Average 1-D P and S wave Velocity Model for NW Bohemia/Vogtland

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Introduction

The West Bohemia/Vogtland region is one of the seismically most interesting areas in Europe because of magmatic processes in the intracontinental lithospheric mantle. However, they are expressed by a series of phenomena distributed over a relatively large area, like occurrence of repeated earthquake swarms, surface exhalation of mantle-derived and CO2-enriched fluids, mofettes, mineral springs and enhanced heat flow,among others. At present this is the only known intra-continental region where such deep-seated, active lithospheric processes currently occur. Active tectonics is primarily manifested by frequent weak to moderate earthquake swarms (Horálek et al., 2000), and by neotectonic crustal movements (Bankwitz et al., 2003)(see Fig.1). Seismicity in West Bohemia/Vogtland mostly occurs in earthquake swarms over distinct time periods concentrated in an area of about 60x50 km which comprises the territories of West Bohemia, SE Saxony (Vogtland) and NE Bavaria (e.g. Hiemer et al, 2011, see Fig. 2). Continuous seismic monitoring, active seismic surveys, fluid and groundwater level monitoring as well as GPS measurements have been carried out in this region for many years. It is therefore an excellent location for an ICDP drilling project targeted to a better understanding of the mantle – crust– deep biosphere in an active magmatic environment.

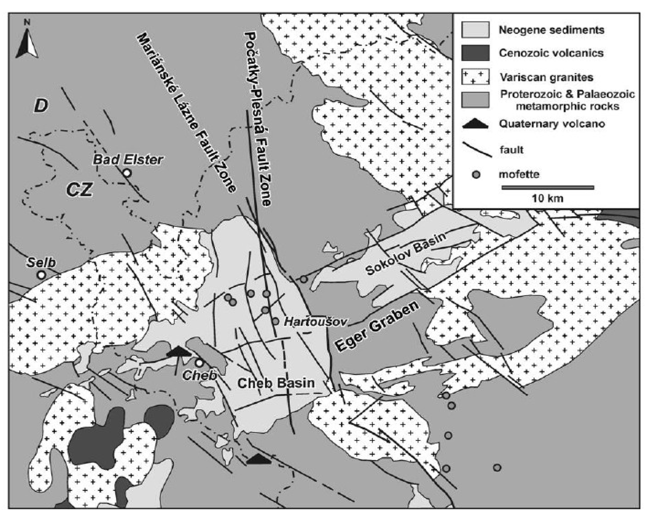

Fig1. Geological sketch map of the west Bohemia(Fuchsig et al.,2008).

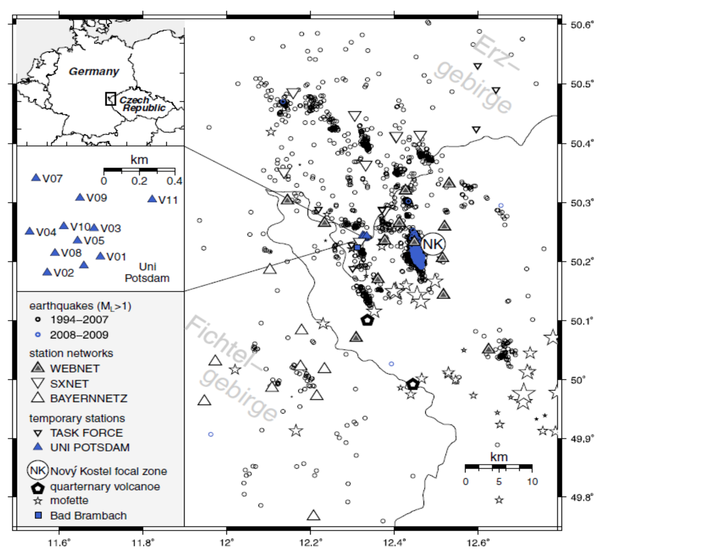

Fig2. Seismicity of west Bohemia(Hiemer et al., 2011).

Data Selection

On the condition in this region several swarm earthquakes occurs and the events in the same hypocentral position transfer same information to the stations so we have divided the surface along latitude and longitude to 0.01 degree grid steps and in the depth to 1km grids So the largest earthquake in each cube has been selected and the rest of earthquakes with similar characteristics omitted, in a word we shrieked our catalogue to the largest events in each location .

In this study the data were taken from permanent networks WEBNET, BAYERNNETZ, SXNET, Thuringian network and from temporary networks BOHEMA, PASSEQ and other institutions data like GFZ and University of Potsdam.

