1. Evaluation on how small variations of the velocity model affect the results

MC5 profile

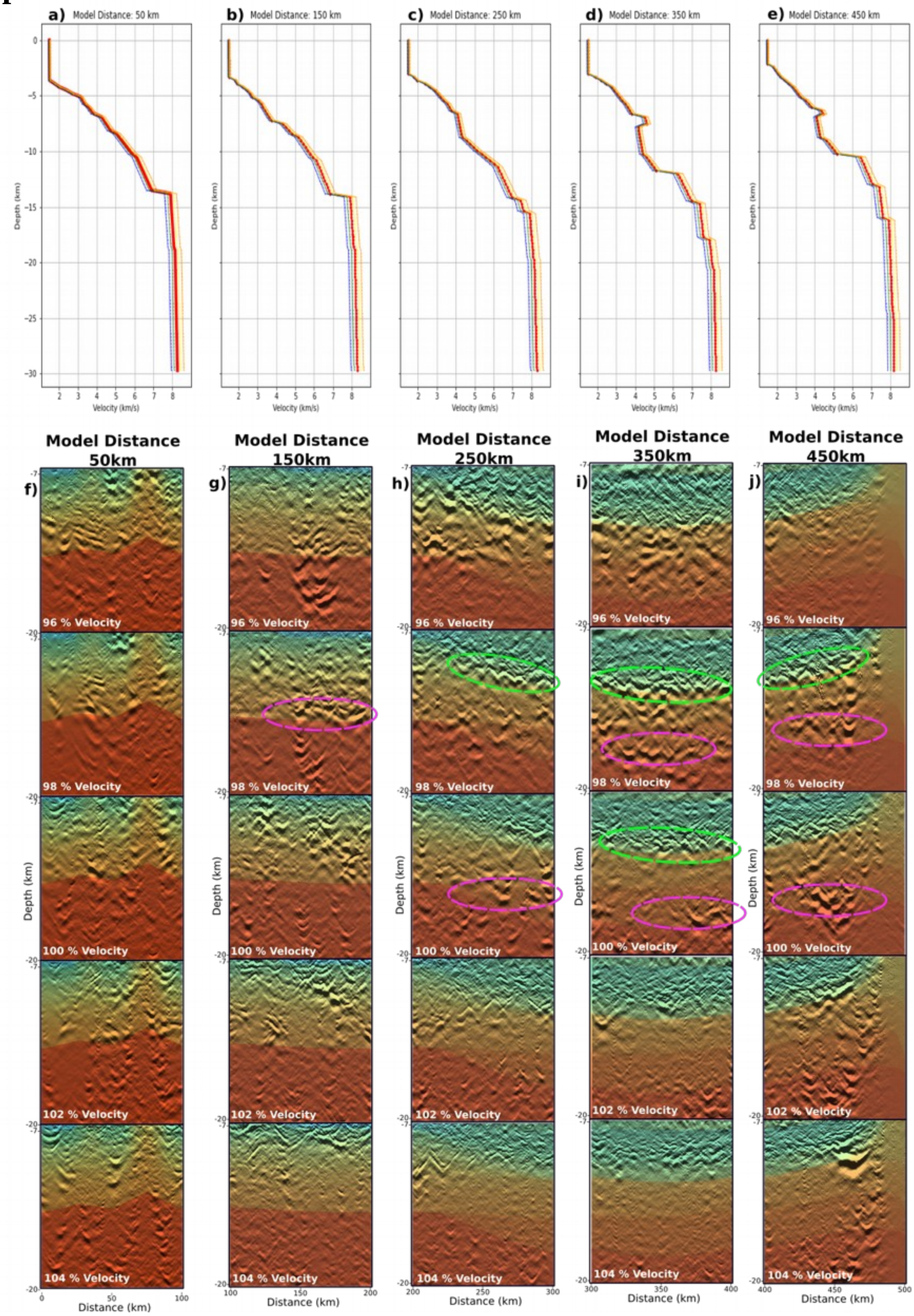


Figure 1 – Velocity evaluation for MC5 profile (Gonçalves, S. et al, in revision (23/04/2023), “Deep crustal structures with Reverse Time Migration applied to offshore wide-angle seismic data: Equatorial and North-West Brazilian Margins”, Journal of South American Earth Sciences)

- Overall increasing/decreasing the velocity values by 2% and 4% for each point of the velocity model grid
- Vertical velocity profiles for five different model distance points in the profile – 50 km, 150 km, 250 km, 350km, 450 km.
- The presented results in figure 1a) to 1e) show that increasing or decreasing the velocity values for all the point in the grid do not create artifacts in the vertical velocity profile. All of the tested velocities – 96 %, 98 %, 102 % and 104 % - have the same vertical variation as the original one (red line in figure 1a) to 1e)).
- The change in the velocity model seem to affect the strength of some refractors – basement and Moho
- In general, the original velocity model gives us the best results

