Geophysical and Geological Data for Smart City Solutions:

Building Safer, More Resilient Communities

SEISMIC IMAGING FOR GEOTHERMAL SURVEYS: EXAMPLES FROM ROMANIAN REPROCESSING

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ABSTRACT

Reflection seismic methods are the geophysical technology of choice in oil and gas exploration. Much of the science underlying seismic oil exploration can also be applied to identifying geothermal reservoirs, where temperature and pressures might influence seismic responses. However, in low-enthalpy systems, the effect of temperature is negligible due to the absence of a substantial vapor fraction. In such cases, seismic analysis must focus on other geological and petrophysical parameters, such as porosity, permeability, and fracture networks, which are critical in assessing geothermal potential.

Porosity and permeability, essential for geothermal reservoir quality, are directly influenced by fracture properties. Equations can be used to estimate permeability based on fracture porosity, although porosity-permeability relationships can be complex and vary widely depending on rock type, fracture networks, and their extent. The fracture state, which is associated with high permeability, can be directly linked to the acoustic properties of the medium, resulting in characteristic seismic responses. A simplified relationship between P-wave velocity and fracture porosity provides a practical method for estimating fracture distribution in reservoirs. By integrating seismic attributes with well data, a more comprehensive understanding of subsurface conditions can also be achieved.

Various existing processing technologies are discussed in relation to geothermal fluid identification, with a focus on fracture mapping and fluid content in low-enthalpy geothermal areas, such as Romania. An understanding of the physical and mathematical theories behind these methods is illustrated, along with their known merits and limitations.

Results from the reprocessing of seismic data from the 2005 Fetești area are presented, highlighting specific data characteristics, regional processing challenges, and state-of-the-art solutions in relation to current industry standards.

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