

A Soil Chronosequence of the Mitchell Ranch Fluvial Terraces of the South Fork Eel River Age Estimates and Tectonic Implications

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INTRODUCTION

Fluvial terraces are abundant in northwestern California, yet few have been studied in detail and, as a consequence, age control and correlations are generally lacking. This study employs relative dating and soil geomorphological techniques to develop a soil chronosequence on a well preserved flight of terraces near Garberville, at the Mitchell Ranch. This soil chronosequence may help to provide a base of data to aid with correlation of similar geomorphic surfaces elsewhere in northwestern California.

At the Mitchell Ranch, a well preserved nested terrace sequence of fourteen surfaces steps upwards from the South Fork Eel River. This sequence of terraces is well suited to the study and development of a soil chronosequence because: 1) the terrace surfaces are spatially distinct; 2) alluvial parent materials for all of the soils are compositionally similar; 3) the depositional stratigraphy for all of the terrace deposits is similar; 4) soils occur as surface soils and most have not had appreciable profile rejuvenation; 5) radiometric ¹⁴C (Stone and Vasey, 1968) age determination of a surface soil in the South Fork Eel River basin provides "low-end", 9.5 Ka (thousands of years before present), soil-age calibration; 6) magnetostratigraphic measurements of terrace soils (LaVen and Fine, 1987) provide supporting evidence for a tentative age of between 104 Ka and 17 Ka; and 7) the relative soil development and topographic data suggest that the terraces and soils can be grouped into age-classes.