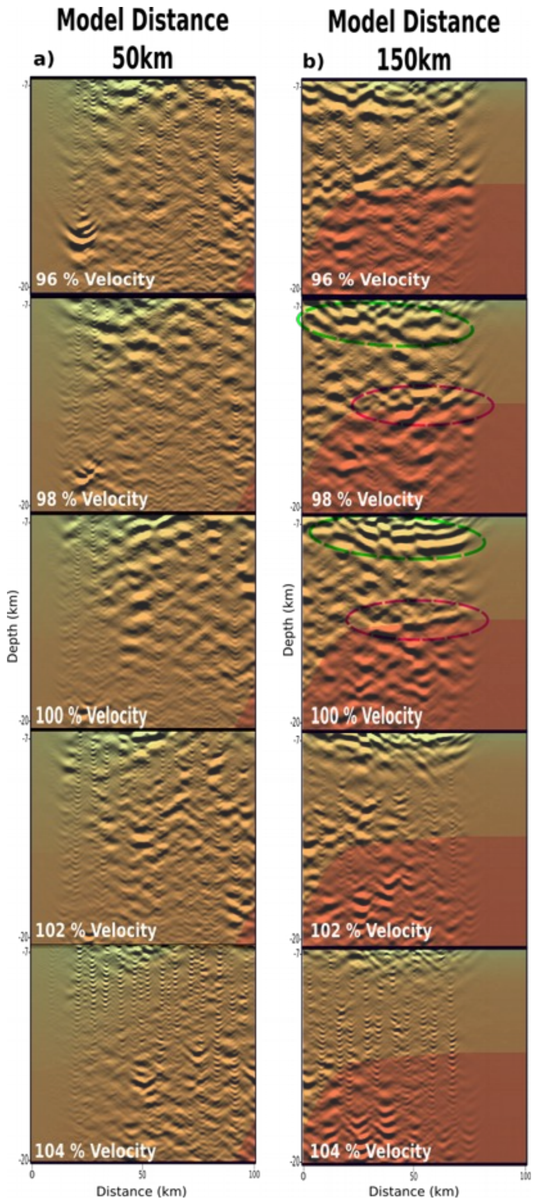


Figure 2 - Velocity evaluation for SL04 profile (Gonçalves, S. et al, in revision (23/04/2023), "Deep crustal structures with Reverse Time Migration applied to offshore wide-angle seismic data: Equatorial and North-West Brazilian Margins", Journal of South American Earth Sciences)

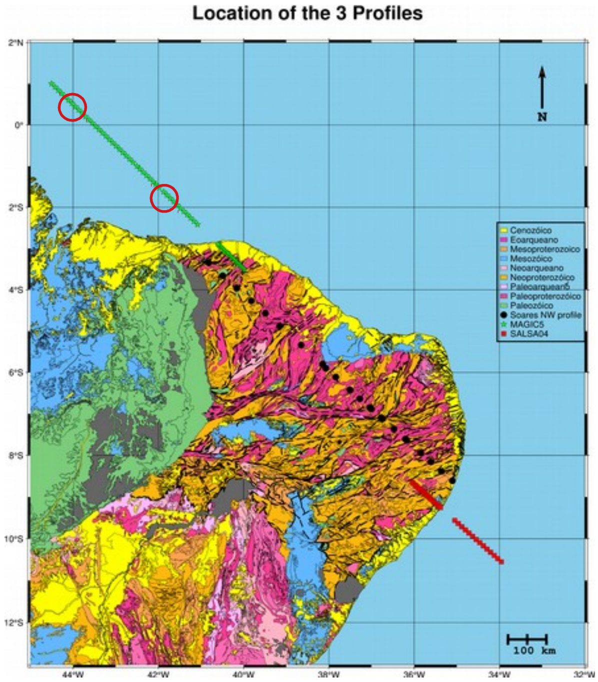
- The same velocity evaluation was preformed to the SL04 profile, with the same parameter. Due to the length of SL04 profile, only two different model distance points were considered.

- Again, the variation of the velocity seem to affect the strength of some of the refractors – basement and Moho discontinuity, for example.
- The complexity of the structure of the subsurface and in particular the dipping of the layers seem to be an important parameter that is affected by the velocity variation.
- The acquisition distances between OBS stations can be another explanation.

2. Results for individual stations

MC5OBS38 and MC5OBS38 individual RTM results

a)



b)

