



Differentiated approach in tomography: Model reconstruction with Mislocation Errors and Testing of the Tjorness Fracture Zone, Iceland.

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Differentiated approach (DA) to tomography is a new inversion method, based, first, on sub-division of an initial sparse mixed-determined system into a set of filled sub-systems, second, on selection of solutions using resolution and correlation criteria and, finally, on the statistical analysis of independent solutions to estimate the most reasonable one. Notoriously the event locations are coupled with the velocity model. Here, we present test results of the velocity model reconstruction when hypocenter locations are fixed. Synthetic data are calculated for a Tjörness Fracture Zone (TFZ) velocity model, based on combined analysis of a priori gravity, bathymetry and seismic information, characterized by low-velocity anomalies along the Husavik-Flatey-Fault (HFF) and the Grimsey Lineament (GL). The network consists of 16 seismic stations, located along the coast line from Melrakkasletta and Axarfjörður to Skjálfandi and Flateyjarskagi. 574 events, recorded from 1986 to 1988, were non-uniformly distributed in clusters and sparsely. Standard tomography, which requires crossing rays from different directions, has a serious resolution problem for such a data set. For the test, DA is applied to synthetic travel time residuals, inverted for two cases: (1) assuming the hypocenters to be accurate and (2) assuming them to have random errors. The results are the following. In case (1) the anomalous zones along HFF (sparse events) and GL (dense cluster) can be reliably reconstructed even under the poor source-receiver configuration. In case (2), the structure is successfully resolved only along GL. Our conclusion is that DA requires the presence of as many as possible events in the investigated volume to overcome the influence of the hypocenter errors, but it can obtain a stable velocity model even under an unfavorable station configuration, restricted by the conditions of a seismic experiment. Note: standard tomography does not work for such configurations. The denser the station distribution (than in the given case), the more detailed structure can be resolved by DA tomography.