Investigation of the Offshore Section of the Northern San Andreas Fault: Slip Partitioning, Shallow Deformation, and Fault Trend Influence

Details

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Authors	Beeson, J W*, CEOAS, Oregon State University, Corvallis, OR, USA Goldfinger, C, CEOAS, Oregon State University, Corvallis, OR, USA Johnson, S Y, United States Geological Survey, Pacific Coastal and Marine Science Center, Santa Cruz, CA, USA
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Abstract

Geodetic studies have shown that the angular velocities between the Pacific Sierra Nevada/Great Valley block are roughly 39 mm/yr and that the Northern San Andreas Fault (NSAF), at Pt. Arena, CA, accommodates roughly 25 mm/yr of that motion. The remaining motion is thought to be accommodated by slip on the Maacamma fault zone and the Bartlett Springs fault zone to the east of the NSAF. Since the NSAF moves offshore north of Point Arena, CA, the use of geodetic techniques to evaluate slip rates on roughly 120 km of the NSAF is challenging. We now have a detailed fault location map from Pt. Arena to Pt. Delgada, CA which allows us to evaluate, qualitatively at present, strain partitioning along this section of the plate boundary. The NSAF is mapped with multibeam bathymetry and ~100 seismic reflection profiles. The fault moves offshore north of Pt. Arena and returns onshore at Pt. Delgada. The entire offshore section of the NSAF can be characterized by a narrow, ~1 km wide deformation zone. Utilizing bathymetric and seismic data we infer that the NSAF loses slip northward based primarily on the presence of numerous northwest-trending splay faults and compressional folds. These splay faults, which are visible for ~10 km away from the NSAF and are steeply dipping, appear to be active and accommodating a proportion of the strike slip motion. These splay faults appear to dive below the penetrating depth of the mini-sparker leaving folded strata above

them. They also appear to have recent deformation on the seafloor expressed as uplift and generally trend to the NW with apparent reverse and strike slip motion. Incorporating industry released multi-channel seismic reflection profiles we have also mapped and evaluated other large compressional structures to the west on the Viscano block. A sharp bend of the NSAF, ~9 degrees to the north, is mapped near the submarine Noyo Canyon Head. This right bend in a right lateral strike-slip fault has created a small asymmetric basin, visible in the bathymetric and seismic data to the east of the NSAF. The basin is young in the north where the local stress field is extensional. Conversely, south of the releasing bend, the old section of the basin is under compression as the stress field is no longer controlled by the releasing bend. This transition from extension to compression is clearly shown in the flat-lying sedimentary unit north of the bend and the folded strata to its south. This area represents a classic example of basin formation and destruction in a transform boundary zone. As the NSAF bends at Noyo Canyon and moves north, it bends back ~10° to the west near Tolo Bank.

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