Geometry transition in the Cocos plate, from flat-steep to constant dip

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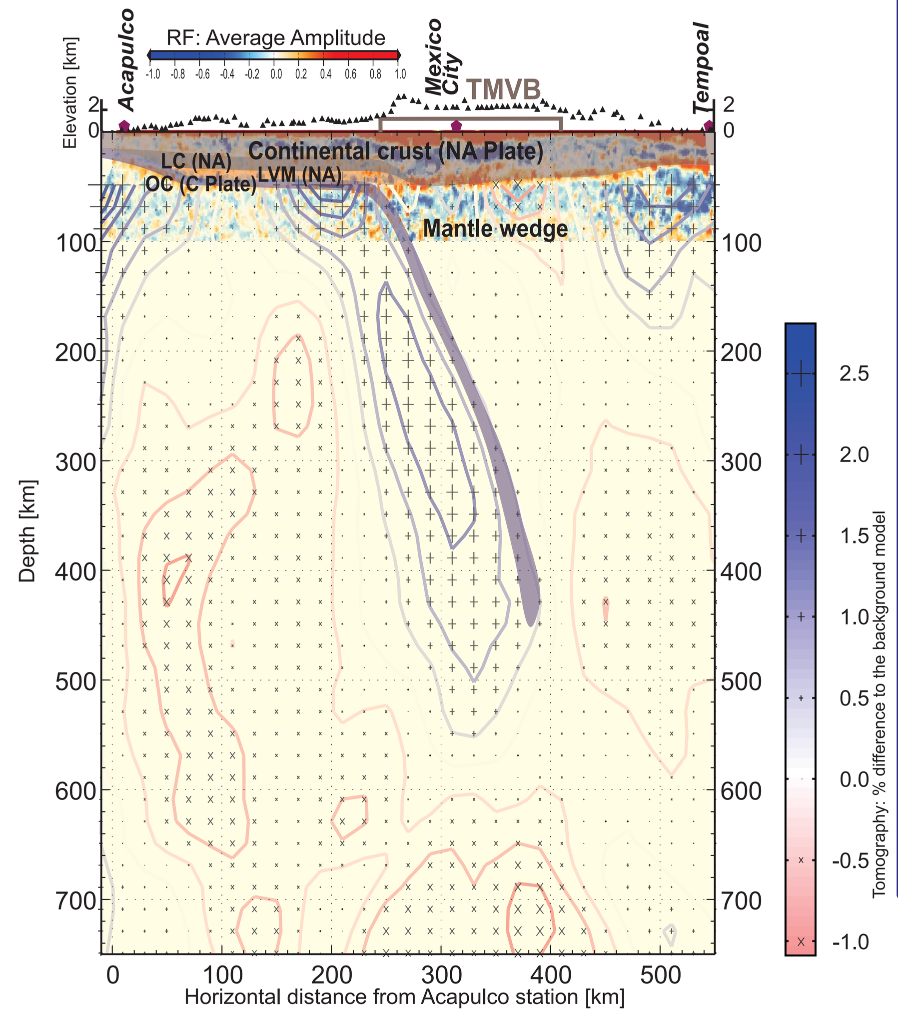
MASE

Pérez-Campos et al. (2008)
Husker & Davis (2009)
Kim et al. (2010; 2012)



Horizontal subduction for ~200 km.
LVL.