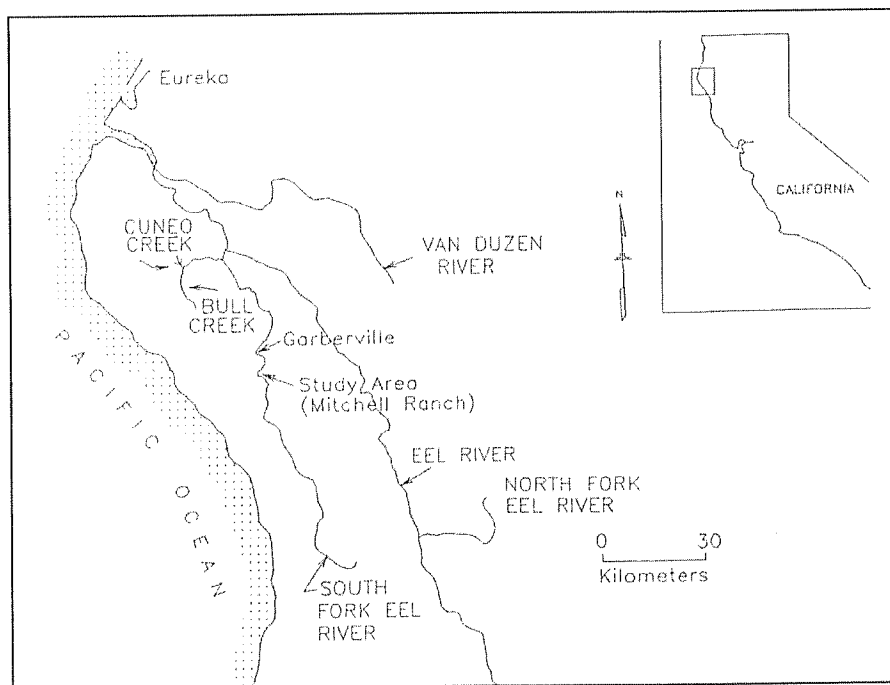


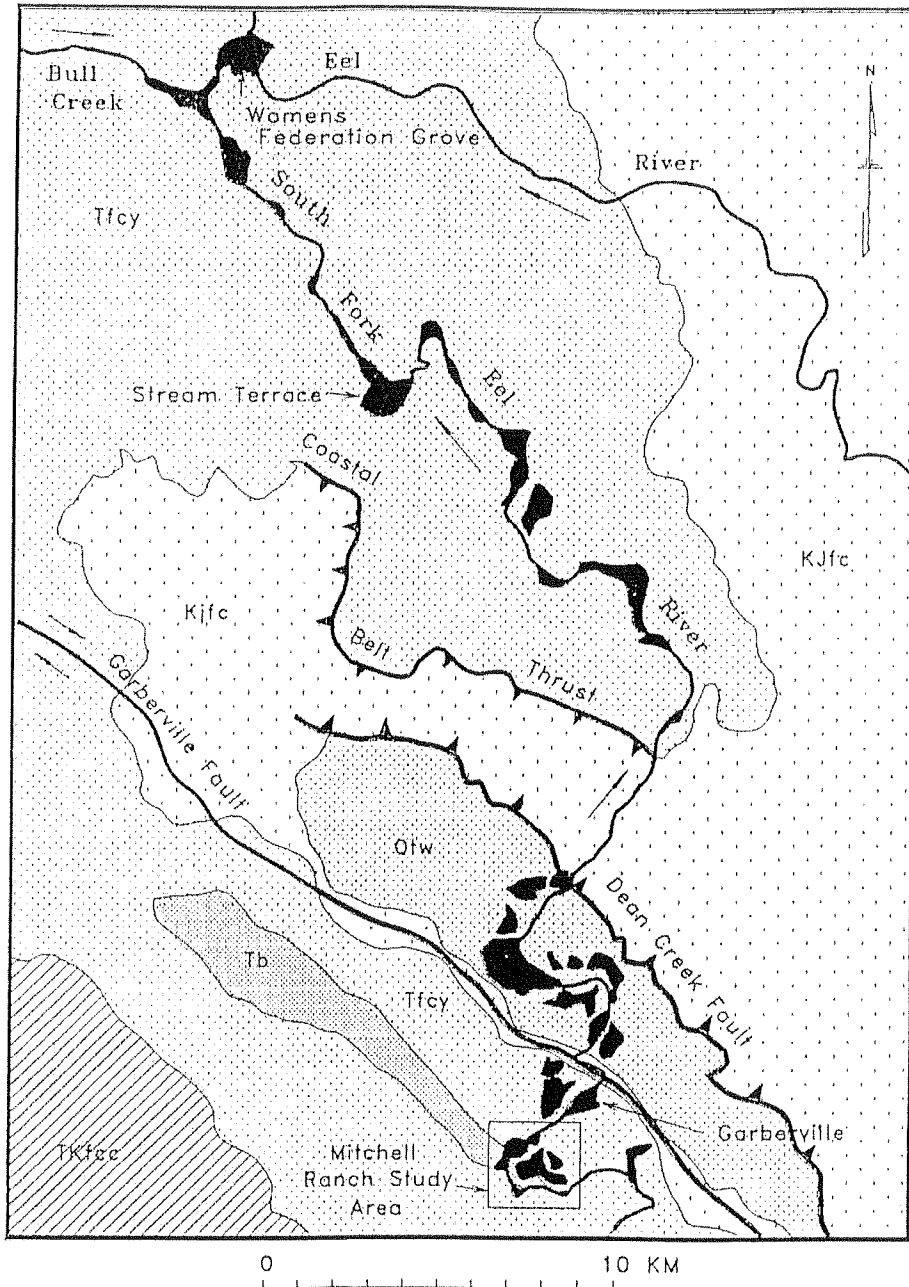
Figure 1. Location map of Mitchell Ranch near Garberville, northwestern California.

ABSTRACT

Alluvial history in the South Fork Eel River basin (1,750 sq. km) of northern California is recorded by strath and fill terraces. Fourteen nested terrace surfaces 3m, 4m, 6m, 8m, 10m, 50m, 62m, 65m, 97m, 108m, 259m, 279m, 305m, and 315m above the South Fork Eel River in the Garberville area at the Mitchell Ranch were studied in detail. The 3m, 4m, and 6m surfaces represent fill terraces composed of active channel gravel and flood deposits. Strath terraces at 8m, 10m, 50m, 62m, 65m, and 108m are composed of gravel and are capped by overbank deposits. The 259m, 279m, 305m, and 315m surfaces are eroded terrace remnants with only resistant chert and metamorphic lag gravel remaining.

Using quantitative data based on weathering and soil development phenomena, a soil chronosequence was developed for the Mitchell Ranch terraces. The Soil Profile Development Index (SPDI) methodologies of (Harden, 1982; Harden and Taylor, 1983) were used to quantify the soil development. Estimated ages based on soil development correlations using the UPDI's suggest that the terraces can be grouped into six age-classes, as follows: age-class 1, recent alluvium; age-class 2, 3.5 Ka - 8.3 Ka; age-class 3, 29 Ka - 48 Ka; age-class 4, 75 Ka - 80 Ka; age-class 5, 100 Ka - 120 Ka; age-class 6, greater than 300 Ka.

