T33G-2496

Passive seismic study of a magma-dominated rift: The Salton Trough

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1. Introduction:

The Salton Trough is a magma-dominated rift linking the Gulf of California to the San Andreas fault system. Because the rift is buried beneath a thick pile of Colorado River sediments, surprisingly little is currently known about the total volume of intrusion into the crust and the magma distribution within and beyond the rift margins.

We present preliminary results of ambient noise tomography using seven months of continuous data. Data were retrieved from the 42 temporary broadband stations of our broadband Salton Seismic Imaging Project (bb-SSIP) and from 37 permanent broadband stations in the area. The resultant velocity model will be used for future receiver function imaging and also to update the Community Velocity Model of Southern California that is the basis for assessing strong ground motion and earthquake hazard throughout that area.

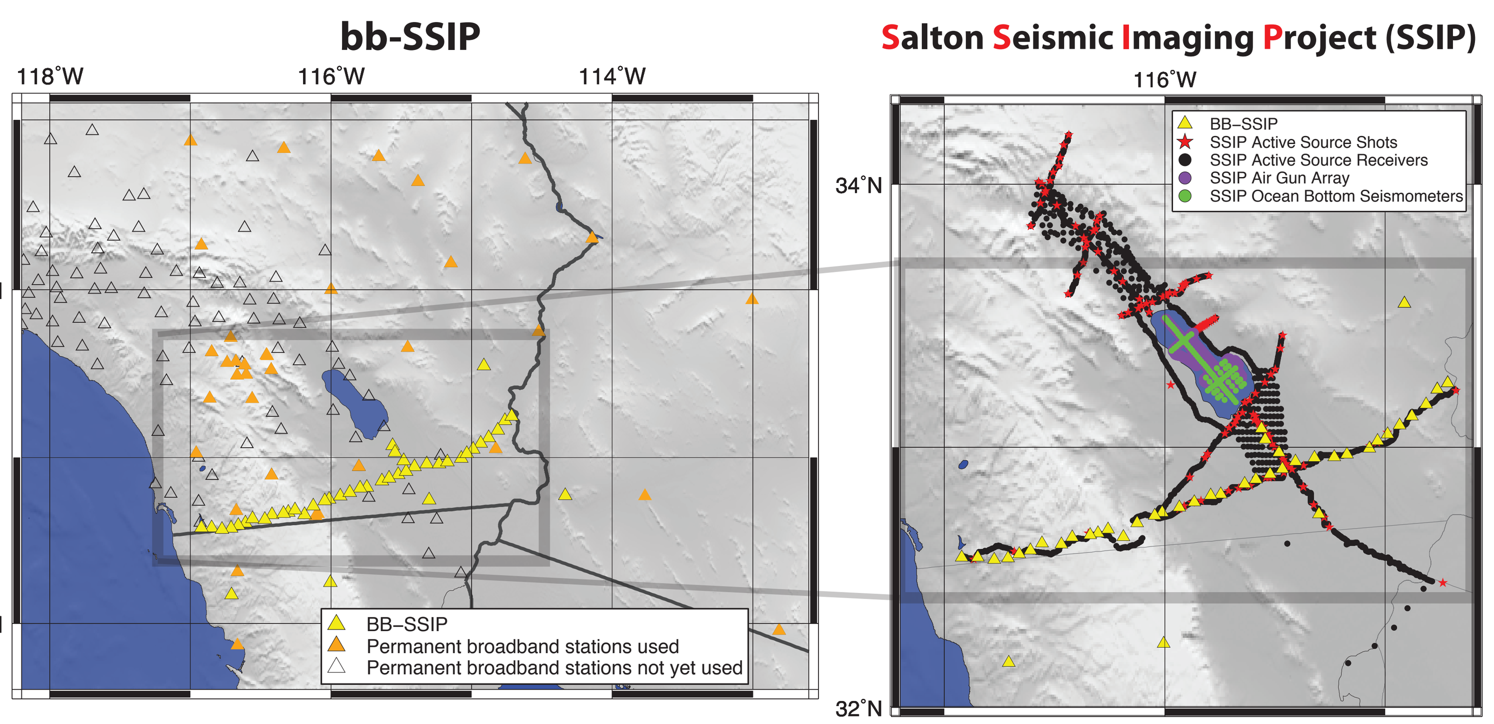

Fig. 1 Map of the Salton Trough region. Boxed area indicates the area of ambient noise tomography image presented in section 3. (A) broadband stations used in the ambient noised tomography. Empty triangles note stations that were not used at this stage due to technical issues. (B) Entire SSIP project, including controlled-source, marine, and passive experiments.

2. About the experiment

The Salton Seismic Imaging Project (SSIP) is a collaborative project jointly funded by the National Science Foundation (NSF) and the U.S. Geological Survey (USGS). In this project, data is acquired through both active- and passive-source acquisition techniques, which will provide detailed, subsurface 3-D images of the Salton Trough of southern California and northern Mexico. This information will provide insights into earthquake hazards, rift processes, and rift-transform interaction at the southern end of the San Andreas Fault system.

In January 2011, 40 broadband seismic stations provided by the PASSCAL pool were deployed across the Salton Trough in southernmost California. Two more stations, on loan from Caltech, were deployed in northern Mexico. Although the two stations in Mexico could only be deployed for 6 months because of import restrictions, the 40 PASSCAL stations will continue to record through the summer of 2012 in support of our primary goal, to record receiver functions and construct a CCP image across the Salton Trough.

For more details about the SSIP experiment refer to neighboring posters: "T33G-2495", "T33G-2497" and "T33G-2498".