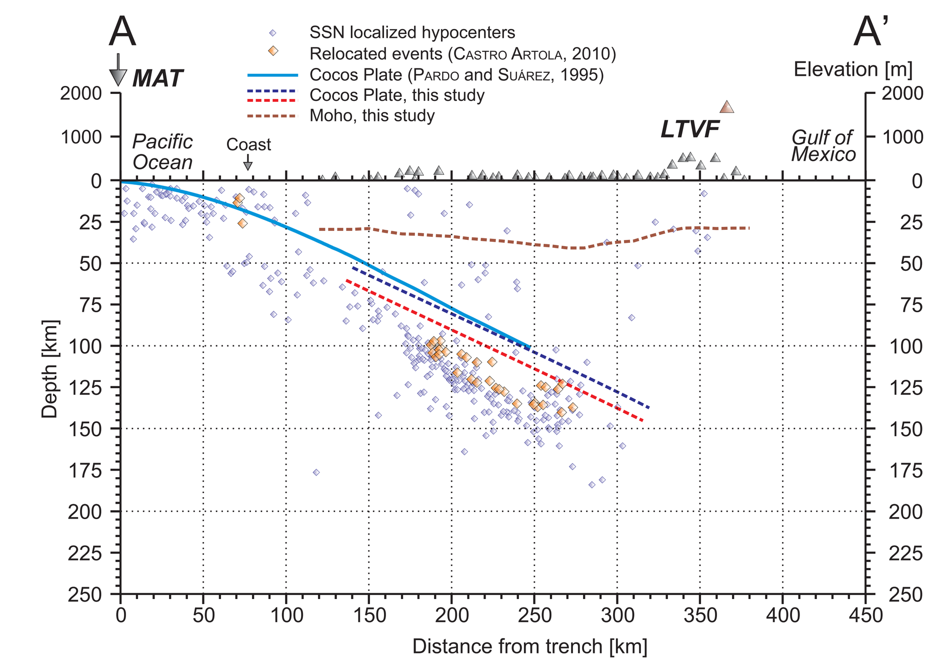
Steep subduction of 76°.
Slab reaches 500 km depth.

ABSTRACT

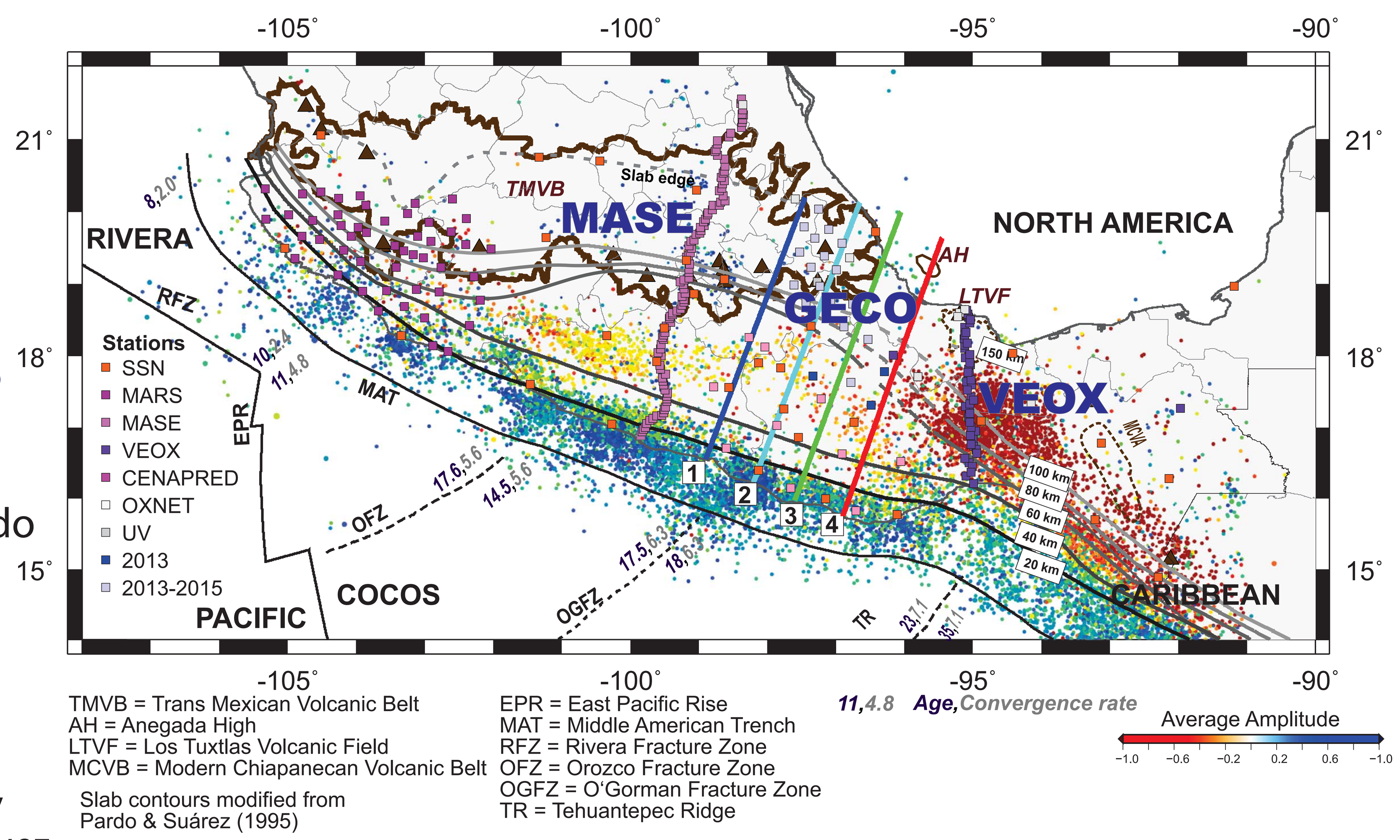
Subduction of the Cocos plate beneath North America has a variable and complex behavior along the Middle-American Trench. Initially, its geometry was delineated from regional seismicity. In the last 10 years, seismic experiments have illuminated some details in the geometry. They have reported, from NW to SE an abrupt dip transition, from 50 to 26°, as the result of a tear that splits Cocos North from Cocos South; then there is a smooth transition to a horizontal geometry under central Mexico. Further southeast, under the Isthmus of Tehuantepec, the Cocos plate shows a constant ~26° subduction dip. This last transition has been assumed to be smooth from the sparse seismicity in the region. A first glimpse of the slab geometry under Oaxaca, shows the slab continues to be flat at least until 97.5°W longitude, where the slab suddenly changes to a ~55° dip to the northeast. This occurs at a distance of ~75 km from the Pico de Orizaba volcano, which is a similar distance as the active Popocatepetl volcano from the place where the slab dives into the mantle along the Meso-American Subduction Experiment line, in central Mexico. East of this region, receiver function images show an abrupt change in the geometry and length of the slab.