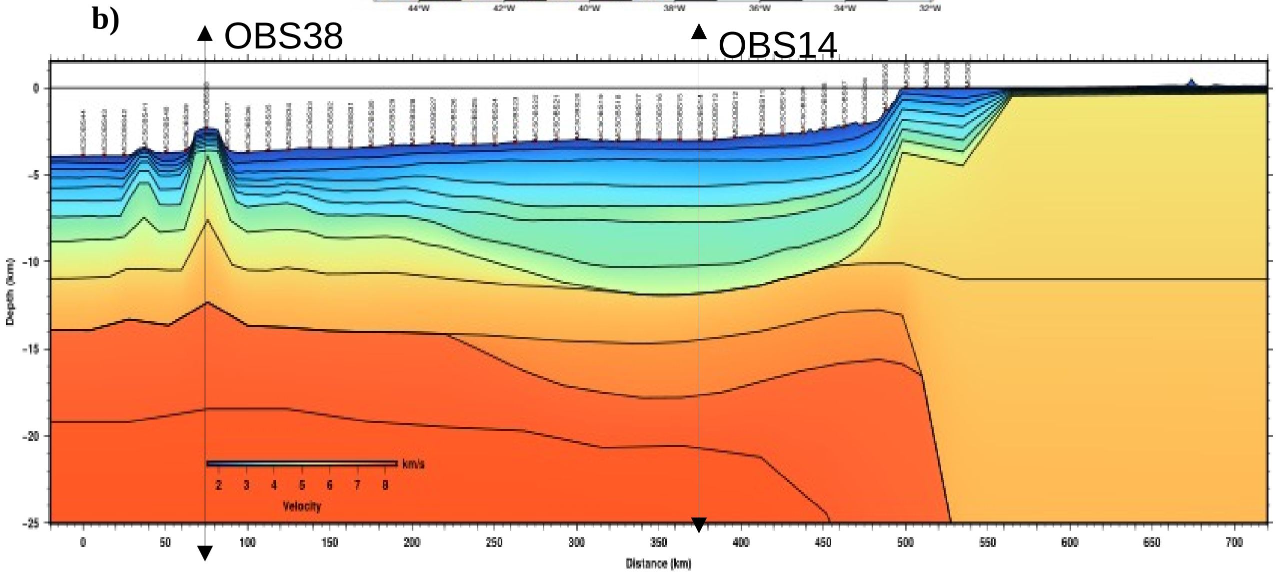
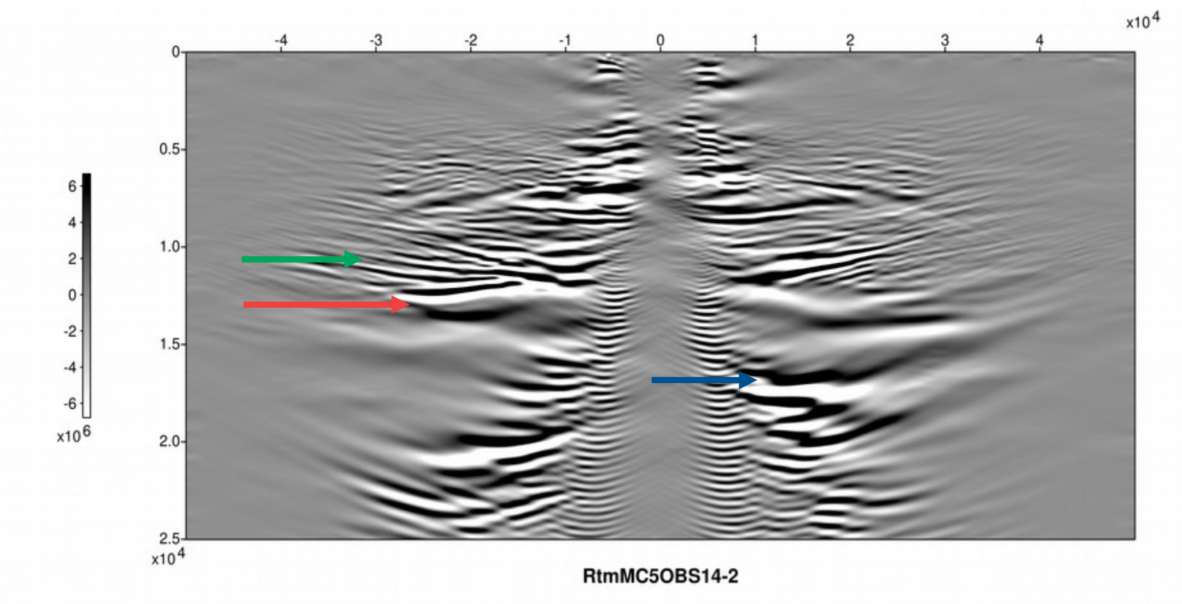


Figure 3 – Location of the MC5OBS14 and MC5OBS38. a) location within the map; b) location within the velocity model

a)



b)