Acknowledgements

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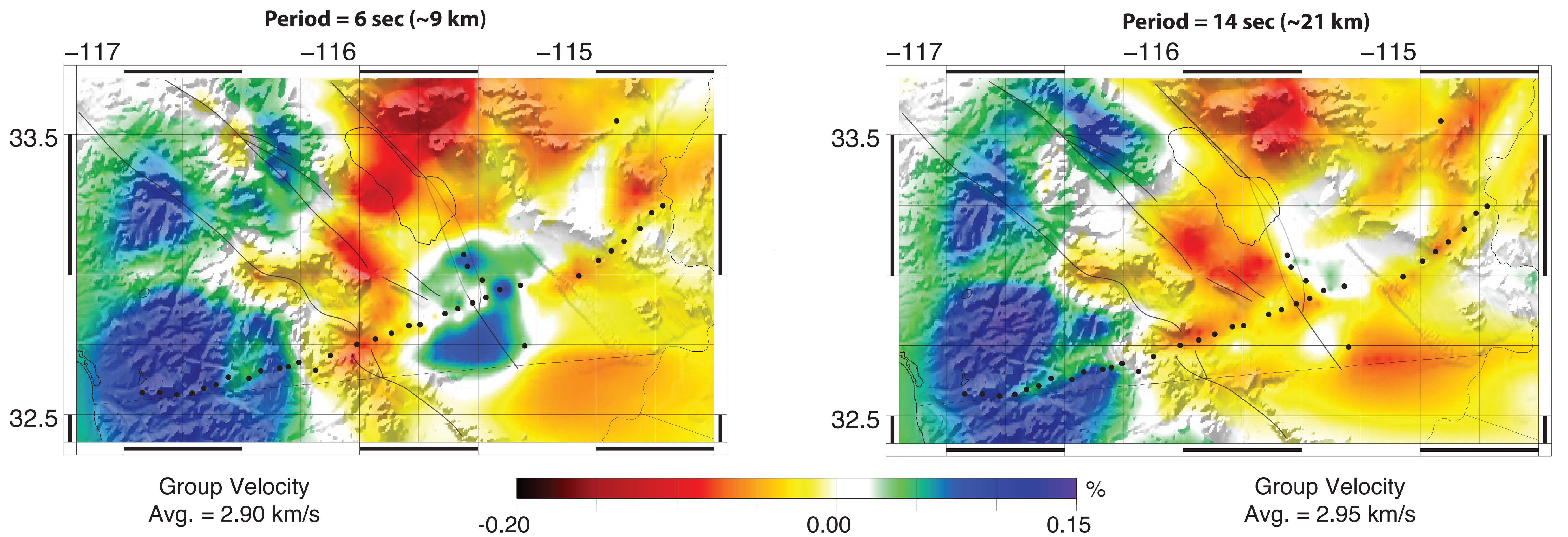
