# Challenges of Microseismic Data Inversion in Case of Strong Anisotropy

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## Abstract

In this study we simulated a microseismic dataset for a single well monitoring scenario, carefully analyzed it and inverted direct wave arrival times as it performed in traditional data processing long and limited realizations of monitoring arrays. We used the finite differences approach to compute synthetic wavefield and manual arrival times determination. The main takeout ideas are:

The observed wavefields may look very differently depending on the orientation of the double-couple source with respect to the receiver array. In some cases observed seismic gathers show only one strong wave (SH-wave) with other waves being rather weak, and thus not clearly indicating presence of anisotropy. The analysis of the data from azimuthally distributed events is necessary to evaluate existence of the shear wave splitting, and thus to evaluate weather formation inhibits anisotropic properties.

A long acquisition system is beneficial for the wavefield analysis on the processing steps, for example to identify the loop. Limited acquisition system in its turn may lead to severe disturbance in wavefield interpretation especially when there is strong anisotropy. The wavefield interpretation mistakes may be solved by further analysis but it requires additional work time.

Small misfits of the data, which are generally used in practice as quality markers, are not always a guaranty of solution quality, especially for poor acquisition system. Small misfit criteria is always to be verified with known prior data and general physical sense. The use of an isotropic model may lead to large disturbances in location quality and usually correspond to unreasonably large traveltime misfits (for wide acquisition system). Unreasonable adding of isotropic layers aimed to reduce misfit function may lead to nonphysical solutions, and even the negative Poisson ratio may be recovered, it may reduce the misfit, but locations will be biased.

This research was supported by Skoltech (Agreement No. 711- MRA from 11.11.14).