P and S wave arrivals from 1600 earthquakes which occurred in 2000 to 2010 within the Vogtland region have been accurately re-picked to obtain a high quality data set. Earthquakes in this data set have a magnitude ranging between -0.5 and 3 which represent most of the energy released by earthquakes in the analyzed period. We did not include events with negative magnitude and ~~the~~ events with only few available arrival times(minimum 6 arrivals) as well as ~~the~~ events with azimuthal gap more than 180° .

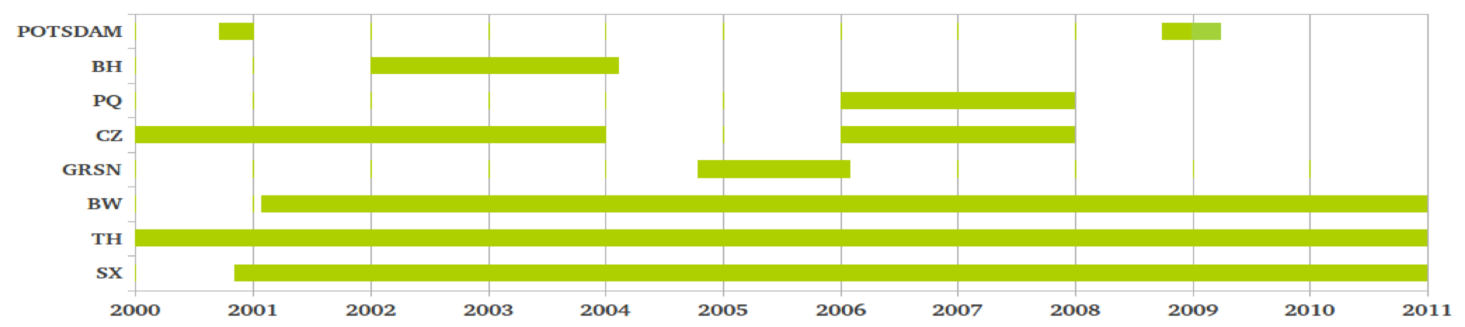

Fig3(up) Networks availability.

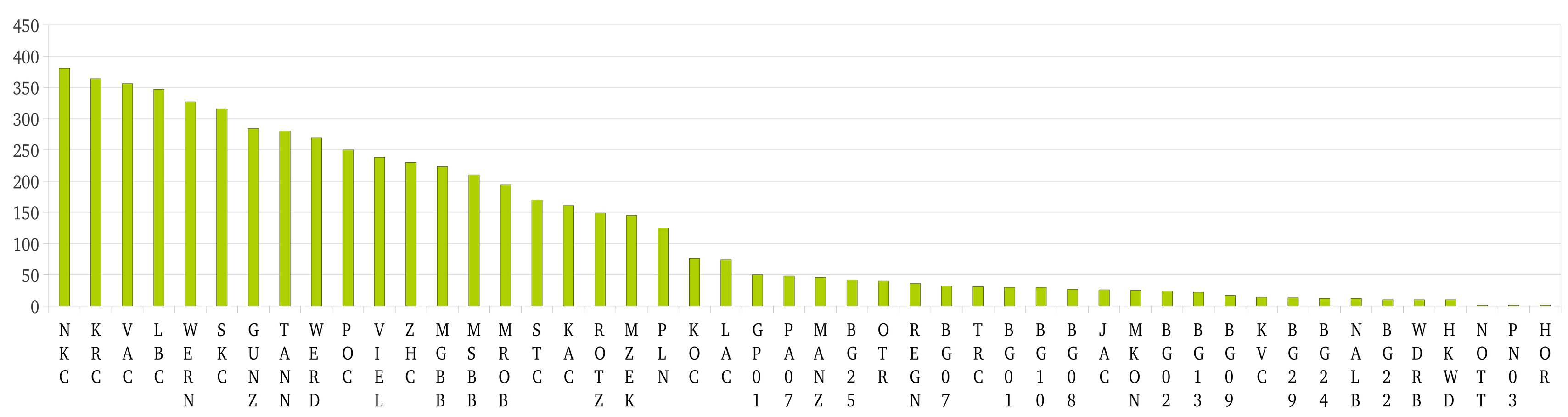

Fig4(below). Number of reading for stations.

