Preliminary interpretations of Late Cenozoic landscape evolution of the northern Sierra Nevada

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Late Cenozoic slip rates and vertical separation rates of the Eastern Sierra Frontal fault system (Frontal fault system) in eastern California have yet to be quantified, and previous studies to define its incipience and structural style are at odds. Furthermore, several of the studies propose landscape evolution of the Sierra Nevada, but results are inconsistent. New radioisotopic ages, paleomagnetic data, and mapping of volcanic rocks will constrain Frontal fault system and Sierra Nevada landscape evolution during the Late Cenozoic. Forty-one Late Cenozoic volcanic deposits yield K-Ar conventional and Ar-Ar incremental heating ages between .15 Ma and 3.3 Ma; these samples are from numerous informally named basalt flows and ashflow-tuffs, and andesites of the Yana volcanic center. Another ten samples from informally named ashflows and Yana and Mehrten Formation andesites have been collected for analysis; the expected age range for these samples is ~3 - 5 Ma. The importance of the ages for interpreting landscape and tectonic evolution is two-fold: (1) Younger volcanic deposits are generally inset in, or found topographically lower than older volcanic deposits suggesting ongoing uplift-related stream incision. Radioisotopic ages will constrain incision rates and temporal incision variations with implications for kinematics of the Frontal fault system. (2) Despite at least 1500 ft. of incision by the North Fork Feather River and some tributaries, the ~3 Ma Yana basal contacts are found at similar elevations across the Frontal fault system. Such relations suggest that the Frontal fault system has vertically separated the west-draining paelolandscape of the region such that previously lower western elevations are now roughly horizontal with previously higher western elevations. Taken together, these relations permit reconstruction of Sierran paleolandscape and quantification of temporal separation caused by the Frontal fault system.

Another deposit of significant importance is the Eocene-Oligocence gravel that crops out locally under the oldest volcanic deposits and above pre-Tertiary metamorphic and igneous basement rock. The gravels are stream-lain deposits with provenance in central or eastern Nevada. The gravels were deposited in paleocanyons that crossed Nevada and the future Sierra Nevada until extensional tectonics beheaded the west-flowing streams. A datum for the pre-tectonic landscape of the mid-Cenozoic can be developed by reconstructing the paleocanyons. Current elevations of the gravels vary across strike of the Frontal fault system from 4200 ft. along the eastern margin of the Sierra Nevada to >6800' at the crest. These relations suggest significant west-side-up faulting of the west-sloping paleocanyons and gravels.

Several closed depressions occur in the field and are interpreted as pull-apart basins caused by non-partitioned, transtensional strain. Two large pull-apart basins host fault blocks capped by volcanics. An inferred fault block in Humbug Valley is capped by ~3 Ma Yana andesite and basalt-andesite, and an inferred fault block in Butt Valley is capped by ~.6 Ma Warner Valley basalt. Paleomagnetic sampling from these locations will provide data to constrain temporal rotation of the fault blocks. Additionally, modeling of rotation will generate data to quantify the amount of strike-slip offset. No other markers have been found to acquire such data.