Imaging the deep root of the Mexican Volcanic Zone: A collaborative project to map the subducting Rivera/Cocos plates and the source region of the overlying volcanic centers

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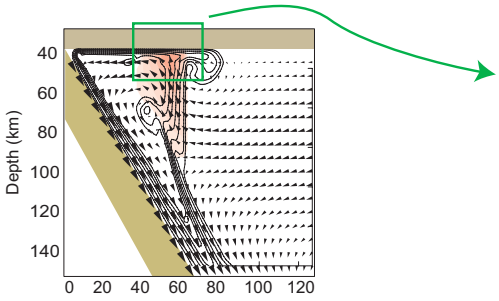
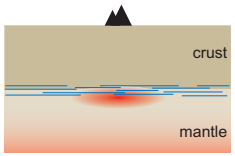
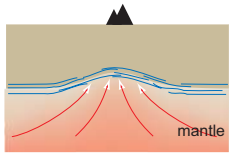
General issues in arc magmatism



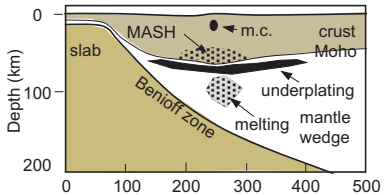
Corner flow may causes advective heating. Slab volatiles depress the solidus. Ripe environment for melting.



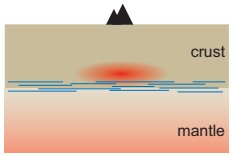
Magma ponding at the Moho and/or underplating?



Melt focusing?

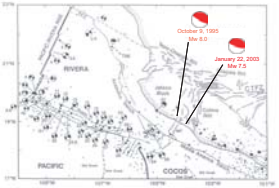


How is mantle melt production linked to intrusion and eruption in the crust?



Magma mixing, storage and assimilation in the lower crust?

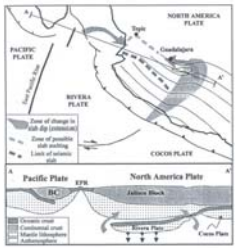
Issues specific to western MVZ



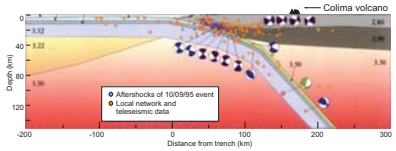
Neotectonics of the Jalisco-Rivera-Cocos system. Modified from DeMets, C. and S. Stein, Present day kinematics of the Rivera plate and implications for tectonics in southwestern Mexico, *J. Geophys. Res., 95,* 21,931-21,948, 1990.

How is the subduction of the Rivera microplate related to extension and evolution of the Jalisco block?

Why do we find ocean-island basalt type lavas in a subduction zone?



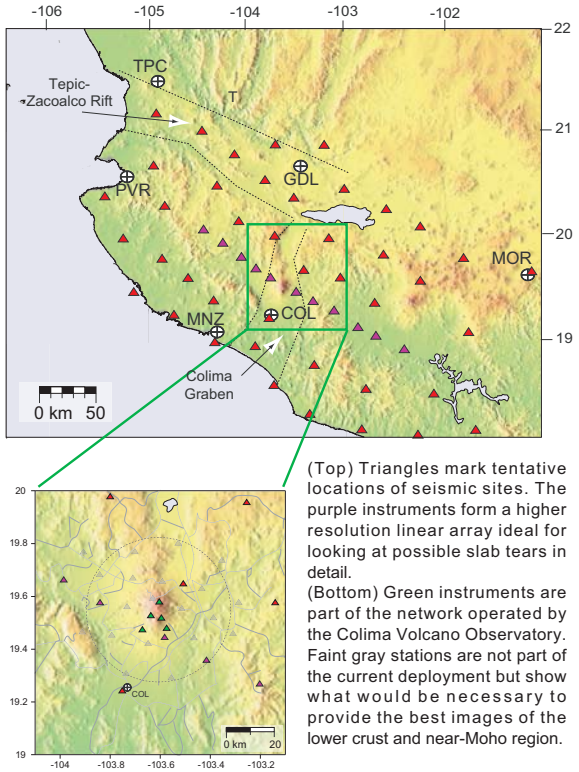
A proposed model of mantle flow around the foundering Rivera slab. From Ferrari, L., C.M. Petrone, and L. Francalanci, Generation of oceanic-island basalt–type volcanism in the western Trans-Mexican volcanic belt by slab rollback, asthenosphere infiltration, and variable flux melting, *Geology*, 29, 507-510, 2001.



Cross-section of Jalisco subduction. Modified from Bandy, W., V. Kostoglodov, A. Hurtado-Díaz, and M. Mena, Structure of the southern Jalisco subduction zone, Mexico, as inferred from gravity and seismicity, *Geofis. Int., 38,* 127-136, 1999. Includes data from Pardo, M., and G. Suarez, Steep subduction geometry of the Rivera plate beneath the Jalisco block in western Mexico, *Geophys. Res. Lett.,* 20, 2391-2394, 1993, and others.

How are the locations of modern volcanic centers related to the subduction of the Rivera and Cocos plates?

The MARS Project



(Top) Triangles mark tentative locations of seismic sites. The purple instruments form a higher resolution linear array ideal for looking at possible slab tears in detail.
(Bottom) Green instruments are part of the network operated by the Colima Volcano Observatory. Faint gray stations are not part of the current deployment but show what would be necessary to provide the best images of the lower crust and near-Moho region.

A recently-funded seismic experiment is designed to help shed light on these issues, both general and specific.

↦ MApping the Rivera Subduction zone (MARS)

↦ 50 broadband instruments in Jalisco/Colima

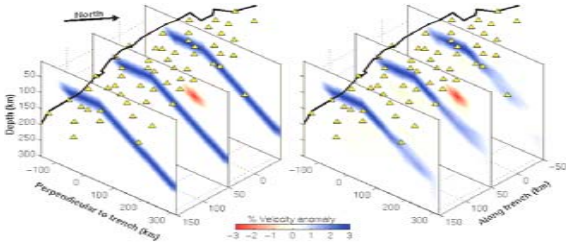
↦ 18-month deployment including inset linear array (shown in purple)

↦ Teleseismic dataset suitable for imaging the subducted slab geometry and characterizing the mantle wedge

↦ Local microseismicity will also delineate slab geometry and indicate stress states in the slab and overlying crust.

↦ Convergence of multiple arrays near volcan de Colima may provide details of lower crust and near-Moho processes

↦ Currently slated for deployment in late 2005 or early 2006



(Top) A test of the resolving power of the MARS array. A synthetic model on the left includes the subducting Rivera/Cocos slab and a hypothetical "warm spot" in the mantle just beneath volcan de Colima. On the right is the resolved image assuming a typical 18 month set of data. The slab is well-resolved to ~300 km depth and the array is able to detect ~75 km anomalies in the uppermost mantle.
(Bottom) Representative teleseimic data set of events between7/1/1999 and 12/31/00. These events form the basis of the synthetic test. Local earthquake data is based on previous deployments in the array (see slab cross-section in box above).