

Preface

The zone near the surface of our planet is the interface between geo-, bio-, hydro-, and atmosphere and the basis for our daily life. Water, natural resources (salt, ore, oil, and gas) and energy, for example heat, are exploited from this zone. Increasingly, waste and other material will be stored underground. We do not only use the surface for infrastructure but rather we increasingly expand construction to the subsurface for example relocating traffic to tunnels.

Suitable exploration and monitoring technologies are therefore of enormous importance to mitigate danger and damages in this economically and ecologically sensitive area. High resolution time-dependent images are necessary to derive crucial information about the subsurface. Thus, there is an urgent need for technologies and methods which enable high-resolution imaging of structures and processes in the subsoil on different spatial and time scales. The objective of this research topic was therefore the refinement of tomographic methods and their application to geological processes.

Despite methodical progress, especially in mathematical and numerical geophysics during the last few years, like the real-time data acquisition and evaluation in addition to computer-aided visualization programs, various methods are often still used independently due to economical reasons. However, the concerted combination and the enhancement of different methods allow new prospecting strategies.

The research work on the topic of “Tomography of the Earth’s Crust: From Geophysical Sounding to Real-Time Monitoring” has focused on the development of cross-scale multiparameter methods and their technological application together with the development of innovative field techniques. Seismic wave field inversion theory, diffusion and potential methods were developed and optimized with respect to cost and benefit aspects.

This volume summarizes the scientific results of nine interdisciplinary joint projects funded by the German Federal Ministry of Education and Research in the framework of the Research and Development Program GEOTECHNOLOGIEN.

Highlights and innovations presented cover many length scales and involve targets ranging from applications in the laboratory, to ground water surveys of heterogeneous aquifer, geotechnical applications like tunnel excavation, coal mine and CO₂ monitoring and the imaging and monitoring of tectonic and societally relevant objects as active faults and volcanoes.

To study these objects, the authors use the full spectrum of geophysical methods (ultrasonics, seismic and seismology, electromagnetics, gravity, and airborne) in combination with new methods like seismic interferometry, diffuse wave field theory and full-wave-form inversion in 3D and partially also in 4D.

To make the results and implementations available to a broader community as well as to end-users, unique knowledge-based platforms were developed in terms of computer code, benchmark data, technical definitions, and recommendations via a web portal.

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