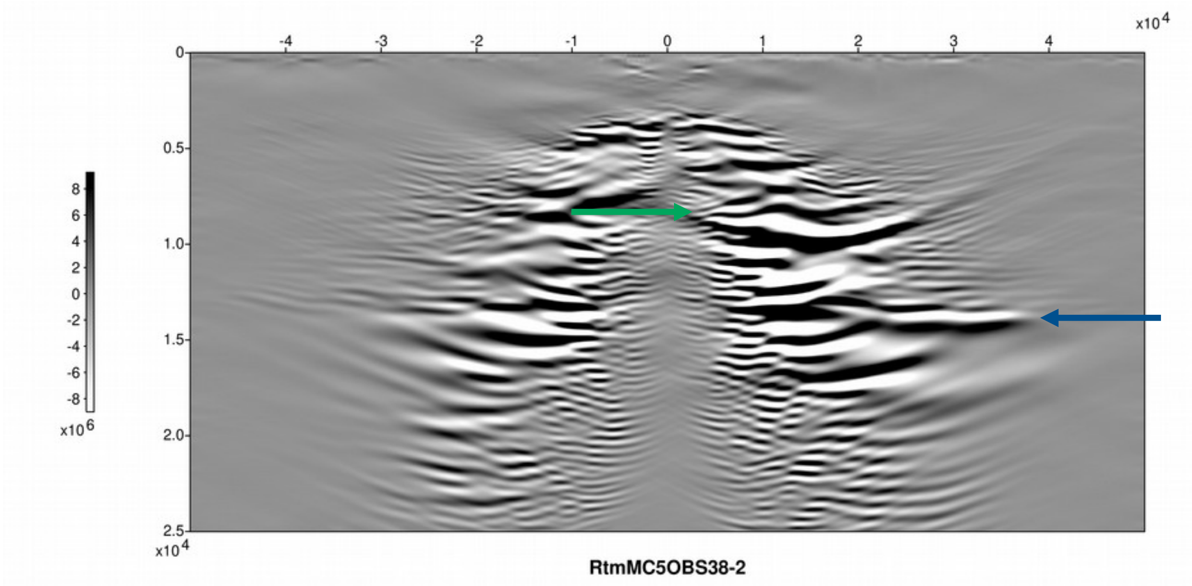


Figure 4 – RTM results for MC5OBS14 and MC5OBS38. a) MC5OBS14 – basement (green arrow), Top of the AVL (red arrow) and Moho discontinuity (blue arrow); b) MC5OBS38 – basement (green arrow) and Moho discontinuity (blue arrow)

- For each individual OBS station it was possible to retrieve refractors that represent different layers or discontinuities.
- The amplitude, depth and length of the refractors change from OBS to OBS station reflecting different characteristics of the subsurface.

SL04OBS08 and SL04OBS02 individual RTM results

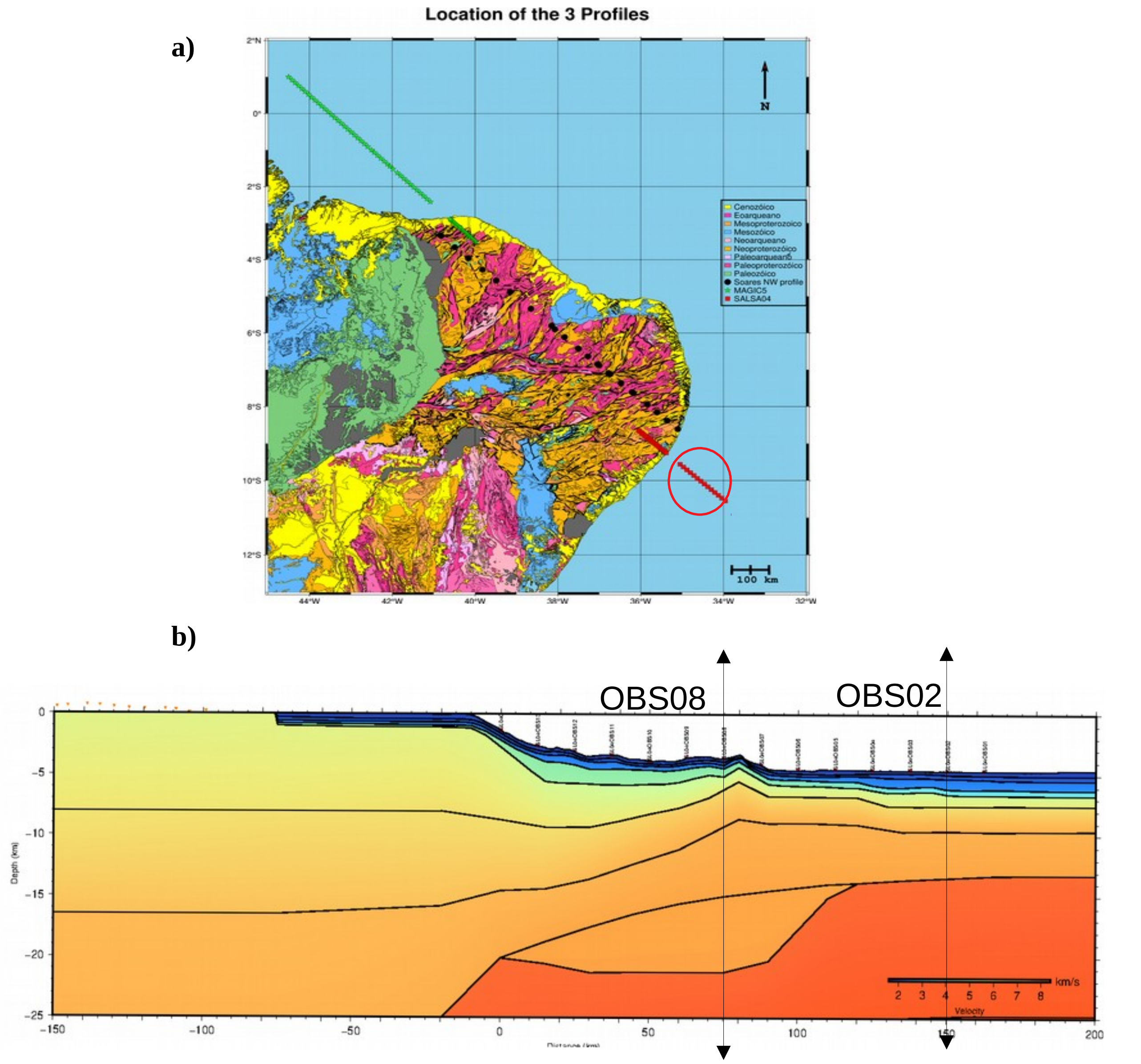
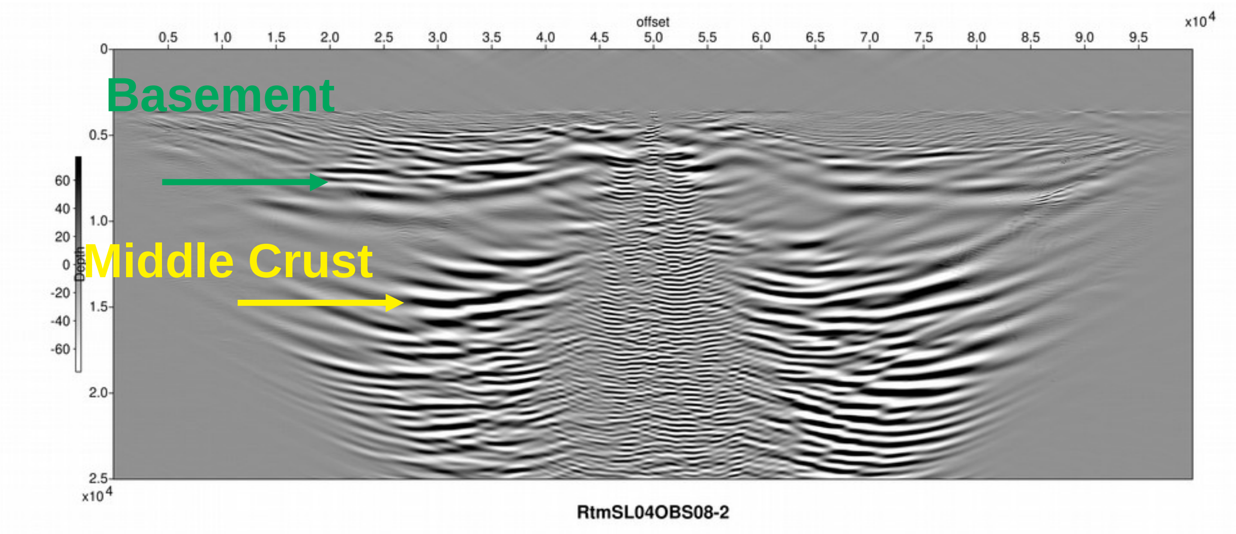


