Abstract

The offshore Mid-Channel blind-thrust fault is located in the Santa Barbara Channel in the southern portion of the western Transverse Ranges. The fault is north dipping and overlain by an asymmetric anticline with a narrow steep forelimb and a wider, more gentle dipping backlimb. The structure is doubly plunging and trends generally north-west, south-east with a slight bend in the middle. The Mid-Channel anticline lies at greater water depth (>110 meters) than many other active structures in the Santa Barbara Channel and therefore, the anticline structure preserves a nearly complete section of late Pleistocene growth strata above the Mid-Channel fault. These units have been well studied with high-resolution seismic surveys and piston cores collected on Melville cruises in 2005 and 2008 to infer basin deposition rates and paleocorelate (e.g., Nicholson et al., 2006; Marshall, 2012; Behl et al., 2016). Here, we use these horizons to provide chronostrophic estimates on rates of folding and uplift, which are used to calculate fault slip rates.

In addition to the dated horizons and shallow seismic, we also use high-resolution industry seismic reflection data, well data, and detailed bathymetric data to define the 3-D geometry of the Mid-Channel structure. We present sections to demonstrate the geometry of the structure along strike and use fault-bend folding and trinear theories to describe its kinematic evolution. We generate a 3-D model of the fault to define the lateral terminations of the structure and its dip variations along strike. Structural relief of the late Pleistocene horizons is measured along strike across the fold and used to calculate slip on the Mid-Channel fault using this 3-D fault model. Based on the geochronology of the horizons, we use these displacements to calculate the late Pleistocene slip rates on the Mid-Channel fault. Together, the 3-D geometry of the fault and its Late Pleistocene slip rate help determine the seismic hazards associated with the Mid-Channel fault and structures that it may link to at depth, which together pose a threat to the coastal populations of southern California that border the Santa Barbara Channel.

Cross Sections

We create three cross sections, with the main section (A-A’) near maximum relief of the Mid-Channel anticline and a section in the East and West to describe the lateral limits of the Mid-Channel fault. Stratigraphy is based on shallow dated horizons and deep well picks.

1. **Location**

2. **Differential Uplift**

We develop a new method to calculate slip from uplift (measured across the backlimb syncline) on faults with multiple bends and non-horizontal lower ramps.

3. **Slip Rate on the Mid-Channel fault at section A-A’**

We measure uplift along the backlimb syncline and calculate slip using differential uplift method for a fault with two bends. A linear fit of data gives slip rate for both the upper and lower fault segments. Intersection of pre-growth and growth lines give age of initiation of deformation.

4. **Summary**

1. The Mid-Channel fault is an active fault system with a south vergent fault propagation fold in the hanging wall.

2. Deformation of the Mid-Channel fault, at section A-A’, initiated at about 650 ka. Along strike, the structure shows E-W propagation.

3. Slip rate on the Mid-Channel fault, at section A-A’, is 1.83 mm/yr. This slip is linked to seismogenic fault systems at depth and useful for calculating earthquake recurrence intervals.

References:

Shaw, J. and J. Suppe, 1994,

Acknowledgments:

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