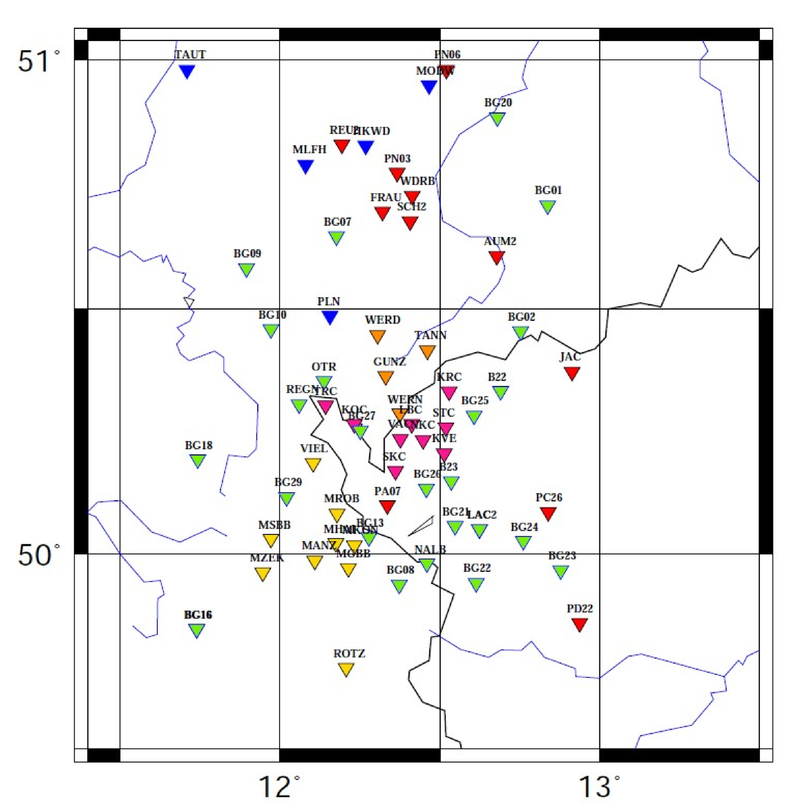

Fig5. Distribution of seismic stations in study area.

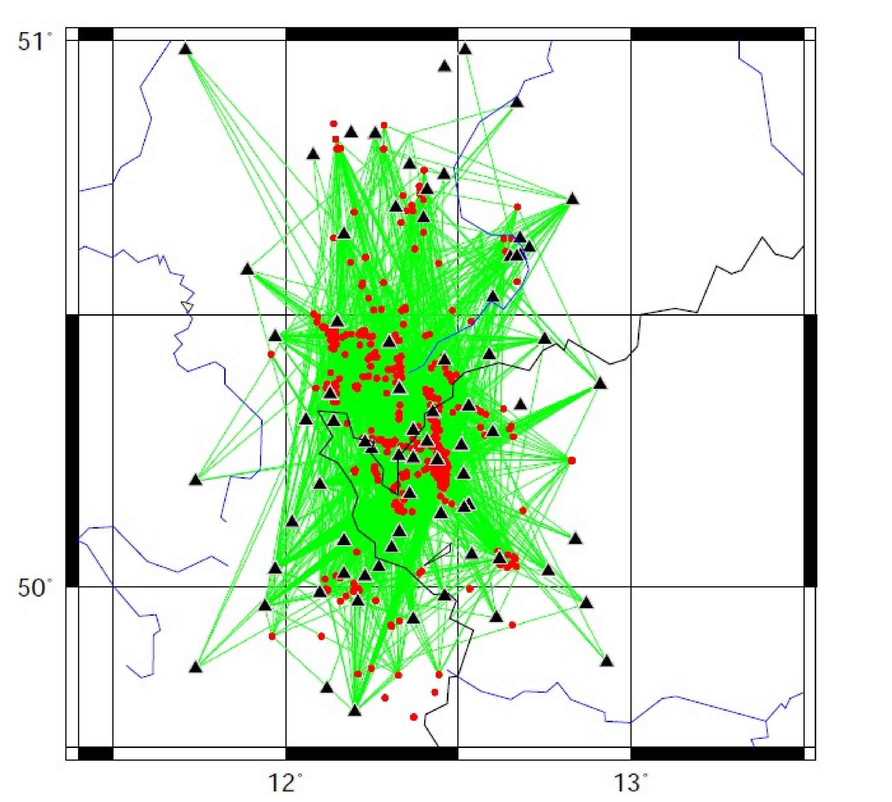

Fig6. Ray coverage, earthquakes and station distribution for the events with more than 6 readings.

