Introduction

The Northern California shear zone accommodates North American plate rotation at a right-lateral transpressional shear driven by the northwest-trending Sierra microplate. Within this zone, the intersection of the ranges of 40° and 42°, 1 - 4 mm/yr of north-south geotectonic contraction is observed (Figure 1). Hammond and Thatcher (2005) and for the most part, remains geologically unaccounted for. We are investigating the Quaternary expression of transpressional shear localized at the northern end of the Sierra Nevada and the Great Valley to evaluate both the recession and rates of deformation across structures that may be accommodating the contractional deformation suggested in geologic studies.

Geophysical seismic reflection data and previous geologic mapping have shown there to be optimally oriented structures able to accommodate this north-south contraction, however, none have been attributed to this contemporary strain field (Figure 2). The northeast-trending Inks Creek fold belt, located north of Red Bluff, CA, consists of south vergent asymmetric anticlines that provides an opportunity to obtain a shortening crustal rate. Here, we present preliminary geomorphic mapping and terrace dating results that suggest enhanced Quaternary incision of the Sacramento River across the Inks Creek fold belt. Future dating of the terraces with radiocarbon and OSL techniques helps the potential to further quantify lateral and vertical propagation rates of fold growth, as well as constrain the rates of regional contraction.

Geologic Mapping and Stratigraphic Units of the Inks Creek Fold Belt Region

Geologic and geophysical mapping of the Inks Creek region reveal stratigraphic relationships and topographic features that suggest structurally controlled Quaternary incision of the Sacramento River across the Inks Creek fold belt. In this region, the river becomes highly sinuous and fluvial terrace deposits become thinner and more confined to the active channel. The isolated fluvially dominated Rockland ash units (~0.4 m) lies elevated at Round Mountain within an older abandoned channel of the Sacramento River resulting from tectonic uplift of the Hooker Dome (Figure 4). Harwood (1986). Within the active channel of the Sacramento River, the presence and distribution of wind and water gaps and elevated Pleistocene terraces on the noses of the anticlines further suggest structurally controlled Quaternary incision of the Sacramento River and lateral propagation of the Inks Creek folds.

Terrace Profiles

Topographic profiling of Quaternary terraces oriented perpendicular to the fold orientation reveals increased height of terrace surfaces above the active river channel on the anticline noses as well as a systematic change in channel gradient through time (Figure 5). Together, these observations suggest regional and local tectonic influence. The discontinuous nature of the terrace deposits and high sinuosity of the channel across the Inks Creek fold belt makes it difficult to observe mapping of the terraces associated with the structures.

Summary of Observations and Planned Future Study

The results presented here are preliminary and do not provide sufficient information to quantify shortening rates across these structures. However, the observations suggest correlation between the observed Quaternary incision with underlying structures that are optimally oriented to accommodate contemporary north-south contraction. We plan to further constrain the ages of these terraces and the geometry of the folds to determine rates of shortening across the Inks Creek fold belt.

Figure 1. Map of northern California and southern Oregon region. Transparent red polygon shows region of possible contraction. Faults from the USGS Quaternary fault and fold database are shown by black lines. Relative motion of the units are shown by black lines. Relative motion of strike-slip faults shown by thick black arrows.

Figure 2. Geologic Map and stratigraphic units of the Inks Creek fold belt (modified from Blake et al., 1995). Mapping along the line was enhanced by LiDAR data collected by the California Department of Water Resources. White star show location of preliminary radiocarbon samples. White dashed line is the map extent of Figure 3. This black line on terraces shows profile view of Figure 5.

Figure 3. Geologic cross section through Bear Creek fault (Tait, 1994). Cross section was developed from preliminary 2-D seismic reflection data interpreted within the region and is represented by the Inks Creek fold belt of Figure 2.

Figure 4. Geologic and stratigraphic units of the Inks Creek fold belt from the USGS Quaternary fault and fold database. Active Alluvium and Active Channel deposits, are represented by red lines. Active Alluvium and Active Channel deposits are formed by channel changes due to lateral movement of channel. Tertiary deposits are represented by yellow lines. Terrane deposits are represented by blue lines. Cretaceous deposits are represented by green lines. Paleocene deposits are represented by brown lines.

Figure 5. Topographic profiling of Quaternary terraces oriented perpendicular to the fold orientation reveals increased height of terrace surfaces above the active river channel on the anticline noses as well as a systematic change in channel gradient through time (Figure 5). Together, these observations suggest regional and local tectonic influence. The discontinuous nature of the terrace deposits and high sinuosity of the channel across the Inks Creek fold belt makes it difficult to observe mapping of the terraces associated with the structures.

Figure 6. LIDAR slope map of location of Sample IC-493. Picture below shows river cut where terrace charcoal sample was acquired from.