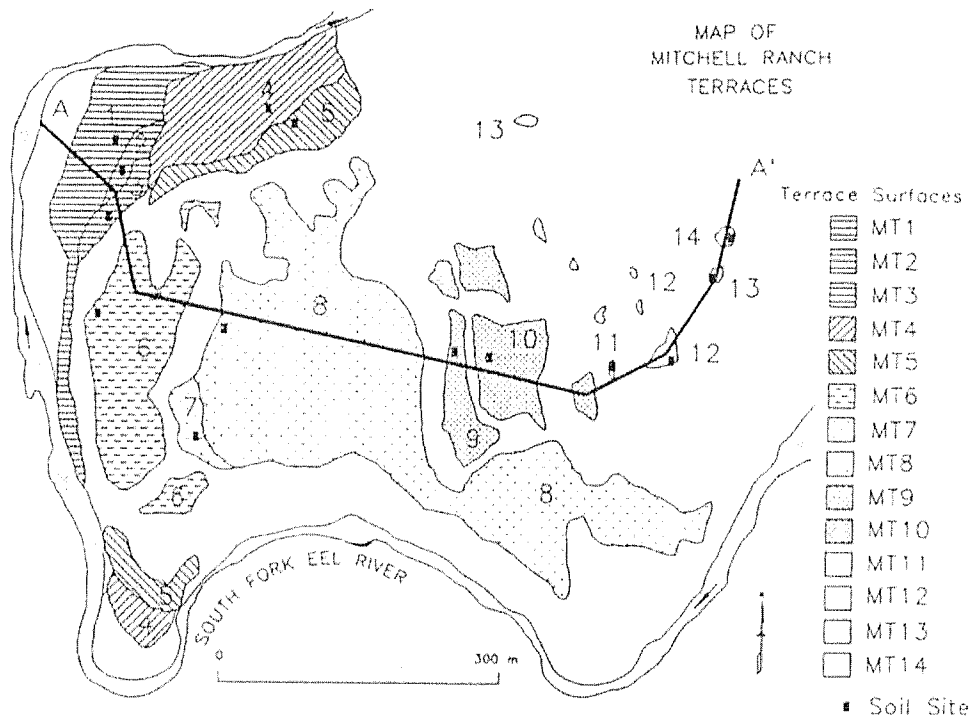
Based on soil development, the average uplift rate at the Mitchell Ranch, up to the age of MT10 is 1.3 m/ky. The long term, average uplift rate of 1.3 m/ky for the Mitchell Ranch terraces compares well to uplift rates inferred from: 1) regional denudation rate of 1.2 m/ky (Judson and Ritter, 1964); 2) work (Menack, 1986) on the edge of the Kimtu Unit of the Wildcat Group, which sets the age of this unit at 1,000 Ka with total incision into this unit of 1219 m, resulting in an uplift of 1.22 m/ky; and 3) published uplift rates ranging from 0.3 m/ky to 4 m/ky for elevated marine surfaces on the coast to the west (15km) of the study area (Lajoie et. al., 1982; Merritts and Bull, 1989).



Kjfc = Central Belt Franciscan Melange
 TKfcc = Coastal Belt Franciscan
 Tfcy = Yager Formation
 Tb = Kimtu Unit of the Wildcat Group
 Qtw = Garberville Unit of the Wildcat Group

Figure 2. Terrace locations and regional geology along the lowermost 30 km of the South Fork Eel River

A



B

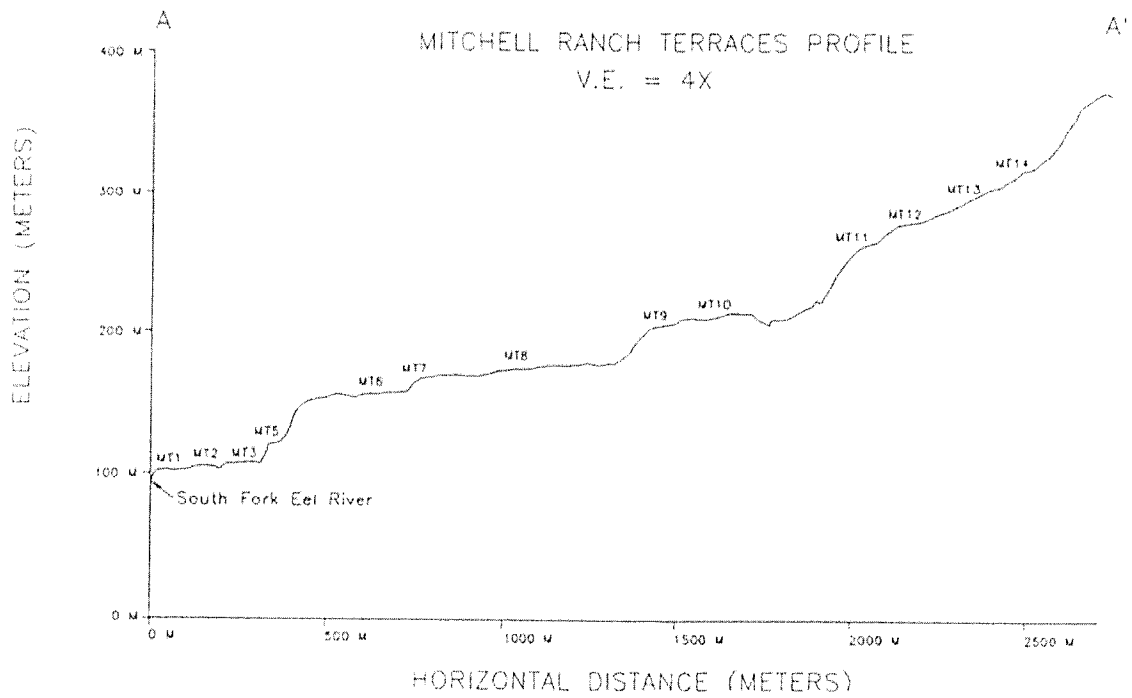


Figure 3. A. A map of the Mitchell Ranch showing the location of terrace surfaces, the profile, and soil pits. B. Topographic profile of the Mitchell Ranch Terraces.