Improved interpretation of SAGEEP 2011 blind refraction data using Frequency-Dependent Traveltime Tomography

Siegfried Rohdewald
Intelligent Resources Inc., Vancouver, Canada (rayfract@gmail.com)

We demonstrate improved resolution in P-wave velocity tomograms obtained by inversion of the synthetic SAGEEP 2011 refraction traveltime data (Zelt 2010) using Wavepath-Eikonal Traveltime Inversion (WET; Schuster 1993) and Wavelength-Dependent Velocity Smoothing (WDVS; Zelt and Chen 2016). We use a multiscale inversion approach and a Conjugate-Gradient based search method. Our default starting model is a 1D-gradient model obtained directly from the traveltime first arrivals assuming diving waves (Sheehan, 2005). As a second approach, we map the first breaks to assumed refractors and obtain a layered starting model using the Plus-Minus refraction method (Hagedoorn, 1959). We compare tomograms obtained using WDVS to smooth the current velocity model grid before forward modeling traveltimes vs. tomograms obtained without WDVS. Results show that WET images velocity layer boundaries more sharply when engaging WDVS. We determine the optimum WDVS frequency iteratively by trial-and-error. We observe that the lower the used WDVS frequency, the stronger the imaged velocity contrast at the top-of-basement. Using a WDVS frequency that is too low makes WDVS based WET inversion unstable exhibiting increasing RMS error, too high modeled velocity contrast and too shallow imaged top-of-basement. To speed up WDVS, we regard each nth node only when scanning the velocity along straight scan lines radiating from the current velocity grid node. Scanned velocities are weighted with a Cosine-Squared function as described by (Zelt and Chen, 2016). We observe that activating WDVS allows decreasing WET regularization (smoothing and damping) to a higher degree than without WDVS.

References:


Shewchuk, J.R., 1994, An Introduction to the Conjugate Gradient Method Without the Agonizing