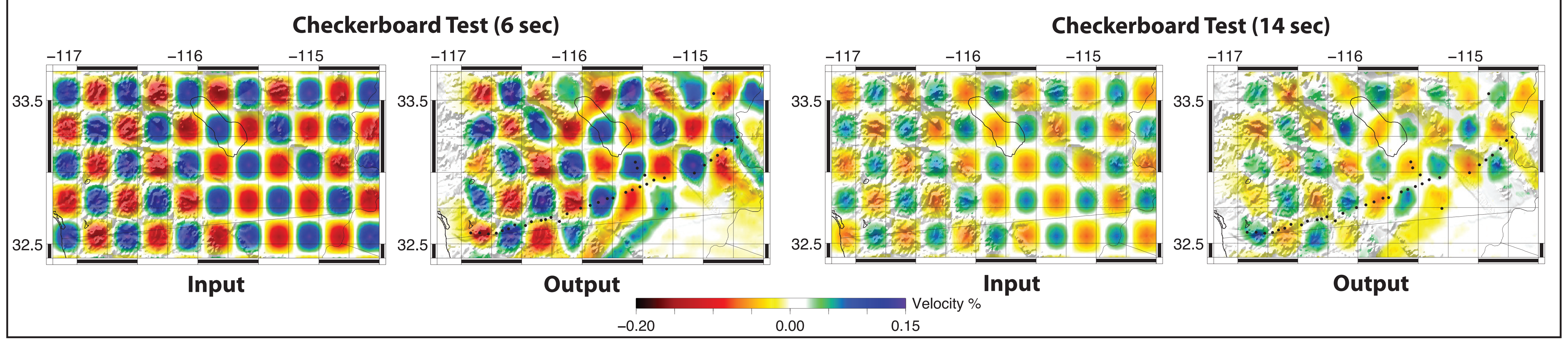
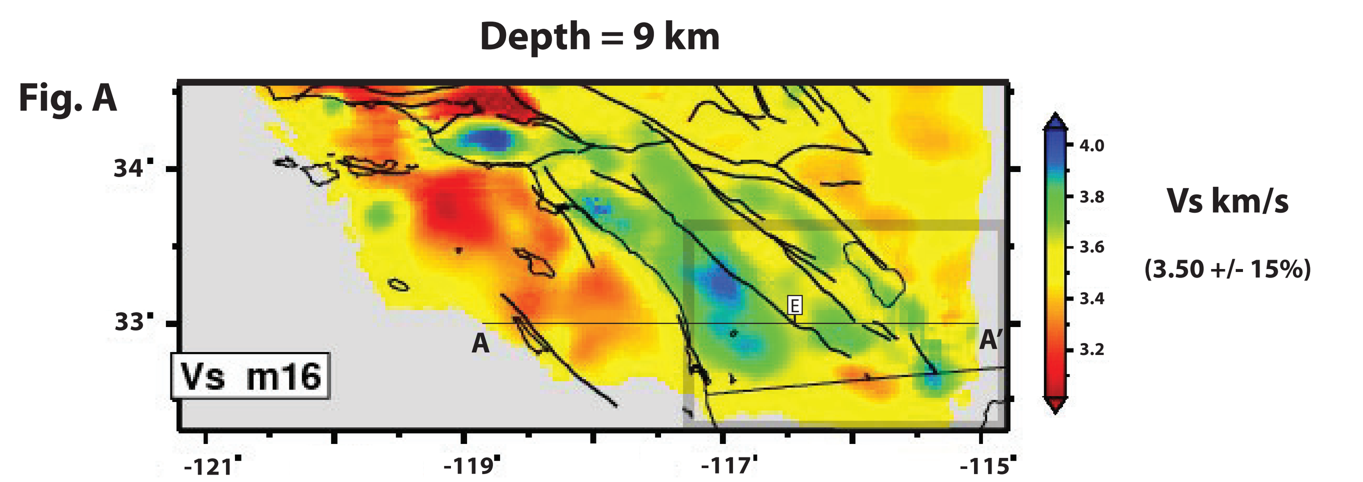
3. Ambient Noise Tomography

