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Gravity Constraints on the Geometry of the Big Bend of the San Andreas Fault in the Southern Carrizo Plains and Pine Mountain Region

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Abstract

The goal of this project is to combine gravity measurements with geologic observations to better understand the "Big Bend" of the San Andreas Fault and its role in producing hydrocarbon-bearing structures in the southern Central Valley of California. The SAF is the main plate boundary structure between the Pacific and North American plates and accommodates ≈35 mm/yr of dextral motion. The SAF can be divided into three main segments: the northern, central, and southern segments. The boundary between the central and southern segments is the "Big Bend", which is characterized by an ≈30°, eastward bend. This fault curvature led to the creation of a series of roughly east-west thrust faults and the transverse mountain ranges.

Four high-resolution gravity transects were conducted across locations on either side of the bend. A total of 166 new gravity measurements were collected. Initial modelling suggest that flower structures occur on both ends of the bend. These structures are dominated by sedimentary rocks in the north and igneous rocks in the south. The two northern transects in the Carrizo plains have an ≈-70 mgal Bouguer anomaly. The SAF has a strike of ≈315° near these transects. The northern transects are characterized by multiple fault strands which cut marine and terrestrial Miocene sedimentary rocks as well as Quaternary alluvial valley deposits. These fault strands are characterized by ≈6 mgal short wavelength variations in the Bouguer gravity anomaly, which correspond to low density fault gouge and fault splays that juxtapose rocks of varying densities. The southern transects cross part of the SAF with a strike of 285°, have a Bouguer anomaly of ≈-50 mgal and are characterized by a broad 15 mgal high. At this location the rocks on either side of the fault are Proterozoic - Cretaceous metamorphic or/and plutonic rocks. Previous work based on geologic mapping hypothesized the existence of a shallow, low angle Abel Mountain Thrust in which crystalline rocks were thrust over Miocene sedimentary rocks, near Apache Saddle. However, our initial gravity models indicate the crystalline rocks are vertically extensive and form a positive flower structure bounded by high angle reverse faults. Overall, the broad gravity highs observed along the southern transects are due to uplift of basement rocks in this area.