VEOX

Melgar & Pérez-Campos (2011)



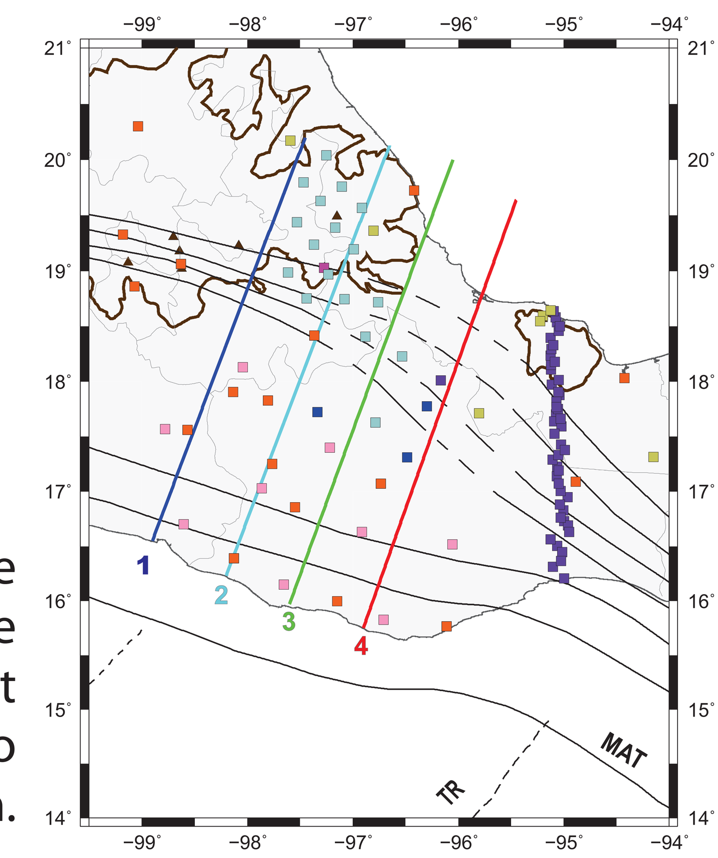
Slab dip: 26°.
No plate is observed beyond 150 km depth.



