

New constraints on subduction and collision processes in the Central Andes from P to S converted seismic phases

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Supplementary Information

1. Robustness and north-south extension of TRAC2 convertor

Fig. S1a shows the same data as Fig. 2a (main text), except the negative amplitudes (blue) are clipped to emphasize the correlation of the positive phases (red). In Fig. S1b and c are shown subsets of the data from Fig. S1a, which are split along 23°S latitude. This divides the quantity of the data roughly in two equal parts, it also separates the Andean Plateaux, the Altiplano is in the northern part and the Puna in the southern part of the data. The two data sets are not overlapping.

are marked by blue lines north of 23° in Fig.S1b, and by green lines south of 23° in Fig.S1c. Both line sets are superimposed on the summation of all data in Fig.S1a. The Nazca slab is a clear observation in all data sets confirmed by earthquake epicenters (Fig.2c in main text). Its location is nearly identical north and south of 23° in the region covered by the data. The other obvious convertor is the continental Moho (for details see Fig3 in main text). The broad appearance of the Moho in Fig.S1a (and in Fig.2a, main text) east of 67.5°W is due to a north-south change in Moho depth.

The three positive convertors Nazca slab, Moho and TRAC2

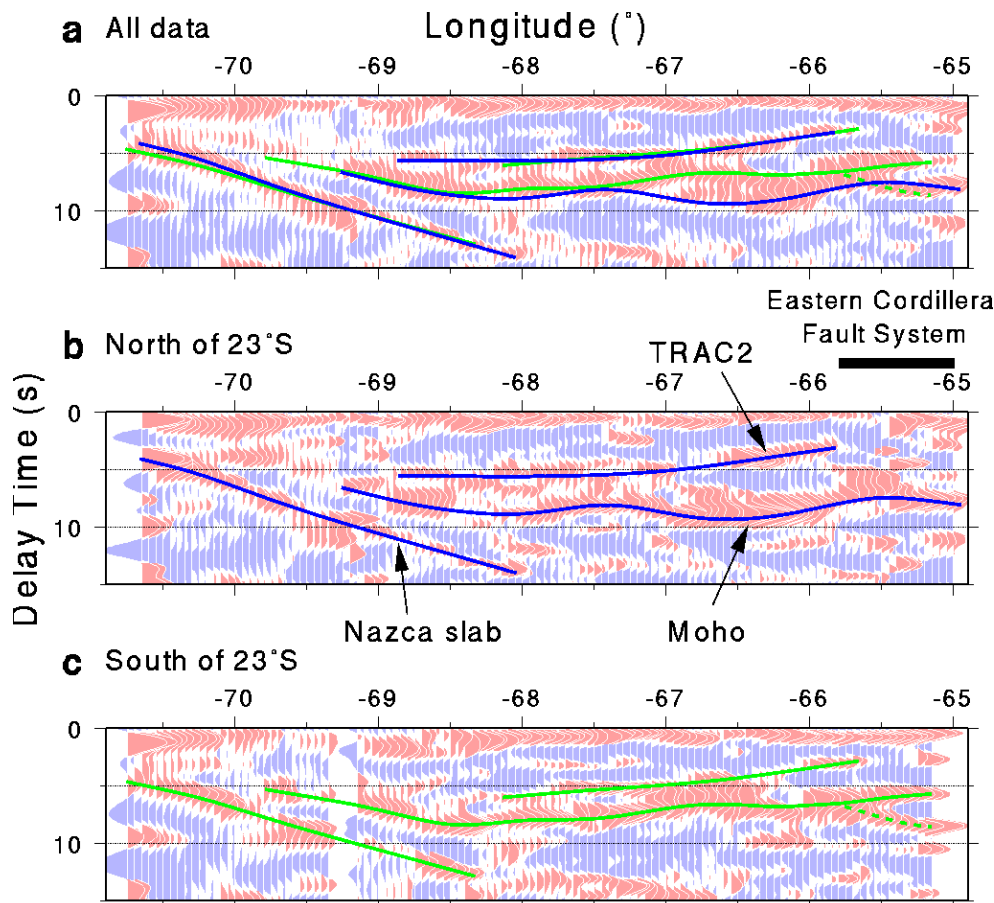


Figure S1 North-south extension of the TRAC2 convertor, Moho and Nazca convertor identified in the data a)- All data, b,c) subsets north and south of 23°S, respectively.