Figure 5 – Location of the SL04OBS08 and SL04OBS02. a) location within the map; b) location within the velocity model

a)



b)

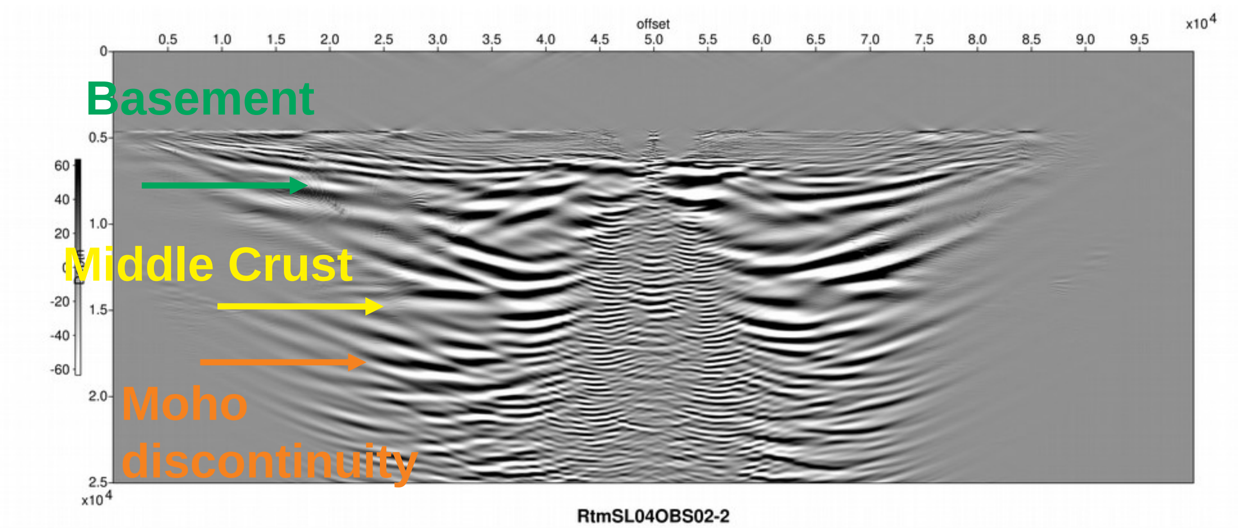
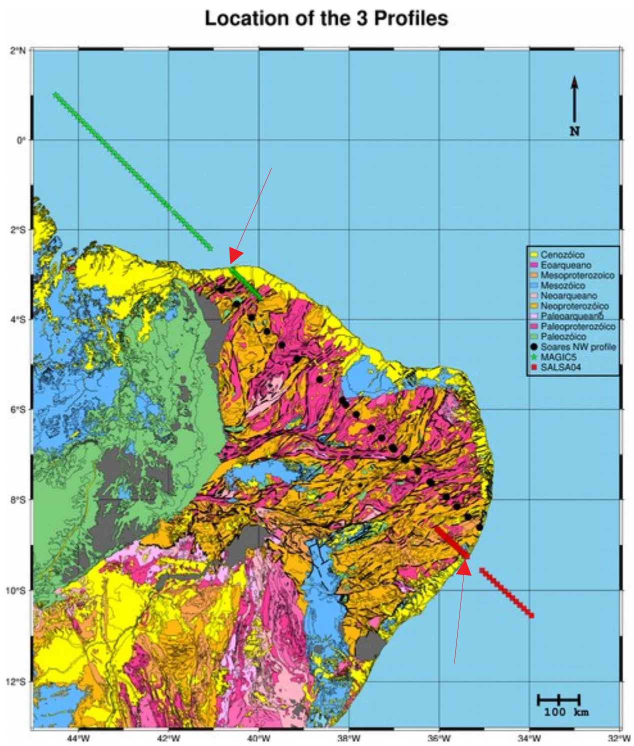