Conclusions and future work

Seismicity and receiver functions delineate the geometry of the slab, going from horizontal subduction in central Oaxaca, and changing abruptly to the east for a smooth 26° dip angle. This suggest a possible tear in the slab.

17 portable stations are to be installed in the area (light blue squares), plus 3 permanent statios (green squares) to focus on the deeper transition.



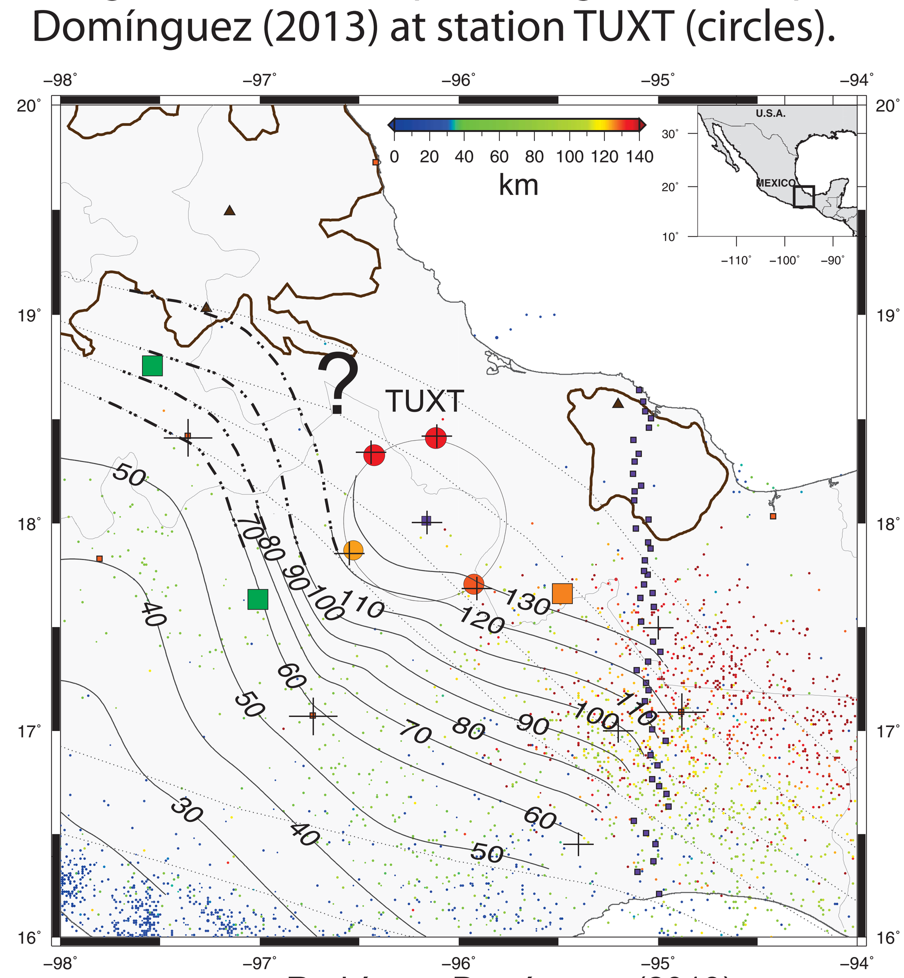
GECO: Geometry of Cocos

EasterTransision

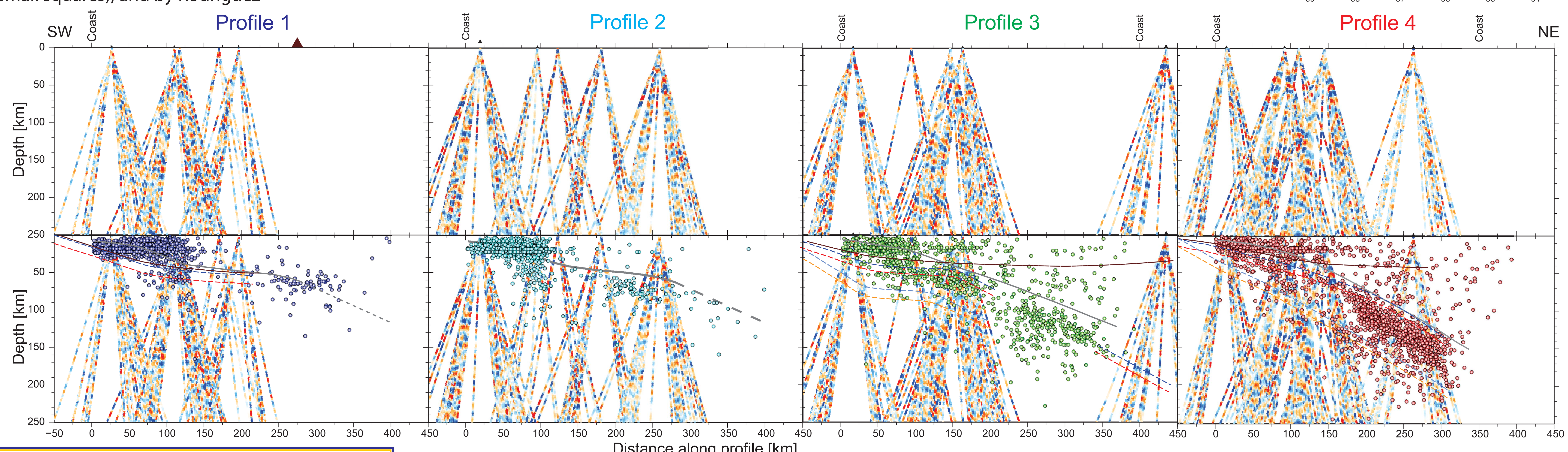
Smooth geometry transition was inferred from scarse seismicity (Pardo & Suárez, 1995).

Slab depth at SSN (Espíndola Castro, 2009) and TUXT stations (Rodríguez Domínguez, 2013), suggests otherwise.

Bottom left: Slab isodepth contours. Dotted lines are isodepth contours from Pardo & Suárez (1995). Continuous lines are interpolated contours given slab depths observed by Espíndola Castro (2009) at SSN stations (large squares), by Melgar & Pérez-Campos along the VEOX profile (small squares), and by Rodríguez Domínguez (2013) at station TUXT (circles).



Rodríguez Domínguez (2013)



Top right: Backprojected RF profiles (top) and interpreted profiles (bottom). Dots are hypocenters reported in the SSN catalogue. Gray lines correspond to Pardo & Suárez (1995) top of the slab. Brown line shows Moho; blue and red lines, top and bottom of the oceanic