Method

We chose program VELEST (Kissling et al., 1995) to achieve an optimized velocity model by minimizing travel time residuals through a joint hypocentre and velocity adjustment. This program minimizes the squared travel-time residuals of a set of earthquakes observations by a simultaneous inversion of velocity and hypocentral parameters. The result is a minimum 1-D velocity model which fits the observed travel times best. The inversion was performed using the travel time data with epicentral distances < 150 km. The data set comprised a total of 1097 readings (466 P- and 631 S-travel times).(Dear Dirk I will add the data for 2000 after completing the picking for this year)

The seismic station NKC was chosen to be the reference station for its reliability and central location in the Vogtland seismic region (Fig.5), and its recording of more events than any other station in the network(Fig.4).

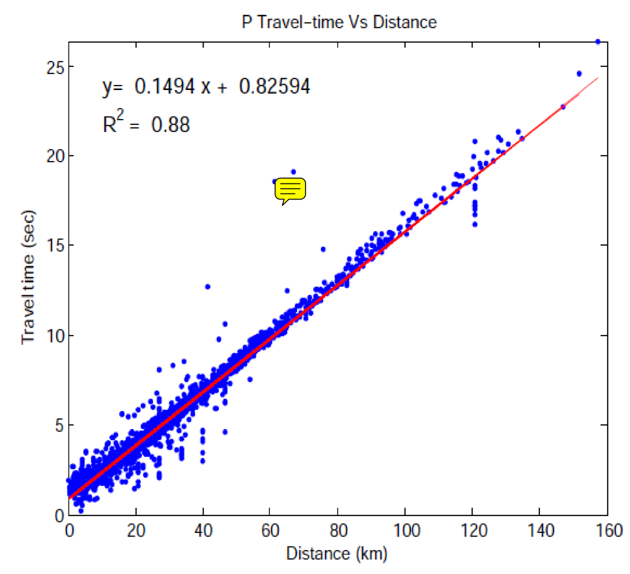

Fig7.Travel-time distance diagram for P-wave.

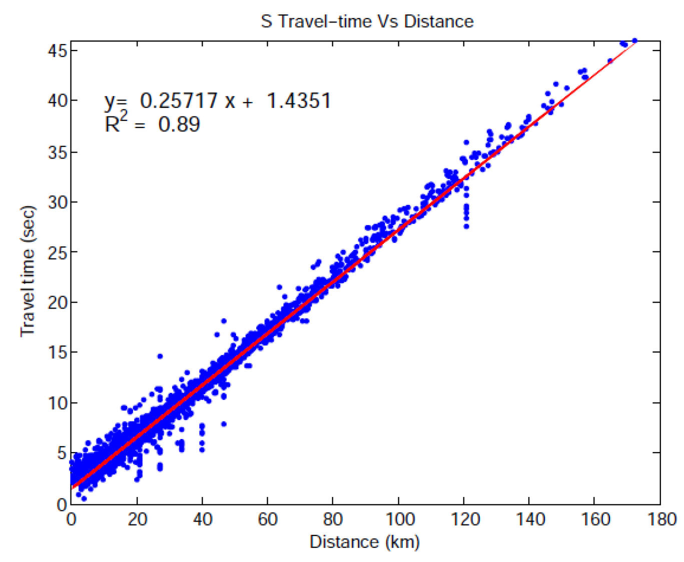

Fig8. Travel-time distance diagram for S-wave.

I'm goinig to pick the data that seems wrong in this plot

Because the resulting structure is strongly dependent on the starting velocity model, we explored 100 initial models randomly distributed.(Fig.9.a,10.a). The inversion procedure was done as follows: we used a starting velocity structure composed of a stack of layers 2 km thick, of velocity 4.5-6.5km/s and for S-wave the velocity between 3-4 km/s. The result of these inversions for P and S waves are respectively in Figures 9 and 10 part b.