Assuming an average group velocity of ~3 km/s and peak sensitivity at half a wavelength,
the 6 sec period layer corresponds to 9 km depth and the 14 sec period layer corresponds to 21 km depth.





4. Comparison to S-wave velocity of Tape et al. (2010)



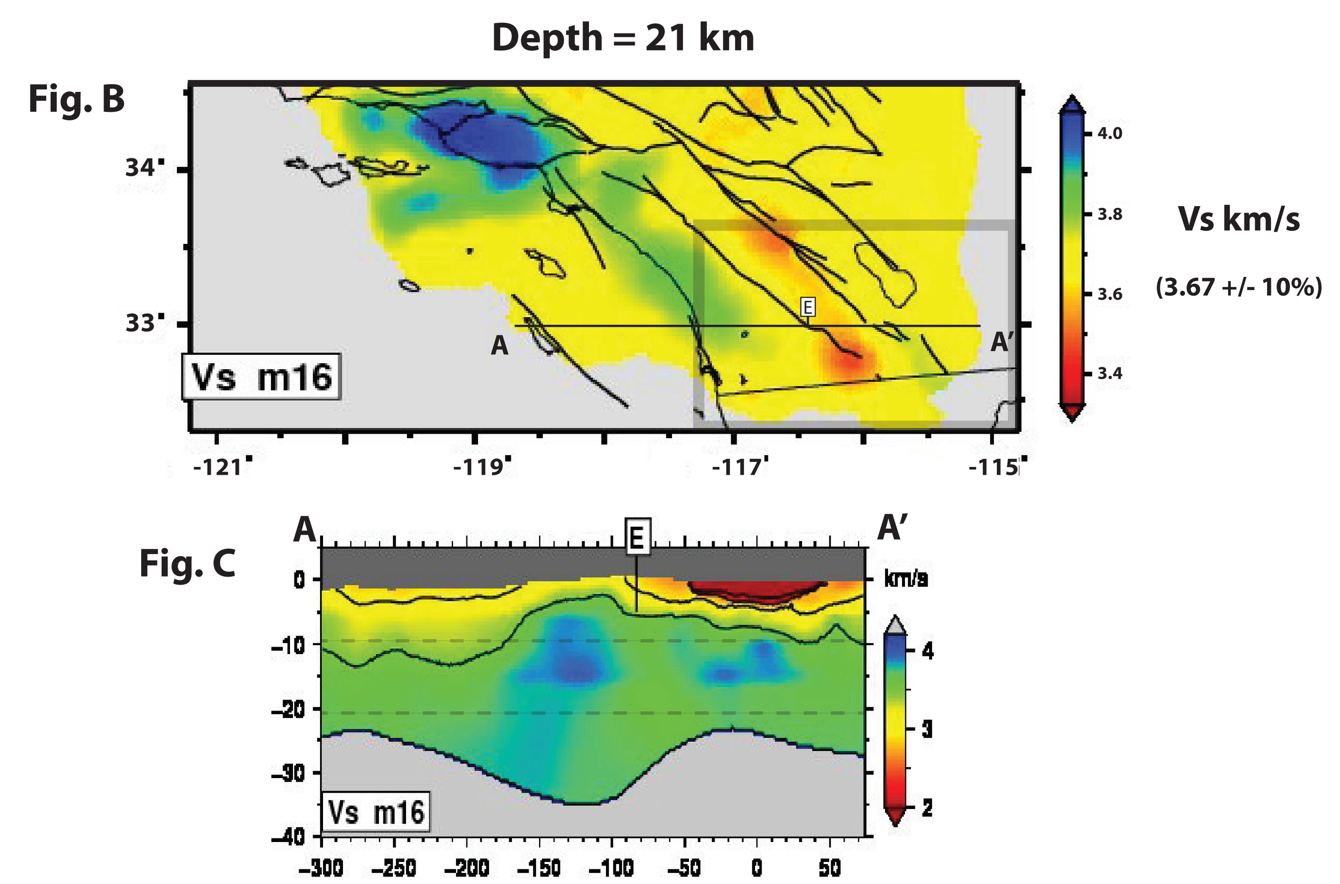


Fig. 4 Results of 3-D joint inversion of body and surface waves: (A) S-wave velocity at 9 km depth. (B) S-wave velocity at 21 km depth and (C) Vertical cross-section A-A'. Boxed area represents area of our ambient noise image. Note that the velocities from our ambient noise tomography are Rayleigh-wave group-velocities that are slower than the S-wave velocities in the Tape et al. model. The Elsinore fault is labeled 'E'.

5. Method: Ambient Noise Tomography

Ambient noise tomography uses seismic noise to measure velocity in the earth.
By cross-correlating long time series of ambient noise, random noise is canceled out and the result is a noise correlation function that approximates the Green's function between a pair of seismic stations.
Here we use the ambient noise data to produce a surface wave tomographic model by computing the surface-wave group-velocity dispersion using the multiple filter analysis technique.

Processing steps:
1. Split data into day-long series, filter and remove instrument response.
2. Compute the cross-correlation between each pair of stations.
3. Stack all day-long cross-correlations between each pair of stations throughout the entire period.
4. Measure group-velocity dispersion curves using time-frequency analysis.
5. Invert travel times to produce a Rayleigh-wave group-velocity model.

6. Future model improvement

- Our checkerboard test show that the area southeast of our array could be improved. Adding the data from more stations in northern Mexico will help address this issue.