crust, as interpreted from RFs. Light blue and light orange lines show alternative RF interpretation. Profiles 1 and 2 show a horizontal subduction, consistent with Pardo & Suárez (1995) and seismicity. Profiles 3 and 4, show two possibilities, one is somewhat consistent with Pardo & Suárez (1995), and the other one shows a deeper slab. This might be due to azimuthal variation, suggesting the geometry transition taking place in this region is not smooth.

Acknowledgements

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REFERENCES:

Espíndola Castro, V.H. (2009). Ph.D. Thesis, Posgrado en Ciencias de la Tierra, UNAM, 120 pp.
Husker, A. & Davis, P.M. (2009). J. Geophys. Res., 114, B04306, doi:10.1029/2008JB006039.
Kim, Y., Clayton, R.W. & Jackson, J.M. (2010). J. Geophys. Res., 115, B06310, doi:10.1029/2009JB006942.
Kim, Y., Miller, M.S, Pearce, F. & Clayton, R.W. (2012). Geophys. Geosyst., 13, Q07001, doi:10.1029/2012GC004033.
Melgar, D. & X. Pérez Campos (2011). Pure Appl. Geophys., DOI 10.1007/s00024-010-0199-5.
Pardo, M. & Suárez, G. (1995). J. Geophys. Res., 110, B7, 12,357-
Pérez-Campos,X., Kim, Y., Husker, A., Davis, P.M., Clayton, R.W., Iglesias, A., Pacheco, J.F., Singh, S.K., Manea, V.C. & Gurnis, M. (2008). Geophys. Res. Lett., 35, L18303, doi:10.1029/2008GL035127.
Rodríguez Domínguez, M. (2013). Bachelor's Thesis, Facultad de Ingeniería, UNAM, 68 pp.