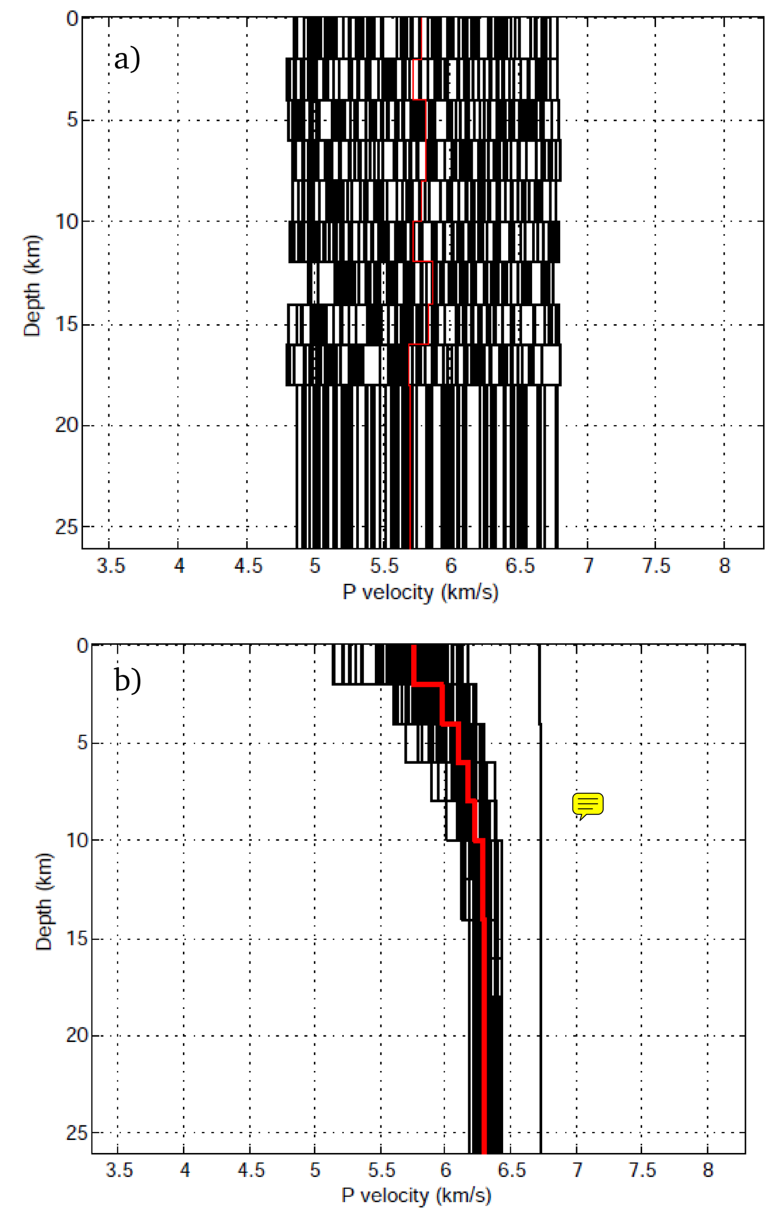

Fig 9. a). Random Model with 10 layers, 2 km thick for P-waves b)Results of inversion

