

# **P-wave velocity model building using first arrival tomographic inversion of profiles ILAB-SP05 and ILAB-SP08**

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This document describes the tomographic inversion methodology applied to the multi-channel seismic data collected during the ILAB-SPARC experiment in 2018 aboard *R/V Pourquoi Pas?* The P-wave velocity models are published in Rohilla et al. (2025). The velocity model building steps are as follows:

1. Pre-processing of the multi-channel seismic data as described in ILAB\_MCS\_processing.pdf till step 5.
2. Downward extrapolation of the shot gathers to a datum 100 m above the seafloor using the methodology of Arnulf et al. (2012) which was based on the theoretical formulation by Berryhill (1979). P-wave velocity in water was chosen to be 1500 m/s.
3. Resorting of the downward continued shot gathers into common receiver location domain followed by interpolation to a shot spacing of 12.5 m.
4. Downward extrapolation of the interpolated common receiver location sorted data to a datum 100 m above the seafloor using a P-wave velocity in water of 1500 m/s.
5. Picking of first arrivals in both common shot and common receiver location sorted downward extrapolated data.
6. Inversion of first arrivals using Harm Van Avendonk's code (Van avendonk et al. 1998, Van Avendonk et al. 2001). Raytracing was performed with a uniform grid of 12.5 m  $\times$  12.5 m and the initial model was discretized on a uniform grid of 50 m  $\times$  50 m. A linear gradient based 1D model was used as an initial model with velocity at the seafloor = 1500 m/s and a linear gradient of 2.4 s<sup>-1</sup>.
7. In total, 182,071 picks were inverted for profile ILAB-SP05 and 99,732 picks were inverted for profile ILAB-SP08. We performed 16 iterations to reach a misfit ( $\chi^2$ ) = 1.4.

## References

Van Avendonk, H.J.A., Harding, A.J., Orcutt, J.A., McClain, J.S., 2001. Contrast in crustal structure across the Clipperton transform fault from travel time tomography. *J. Geophys. Res.* 106, 10961–10981.

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