Joint inversion of seismic data for temperature and lithology in the Eastern Alps

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The high density SWATH-D and AlpArray seismic networks provide a unique opportunity in the Eastern Alps to resolve the complex plate configuration and investigate how the crustal structure seen today reflects the dramatic changes in mountain building style and reorganisation of plate boundaries at about 20 Ma. This study complements the partner project where scattered wave tomography is applied to the same area (presented in the poster 'Applying scattered wave tomography and joint inversion of high-density (SWATH D) geophysical and petrophysical datasets to unravel Eastern Alpine crustal structure', Tilmann et al).

In order to bring together the seismological and geological-mineralogical constraints in a probabilistic self-consistent way, we employ the joint inversion of seismological and petrophysical data sets. Receiver functions and surface wave dispersion curves, calculated in partner projects, are usually jointly inverted for elastic properties. By utilising the strengths of Markov Chain Monte Carlo inversion, we are able to instead parameterise our model by temperature and mineral assemblage. By inverting seismic data directly for the crust's constituent mineral assemblages, we are led to a deeper understanding of intra-crustal structure, temperature, and petrophysical properties of crustal layers. A further significant advantage is in interpretation where the probabilities of certain lithologies being present allows for a more seamless integration of qualitative geological data and a reduction in interpretation biases compared to when only seismic velocities are presented.

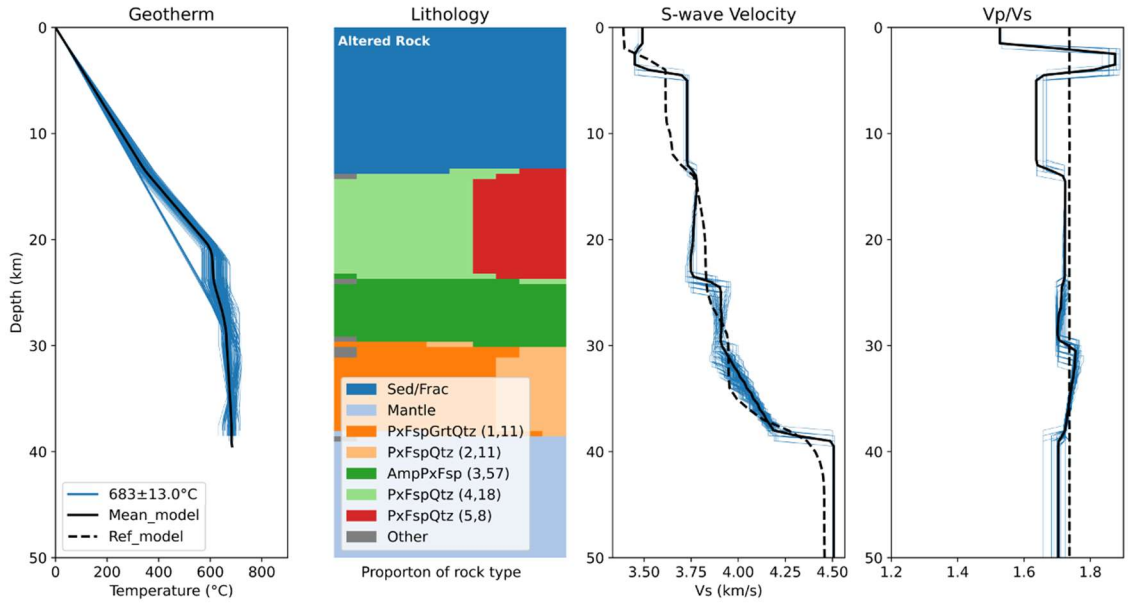

Figure 1: Result from a test station of a joint inversion for temperature and lithology compared to a reference model (dashed line) calculated with a usual joint inversion. Blue lines represent the best 5,000 models. Each colour in the *Lithology* panel represents a different mineral assemblage (the legend gives shorthand for their main constituents). The proportion of different assemblages at each depth in this panel represents the proportion of models with that rock type at that depth. This can be interpreted as the probability of particular assemblage being present (given the model assumptions).