After the Moho TRAC2 convertor is the clearest intracrustal signal in Fig.S1. It is rising to the east and approaching the surface below the Eastern Cordillera (Fig.S1b). We interpret the convertor TRAC2 as the base of the low velocity zone associated to devolatilized deeper crust. It may be followed north of 23°S (Fig.S1b) to the Forearc (69°W). Seismic refraction studies (Wigger et al., 1994) have identified a high velocity layer, in the middle-

lower crust between 65 and 66.5°W at 21°S, which was interpreted as a base of the crust underthrust from the east. South of 23°S (Fig.S1c). TRAC2 is most clearly visible between about 65.5 and 68°W. Underneath the Altiplano TRAC2 is clearer than underneath the Puna, where the Moho is also shallower than underneath the Altiplano.

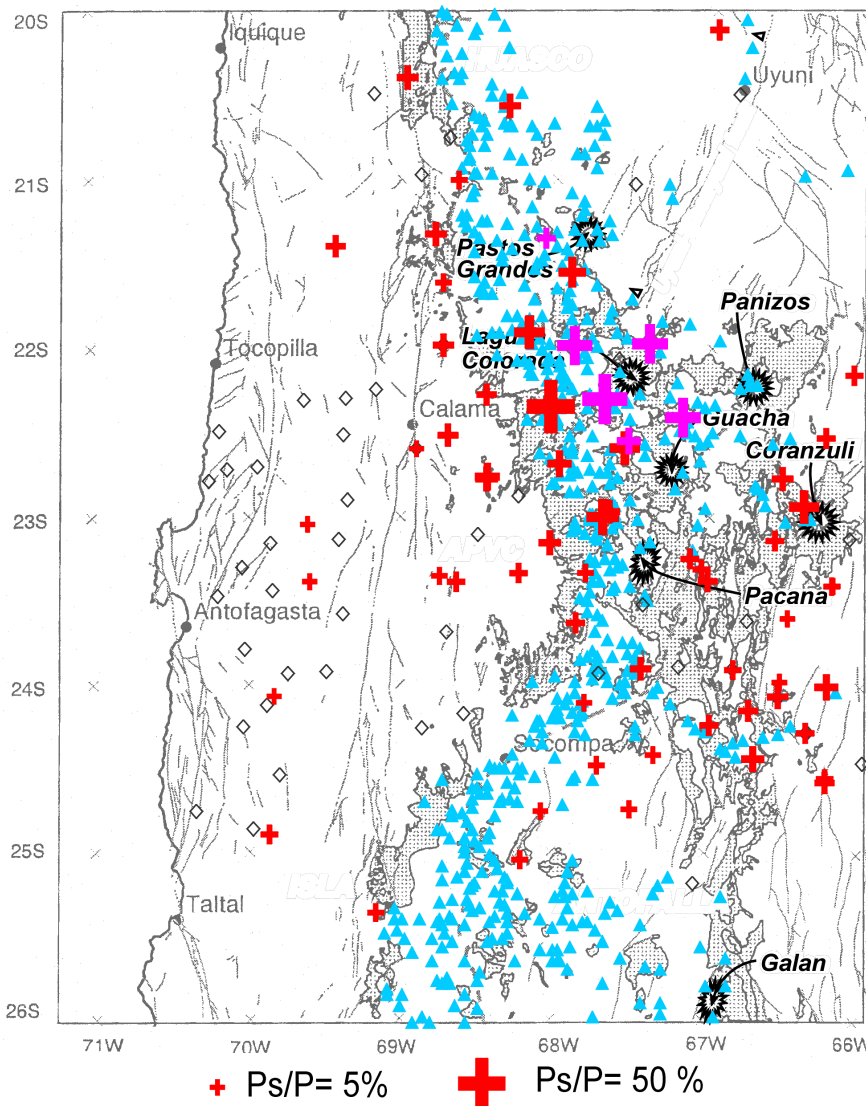


Figure S2. Lateral extension and strength of the Andean Low Velocity Zone.

2. Lateral extension and strength of the Andean Low Velocity Zone

Fig. S2 shows our data on the Andean Low Velocity Zone (ALVZ) together with major post Oligocene ignimbrite fields (gray dotted domains), major calderas (black ringed circles), and volcanoes (blue triangles). Red and purple crosses show conversions from the top of the ALVZ (TRAC1 convertor), their size being proportional to the amplitude ratio of the converted S and direct P waves. Only clear conversions with a Ps/P amplitude ratio higher than 5% are shown. Red crosses denote conversions from our observations and purple ones from the recent PASSCAL experiment (Chmielowski et al., 1999). Stations without clear TRAC1 inversion are shown by open diamonds. Base map with major ignimbrite fields and calderas was provided by R.Trumbull.

