CRUSTAL STRUCTURE OF THE AMAZONIAN CRATON AND ADJACENT PROVINCES IN BRAZIL

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INTRODUCTION

The study of the crust using receiver functions can provide valuable geological information such as average crustal composition, formation dynamics and tectonic evolution of a region. It also serves as an initial reference for the generation of seismic velocity models to improve earthquake location. In order to fill in the crustal information gaps in the Amazonian Craton (Brazil) and adjacent provinces, we used receiver functions (Ligorría & Ammon, 1991) and H-k stacking (Zhu & Kanamori, 2000) to estimate crustal thickness and the Vp/Vs ratio for 47 broad-band stations.

METHODS

The receiver functions were computed using the iterative time-domain deconvolution (ITERDECON) developed by Ligorría & Ammon (1999).

We estimated crustal thickness (H) and Vp/Vs using H-k Stacking (Zhu & Kanamori, 2000), with the following input parameters: Vp = 6.4 km/s and w1 = 0.7, w2 = 0.2 and w3 = 0.1 (weights for Ps and multiples).

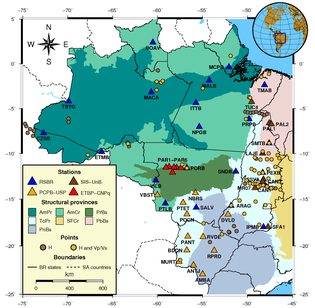

Figure 1. Brazilian structural provinces (Almeida et al., 2000), the locations of the stations, of the crustal thickness and Vp/Vs estimates obtained in the references. Caption acronyms: Amazon Province(AmPr), Amazon Craton (AmCr), Parecis Basin (PrBs), Tocantins Province (ToPr), São Francisco Craton (SFCr), Parnaíba Basin (PrBs) and Paraná Basin (PnBs).

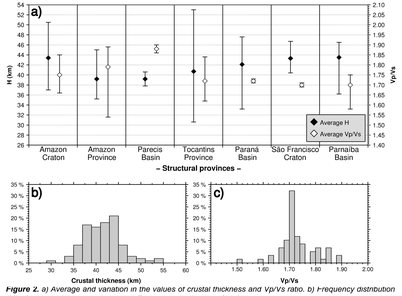

Figure 2. a) Average and variation in the values of crustal thickness and Vp/Vs ratio. b) Frequency distribution (%) of crustal thickness estimates. c) Frequency distribution of Vp/Vs.

We used data from 47 stations (Fig. 1), belonging to 4 networks: RSBR (20 stations), SIS-UnB (9 stations), ETBP-CNPq (6 stations), PCPB-USP (12 stations). We also compiled 100 data points of published papers and congress proceedings (Fig. 2).

RESULTS

The crustal thickness (H) in the Amazonian Craton and adjacent provinces is quite variable, with the lowest value found for the Amazon Province (27.4 km, Fig. 3, sattion CZSB) and the largest for the Amazonian Craton, in the region known as the Guiana Shield, reaching 55.3 km (Fig. 3, station BOAV).

The regions with thicker crust, often over 43 km, located in the Amazonian Craton and Paraná Basin, may be related to ancient cratonic blocks (Fig. 4), which were part of the paleocontinents Amazon, São Francisco/Congo and Paranapanema (Mantovani et al., 2005).

There is a good correlation between crustal thickness and the limits of the Amazonian Craton. Therefore, it is possible to delimit it as the NW crustal region with thickness greater than 39 km (Fig. 4, black dotted line). The distribution of seismicity tends to concentrate around the Amazonian Craton boundaries.

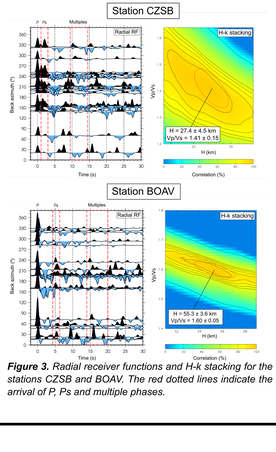

Figure 3. Radial receiver functions and H-k stacking for the stations CZSB and BOAV. The red dotted lines indicate the arrival of P, Ps and multiple phases.

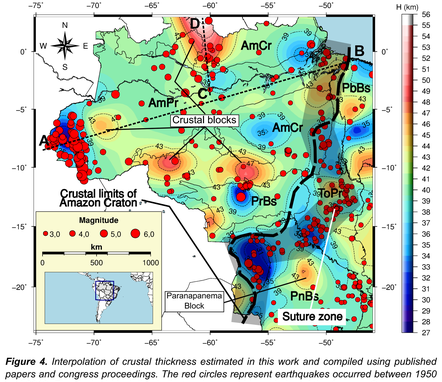

Figure 4. Interpolation of crustal thickness estimated in this work and compiled using published papers and congress proceedings. The red circles represent earthquakes occurred between 1950 and 2016. The dashed black line indicates the crustal boundaries of the Amazon Craton and the darkened region indicates the suture zone between the craton and the other provinces.

According to Mooney et al. (2012), the limits of a craton are regions of stress concentration. Assumpção et al. (2014) also interpret the seismicity as a function of lithospheric thinning, as we can see in the suture zone of the craton and other provinces (Fig.4).

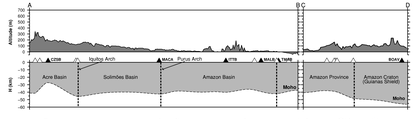

Figure 5. Topographic and crustal thickness variation along AB and CD profiles. The dimensions were exaggerated to enhance some features.

A central domain can be established in the Amazon Province (Fig. 5), with a crustal thickness ranging from 40 to 45 km, composed of the Solimões and Amazon basins. It also possible to see that Moho dips in the direction of the North of Amazon Craton (Fig. 5, profile CD).

CONCLUSIONS

The Amazonian Craton is the region delimitated by an average crustal thickness usually greater than 39 km.

The regions with thickness often over 43 km in the Amazonian Craton and Paraná Basin may be related to ancient cratonic blocks, which were part of the paleocontinents Amazon, São Francisco/Congo and Paranapanema. The latter, in turn, also has existence confirmed by geophysical data (Mantovani et al., 2005).

The limits of the Amazonian Craton, in terms of crustal thickness, follows the pattern of seismicity distribution at its edges, which is related to a suture zone between the paleocontinents that collided in Brasiliano event.

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