- We also plan to add data from more permanent broadband stations present in the Salton Trough region and the Los Angeles basin. We expect a large improvement as the number of stations will more than double.
- Note the streaking along the line of our BB-SSIP array, more clearly observed at the longer period image. There is a bias in amplitude where we have more data (more stations) relative to where we have less data (fewer stations). We plan to resolve this issue by applying appropriate weights in the inversion and test the results with bootstrapping.

7. Preliminary discussion of geology

- Our model shows high velocities under the batholiths to the west (Peninsular Ranges and Santa Rosa Mountains) relative to the low-velocity sedimentary rocks in the Salton Trough. This is observed both in short and long periods. As in previous lower-resolution models (Figure 4 at left, Tape et al.), the ranges to the west exhibit high velocities (blue-green) and low velocities (yellow-red) under the Salton Trough.
- A prominent high-velocity feature is observed SE of the Salton Sea at a depth of ~9 km (6 sec). A basement layer - interpreted as metamorphosed sediments mixed with mafic intrusions - was previously found to extend from the base of the sediments at 5-6 km down to 10-15 km under the Salton Trough (Fuis et al., 1984). Therefore, we interpret our high-velocity anomaly as a concentration of intrusions in the basement, aligned with and marking the rift axis. Note that the same feature is present in the velocity model of Tape et al. (Fig. 4). Gravity and magnetic data should help to constrain our observation and interpretation.

References

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