It is clear from Fig. S2 that the ALVZ extends through the entire Central Andes. Conversions with amplitudes higher than 10% correlate very well with ignimbrite fields and recent volcanoes indicating a relation between seismic velocity reduction within the ALVZ and melting. The strongest convertors (Ps/P > 20-30%) are definitely related to the domains with a higher degree of partial melting within the upper-middle crust (15-25 km depth) as inferred from the occurrence of major calderas and centers of ignimbrite production.

3. On the Vp/Vs ratio in the Central Andes crust

Fig S3 shows 3 different migrations of all our data. In Fig.3a the data are migrated as Ps waves (same as in Fig. 2c in main text). In Fig S3b and c

the data are migrated as PpPs and PpSs multiples, respectively (see inlets in the right part of the Fig. S3 for the ray geometry). It is seen that the Moho and partially also the slab are imaged not only by P-to-S converted waves, but also by their multiples. The best fit of the data is obtained if V_p/V_s ratio is about 1.8.

References

Chmielowski, J., Zandt, G. & Haberland, C. The central Andean Altiplano-Puna Magma body. *Geophys. Res. Lett.* **26**, 783-786 (1999).
 Wigger, P. J. et al. in *Tectonics of the Southern Central Andes* 23-48 (eds Reutter, K.-J., Scheuber, E. & Wigger, P. J.) (Springer Verlag, Berlin, 1994)

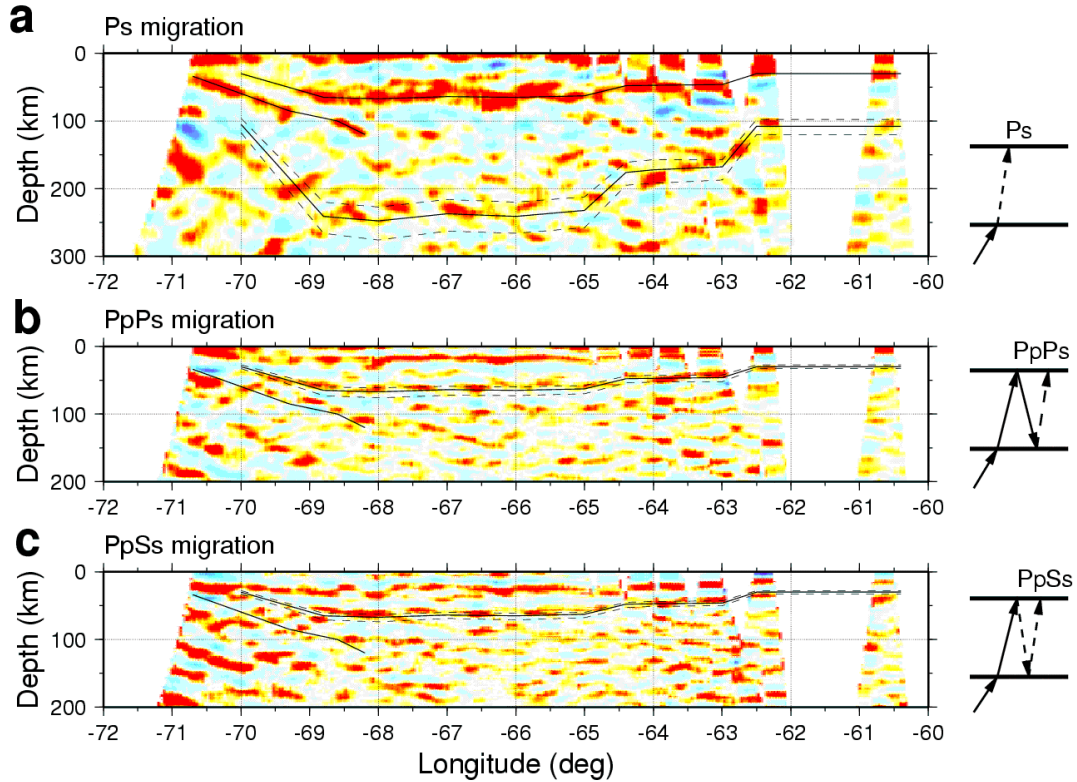


Figure S3. Migration of P-to-S converted phases and their multiples observed in the Central Andes. a) All RFs are migrated as Ps phases. The locations of the continental Moho and the subducted oceanic Moho are shown by solid lines. b) and c) RFs are migrated as PpPs and PsSs multiples, respectively. The amplitudes in (c) are reversed. The solid line marks the multiples of the continental Moho and the slab assuming a V_p/V_s ratio of 1.73. The dashed lines are calculated using V_p/V_s ratios of 1.83 (upper line) and 1.63 (lower line), respectively. Note that most of the multiple energy is above the 1.73 line, indicating that average V_p/V_s in the crust is above 1.73.