The growing civilization challenges related to human interactions with the geosystem (e.g. Earth hazards, resources and sustainability) all require reliable methods for subsurface imaging. The project intends to significantly develop methodologies of seismic imaging and their applications in 4 research topics:

1) Full waveform inversion (FWI) for wide-angle seismic reflection/refraction (WARR) profiles

Wide-angle seismic reflection/refraction method (WARR) is a powerful tool to image crustal-scale structures, it consists of recording and interpreting refracted and reflected waves. It allows to model the physical parameters of the Earth's crust and upper mantle in the surveyed area. Full waveform inversion (FWI) is a data-fitting procedure that aims at obtaining detailed estimates of subsurface properties from seismic data. The research goal of this part of the project is to improve the algorithm of the FWI and apply it to several WARR/deep reflection profiles from China, which can dramatically improve the resolution of our crustal models

2) Source-independent structure imaging method with full waveforms from passive seismic sources

Active methods use a man-made source for signal (e.g. dynamite). Passive methods use natural source for signal (earthquakes). Location of passive sources is often hard to determine, which influences accuracy of measurements. Better resolution is usually provided by active methods, but in order to investigate deeper structures, large explosives have to be used which may draw safety concerns. During the project, the team will develop a source-independent structure imaging method with full waveforms from passive seismic sources that does not depend on knowing source information. This method will be applied to natural earthquakes to better understand seismogenic structure as well as induced seismicity to better characterize reservoir structures.

3) Identification of noise sources and noise modeling

In every kind of seismic measurements some noise is recorded together with the expected signal. Within the project, new methodology of noise reduction will be developed. Data denoising is crucial for successful structural imaging as well as for deriving physical properties like earthquake source parameters.

4) Rock-mass deformation monitoring using channel and coda waves

The underground mining changes the stress field within surrounding rock mass. The consequence is seismicity which can provoke the rock burst. Therefore, information about the rock mass deformation is crucial in terms of safety and economic. Therefore, high resolution seismic methods for imaging and monitoring of rock mass during mining will be developed. This will also bring better understanding how rock mass is responding to mining, and can be used in monitoring other natural hazards (landslides, volcanoes, earthquakes).

The project will contribute to improving our understanding of the deep Earth processes in 4 different aspects with many interdisciplinary applications: it will **facilitate the work of seismologists** studying the Earth's interior; demonstrate how to **obtain as much as possible from the experimental data** and how to **improve the resolution of crustal models**, which is important e.g. for **geologists** working on tectonic evolution of the whole crust. The success of the methodology for source-independent imaging of passive seismic data can **revolutionize and reduce the costs of future seismic experiments** – both for purely scientific (**seismogenic structures**) and applied purposes (**reservoir monitoring**). Project results can be widely applied in mining (rock burst prevention) or volcano/landslide monitoring.