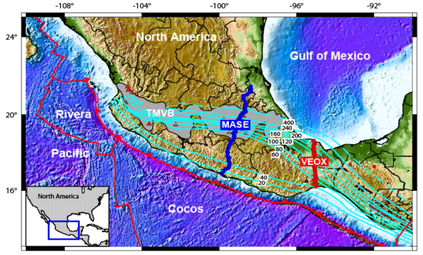
VEOX: Subduction in Southern Mexico



Participants:

TO/Caltech:
Robert Clayton
YoungHee Kim
Ting Chen
Sara Dougherty
Steve Skinner

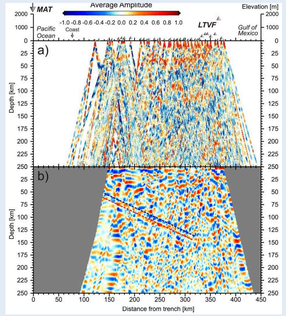
I.G./UNAM
Xyoli Perez-Campos
Arturo Iglesias
Vladimir Kostoglodov
Krishna Singh
Diego Melgar

Funding:

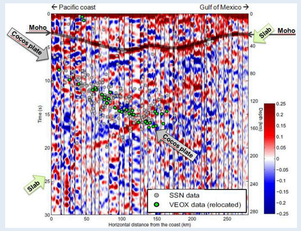
Tectonics Obs./Moore Foundation
NSF EAR-0609707

Web Site: http://www.gps.caltech.edu/~clay/MexWeb/MexSubduction.html

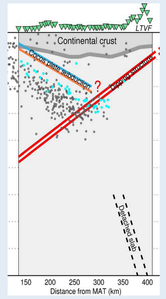
Slab Structure – Southern Mexico



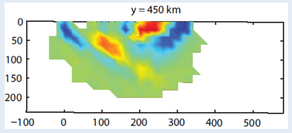
Receiver function image from Melgar and Perez-Campos. The upper panel shows the raw image and the lower one is interpreted.



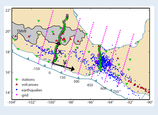
Receiver function image from Kim et al, showing a south dipping structure, which is interpreted as the slab of a Yucatan micro-plate. Green and gray dots are the seismicity.

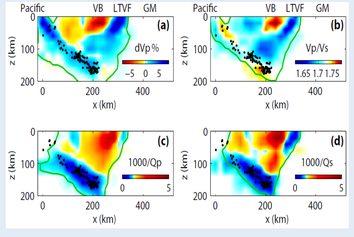


A cartoon of the Cocos being truncated by the south dipping structure. There is some indication that the detached slab is seen in global tomography models.

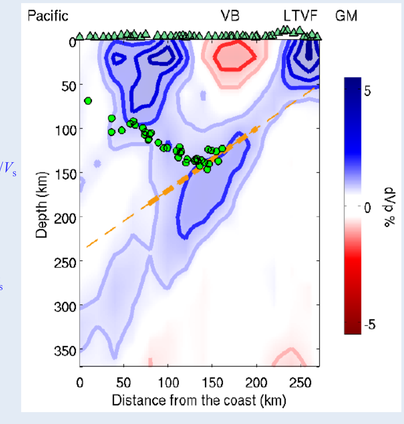


A tomography velocity model base on local seismicity, that also shows the south dipping structure. Note the relatively shallow seismicity (depth < 150 lm) limits the depth resolution of the image.



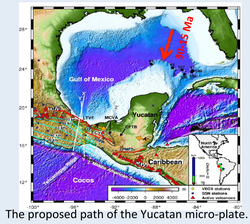


A more detailed view the local-seismicity tomography. The Cocos slab is clearly evident in the attenuation images. The south dipping structure shows up in all images, but particularly the Vs/Vp ratio.

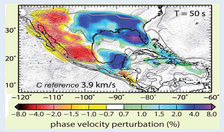


A tomography image derived from teleseismic earthquakes. This image shows that the south dipping structure extends to beyond 250 km in depth. The orange line is the slab interpreted from the receiver function image. The difference in slope is due to an artifact in the tomographic method.

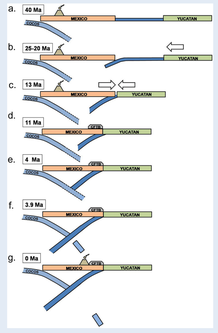
Yucatan Micro-Plate



The proposed path of the Yucatan micro-plate. The age constraint comes from the date of uplift Of the Chiapas Fold and Thrust Belt (CFTB), which Is assumed to be the collision zone.

