

Near-Surface Characterization for Seismic Exploration Based on Gravity and Resistivity Data

Jan Mrlina¹

¹Institute of Geophysics

Abstract

No doubt there is continuous progress in the methodology of exploration seismic surveys. However, especially on land, seismic data processing is still facing difficulties in near surface detailed characterization that is affecting the seismic resolution on the whole. If the static corrections and subsurface velocity model are not accurate, not only fine deep details, but the complete section quality is deteriorated to certain level. It is evident that application of supporting geophysical techniques may be crucial in certain geological environments.

Detailed and micro gravity, as well as resistivity (multi-electrode tomography, vertical electrical sounding or electromagnetic methods) can assist in improving the near-surface characterization. Numerous structural or petrophysical features can be distinguished by these techniques. Gravity may indicate e.g. karst, voids, faults, reefs, buried channels, provided sufficient density contrast.

Resistivity is strong in horizontal layers, like weathered layer, or water-saturated level, as well as vertical boundaries definition, provided resistivity contrast. Even if the interpretation is not perfect due to ambiguity, these features, or at least respective anomalies of density or resistivity enable adjusting of the seismic velocity model and improving statics.

The examples from real surveys in big fields in the Middle East demonstrate the integration of gravity and resistivity data with seismic processing. Substantial improvement of static corrections and consequently the clear shape of horizons in seismic sections are shown in a figure. As well, lateral changes in a gravity map served as basis for adjusting 3D velocity model for detailed seismic exploration in an already developed field. Major fault was sharply defined by both gravity and resistivity where no such clear picture was provided by seismic alone. These examples justify application of detailed gravity and resistivity surveying alongside with high resolution 2D – 3D seismic.