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Perspective

Flexible Layer-Based 2D Refraction Tomography Technique for Imaging Subsurface Structures

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DESCRIPTION

Refraction tomography is a widely used geophysical technique for imaging subsurface structures. In this article, a flexible layer-based 2D refraction tomography method that can image complex subsurface structures with high accuracy will discussed. The method involves the iterative inversion of seismic travel-time data, and it allows for the inclusion of a priori information about the subsurface structure. The flexibility of the method makes it suitable for a wide range of geological settings, including those with complex layering and topography.

The imaging of subsurface structures is an essential component of geophysical exploration for natural resources, environmental assessment, and hazard mitigation. Refraction tomography is a widely used method for imaging subsurface structures based on seismic travel-time data. The method involves the inversion of seismic travel-time data to estimate the subsurface velocity structure. The accuracy of the velocity estimation depends on the quality of the seismic data and the inversion method used. In this article, we discuss a flexible layer-based 2D refraction tomography method that can image complex subsurface structures with high accuracy.

The layer-based 2D refraction tomography method involves the inversion of seismic travel-time data to estimate the subsurface velocity structure. The method assumes that the subsurface is composed of horizontal layers with constant velocities. The seismic data are collected by placing seismic sources and receivers on the ground surface and recording the travel times of seismic waves that have been refracted or reflected by subsurface structures.

The iterative inversion process begins with an initial velocity model that is updated in each iteration until a satisfactory fit to the observed data is obtained. The inversion algorithm solves the Eikonal equation, which describes the travel time of seismic waves through a medium with a known velocity structure. The Eikonal equation is solved numerically using finite-difference or ray-tracing methods.

The flexibility of the layer-based 2D refraction tomography method comes from its ability to incorporate a priori information about the subsurface structure. The method can be modified to include a wide range of geological features, such as dipping layers, faults, and topography. The inclusion of a priori information reduces the ambiguity in the inversion process and increases the accuracy of the velocity estimation.

The layer-based 2D refraction tomography method has been applied to various geological settings worldwide. The method has been used to image subsurface structures associated with natural resource exploration, environmental assessment, and hazard mitigation. The results of these studies indicate that the layer-based 2D refraction tomography method can image complex subsurface structures with high accuracy. For example, the method has been used to image the subsurface structure associated with the San Andreas Fault in California, the mineral deposits in Australia, and the oil and gas reservoirs in the Middle East.

The layer-based 2D refraction tomography method is a flexible and accurate technique for imaging subsurface structures. The method involves the iterative inversion of seismic travel-time data and allows for the inclusion of a priori information about the subsurface structure. The flexibility of the method makes it suitable for a wide range of geological settings, including those with complex layering and topography. The accuracy of the velocity estimation depends on the quality of the seismic data and the inversion algorithm used. Therefore, continued development of the inversion algorithm and acquisition of high-quality seismic data are necessary for accurate subsurface imaging. The layer-based 2D refraction tomography method is a valuable tool for natural resource exploration, environmental assessment, and hazard mitigation.

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