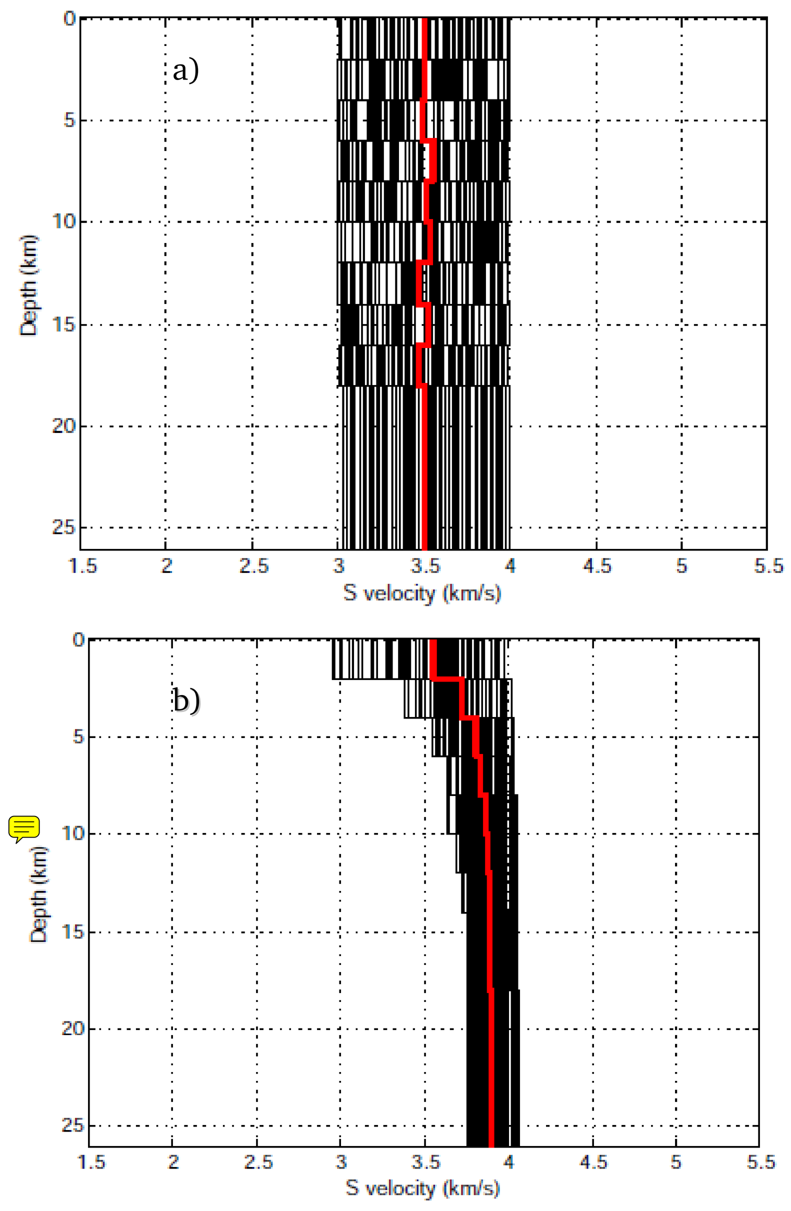

Fig 10. a). Random Model with 10 layers, 2 km thick for S-waves b)Results of inversion

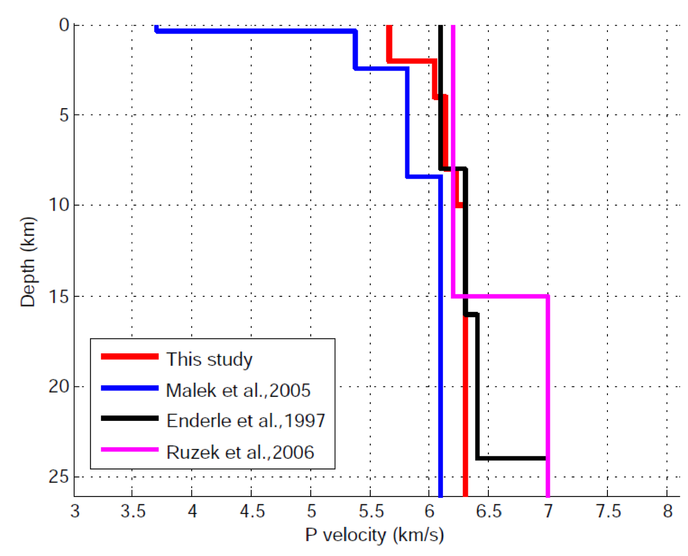

Fig 10. Comparison of different Velocity models For P-wave

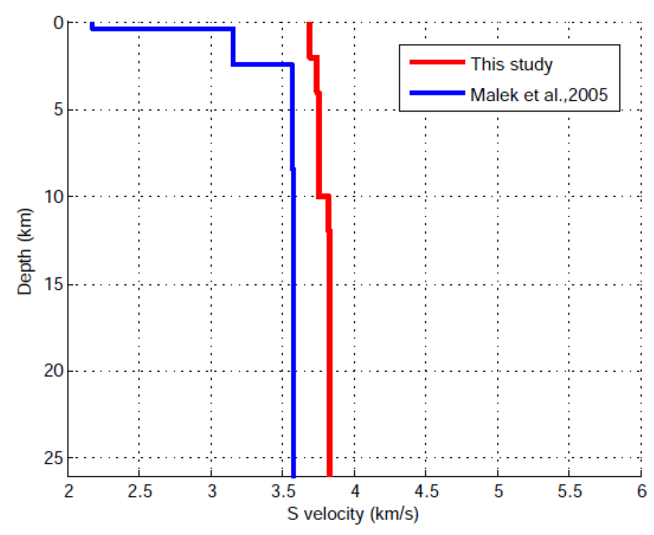

Fig 11. Comparison of different Velocity models For S-wave

Conclusion

The results and conclusions of the minimum 1-D model determination are summarized here. The convergence of the high-low test is very promising from depths of 4 km down to 20 km. At the shallow layers from 0 km to 2 km we see a lot of variance among our output models. From this test I believe that layers 1 through 2 are not well resolved because I couldn't find any tight constraints on the true velocity values. Layers 3 through 8 contain more than 90% of all recorded seismicity in the Vogtland ~~at these depths~~ giving a dense coverage of ray paths throughout these layers constraining the velocity model to one minimum model. However, in the last layers there are a few events occurring at these depths giving little to no constraints on the velocity model at depth. Finally the results of this part will be used in the next step for 3D tomography.

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