Figure 6 – RTM results for SL04OBS08 and SL04OBS02. a) SL04OBS08 – basement (green arrow) and middle crust (yellow arrow); b) SL04OBS02 – basement (green arrow), middle crust (yellow arrow) and Moho discontinuity (blue arrow)

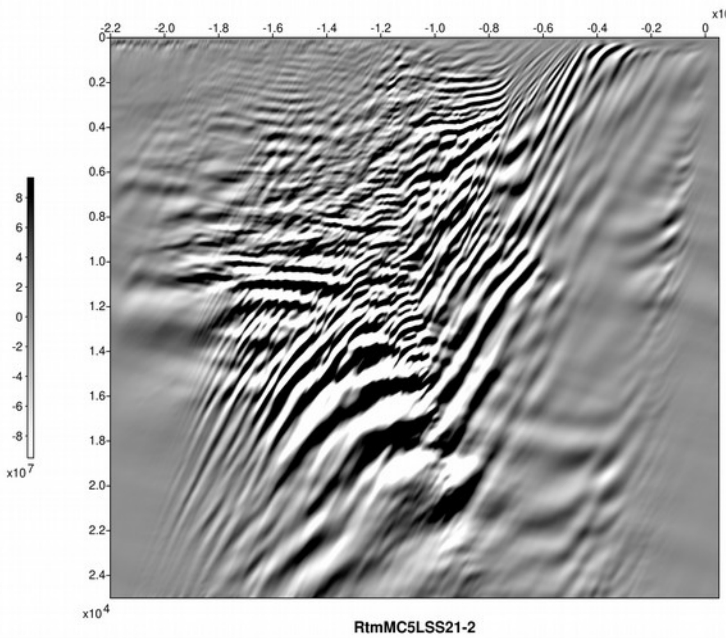
- The RTM results for individual OBS stations of profile SL04, presented in figure 6, we found different amplitudes and geometries for refractors that image the same layer. Like for MC5 profile, within the individual OBS stations results, we can link those differences with the geometry and depth of the imaged layer and also find a match with the velocity model used.
- The refractors extent (in offset) is larger for OBS stations on SL04 profile, when compared with MC5. We may link this feature with the length of each profile but may also be linked with the intrinsic characteristics of each studied area.

SL04OBS21 and MC05OBS21 individual RTM results

a)



