



## **Seismic imaging around and ahead of tunnel construction sites**

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The project OnSITE (Online Seismic Imaging for Tunnel Excavation in hard rock) aims at developing an integrated approach for seismic imaging around the tunnel and prediction ahead of the tunnel face during construction work. We present our approaches and the recent results with respect to the determination of the spatial locations of faults, fractures and heterogeneities by advanced seismic imaging techniques.

So far we have implemented and applied 3D Kirchhoff-Prestack-Depth-Migration (KPSDM), Fresnel-Volume-Migration (FVM) and Reflection-Image-Spectroscopy (RIS). The 3D P- and S-velocity models required for the calculation of the Greens functions have been generated by using the 2D first-break tomography velocity models and rotating them around the tunnel axis. The 3D images were obtained by stacking the migrated data taking into account either the true phase or the absolute value.

The application of the mentioned imaging techniques to data from the Gotthard base tunnel (Piora adit) show significant improvements compared to standard processing methods. The 3D RIS approach suppresses scattering effects in the low frequency band and increases resolution in the high frequency band so that some of the geological structures are much better visible. The 3D FVM technique uses slowness and polarization based estimates of the emergence angles at the receivers and restricts the imaging to the region around the actual reflection or diffraction point. We observe less spatial ambiguity and a higher resolution of most structures already in single receiver gathers.

Currently we perform a combination of both approaches (FVM and RIS) in order to exploit their advantages and to deliver an even more pronounced and clear image of

the tunnel environment.