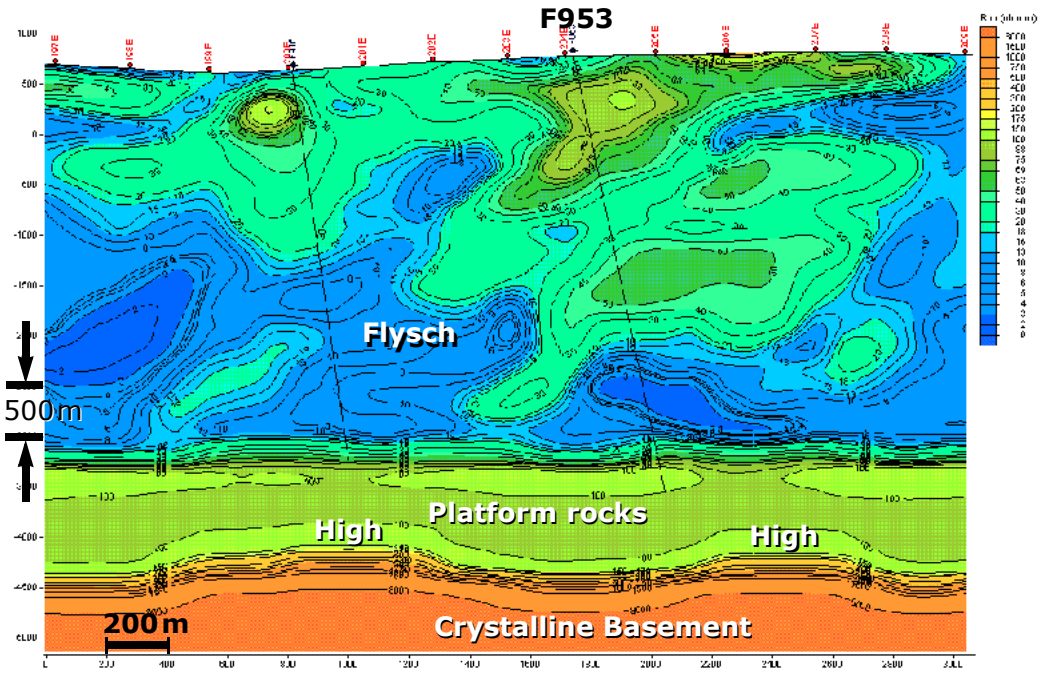
The figure above shows wells F953 and F916, drilled on the basis of the older regional MT work. The result of F953 was at first hard to understand, since it did not encounter any Badenian (middle Miocene) formations—it traversed a fault zone and then encountered commercial gas in Upper Cretaceous Senonian and Albian deposits (the first such discovery below the thrust sheets).

Therefore, to map the detailed deep block structure below the thrust sheets, Romgaz performed a 3-D MT survey in the Frasin area using Phoenix Geophysics System 2000 MT equipment. The survey comprised 350 stations on a regular net (250m x 250m) on 28 lines in an area approximately 20km square.

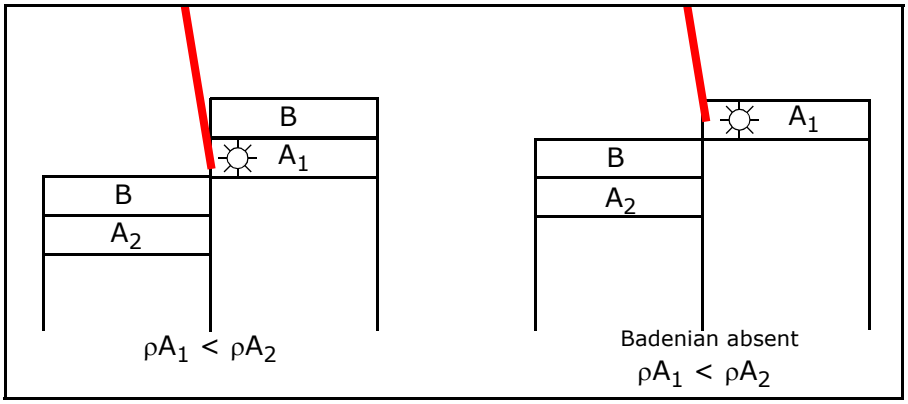
The plan map at right shows resistivity at a depth of 3100m in the area. The black symbols are wells. Profile P015, one of the 28 parallel profiles, crosses the area from SW to NE. The warm colours (orange, yellow) are higher resistivity, and the cool colours (blue, green) are lower resistivity.



The figure below shows the 2-D inversion—a vertical section—along Profile P015. The deep crystalline basement (below approximately 4500m) has high resistivity. Note the two basement highs between stations 300 and 1400 (left side) and 2100 to 2800 (right side). The sedimentary platform (Paleozoic to Middle Miocene) lies atop the basement and is draped over the basement highs and has much lower resistivity. Finally, the flysch deposits (low resistivity, blues, greens) lie atop the platform. A fault zone is indicated where well F953 penetrates the platform rocks.



The block diagram at right suggests two possible explanations for why Well F953 did not penetrate the Badenian.



Romgaz's Conclusion

The MT survey in a very complicated flysch area with rough topography, together with detailed gravity and magnetic measurements, confirms that non-seismic methods can produce reliable results. Furthermore, MT data acquisition in a close spacing net is a good exploration method for oil and gas structures in this area.

References

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