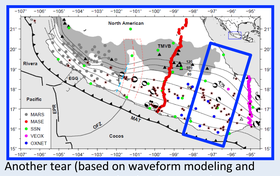


The phase velocity map for 50s surface waves shows the affinity for the Yucatan Peninsula for the other carbonate platforms of the Gulf of Mexico

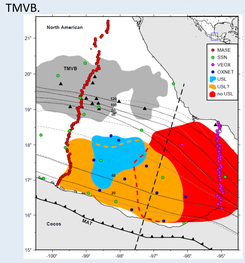


A cartoon of the subduction of the Yucatan slab. Subduction of the Yucatan slab started about 25 Ma. At 11 Ma the continental crust of each plate collides with the Chiapas Fold and Thrust Belt (CFTB). At ~4Ma the Cocos slab is cut off, leaving the current situation.

Slab Tearing

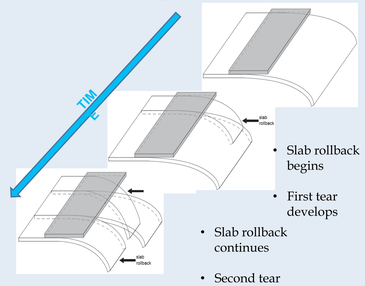


Another tear (based on waveform modeling and seismicity appears to be developing in the eastern TMVB.



The waveform modeling show the regions where the ultra-slow velocity layer (USL) exists between the slab and the overriding continent. The color mean:

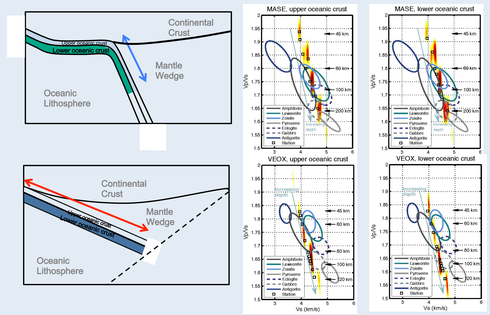
- Blue is where the USL definitely exists
- Red is where the USL does not exist
- Orange is a mixed case



- Slab rollback begins
- First tear develops
- Slab rollback continues
- Second tear develops

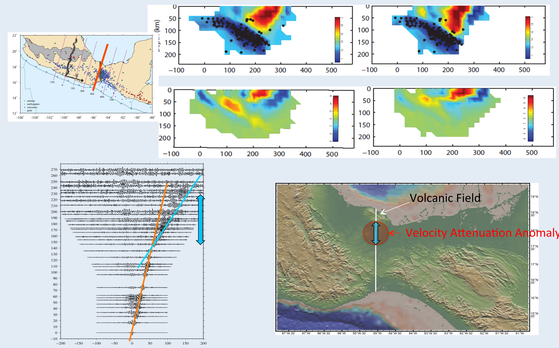
The evolution of the slab roll back appears to be taking place with the slab fragmenting into "fingers", each of which roll back separately. This is more efficient for the return flow from the back-side of the slab to the wedge.

Minerology



The minerology of the dipping part of the central and southern Mexico are different. In central Mexico, the dipping part of the slab appears to have zoisite and/or lawsonite down to 60 km depth, and eclogite and gabbro below that. In southern Mexico, the composition appears to be amphibole and gabbro.

Southern Mexico Anomaly



The Veracruz Basin is the location of a very slow and highly attenuating anomaly, that appears to penetrate well into the lower crust (i.e. far beyond the physical Basin). Resolution tests indicate is not just the Basin effects being smeared to deeper depth by the tomography. It is well south of the Los Tuxla Volcanic Field.
In the ambient noise correlations, this region is the source of anomalous slow high- frequency waves.

Publications

1. Kim, Y., R. Clayton, and F. Keppie, Evidence of a collision between the Yucatan Block and Mexico in the Miocene, (2011), Geophys. J. Int., doi:10.1111/j.1365-246X.2011.05191
2. Melgar, D. and X. Pérez-Campos, (2011), Imaging the Moho and subducted oceanic crust at the Isthmus of Tehuantepec, Mexico, from receiver functions, Pageoph 168, doi: 10.1007/s00024-010-0199-5

Data Products

VEOX (2010): Veracruz-Oaxaca Subduction Experiment. Caltech. Dataset. doi:10.7909/C3MW2F2C