b) **c)**



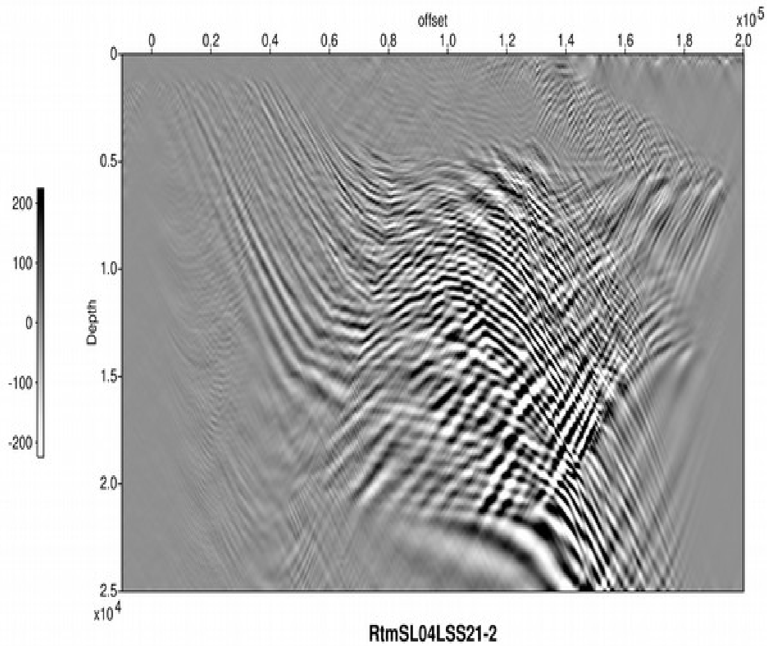


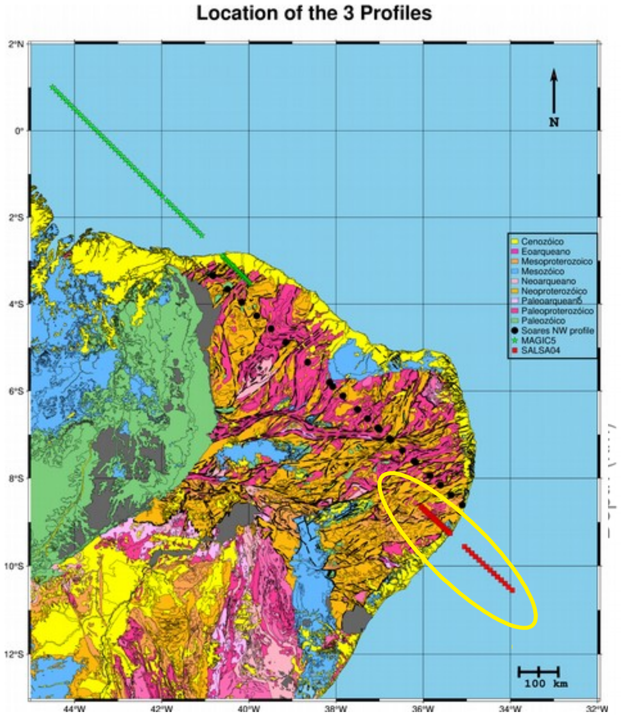
Figure 7 – RTM results for individual land LSS stations. a) Location of LSS stations on the map (red arrows); b) RTM result for MC5LSS21; c) RTM result for SL04LSS21

- In figure 7 we present the RTM result for the LSS stations closer to the shore of each profile.
- In spite of the asymmetry of both profiles, the obtained results for each land station are coherent with each velocity model used and enable us to characterize the necking zone in each profile.

- The geometry of the necking zone and the characteristics of the layers also have an influence on the results. It is clear from the results presented that the obtained refractors for MC5LSS21 have a much higher amplitude when compared with the ones obtained for SL04LSS21. The necking zone of MC5 profile is sharper and has more reflectivity, in particular for the deeper layer.

3. Stacked result for SL04 – red profile in the map

a)



b)

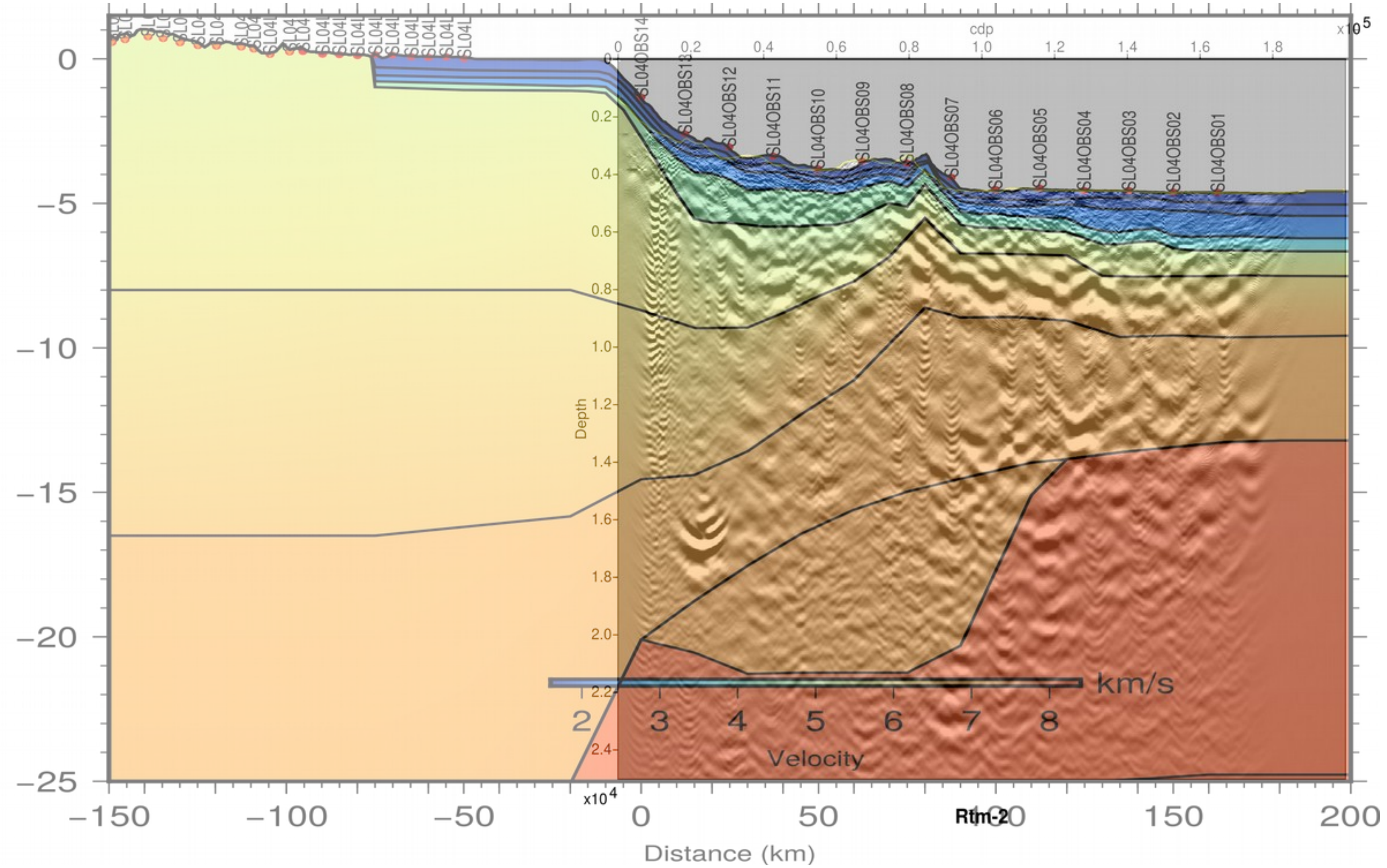


Figure 8 – Stacked RTM results for OBS stations of SL04 profile. a) location of the profile; b) RTM stacked result overlaid with the velocity model used

- The SL04 profile is composed by 14 OBS and 21 LSS stations. The total length of the profile is 350 km.
- The geometry and the length of the profile influence the obtained results.
- Coherent refractors for the Moho discontinuity, Crust and Basement that agree with the velocity model used. The obtained structure is also in agreement with previous studies in the area. The dipping of the refractors up to the upper crust between stations SL04OBS08 and SL04OBS07, are in agreement with the existing volcanic structure.
- The continuous refractor, between SL04OBS14 to SL04OBS07 that correspond to the Moho discontinuity at 15 km depth and their disappearance landwards for the rest of the profiles brings to light the geometry of the Moho discontinuity but also the possible presence of an anomalous velocity layer (AVL) between the lower crust and the Moho discontinuity.

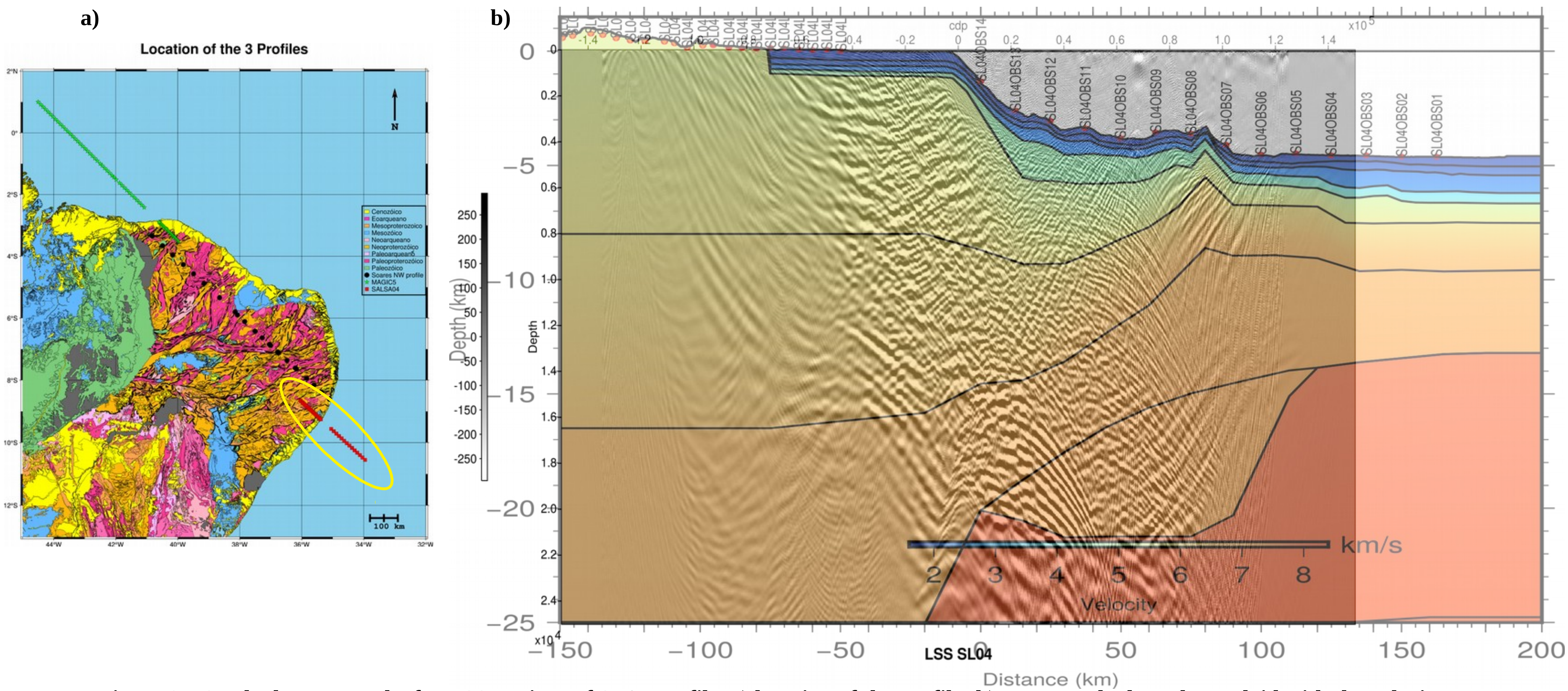


Figure 9 – Stacked RTM results for LSS stations of SL04 profile. a) location of the profile; b) RTM stacked result overlaid with the velocity model used

- The stacked results for the land stations of the same profile it is possible to image the necking zone and the transition ocean / continent – the sharpness of the basement and the dipping of the Moho discontinuity are clear.
- The limit between middle and lower crust imaged by the obtained reflectors. The limit between the upper and middle crust is not as clear.
- There is a signal signature between the lower crust and the Moho discontinuity that may be correlated with the presence of the AVL as described for the previous image.

- The combination of the stacked results for the LSS and OBS stations contribute to the seismic interpretation of the deeper layer without losing the imaging of the shallower ones.