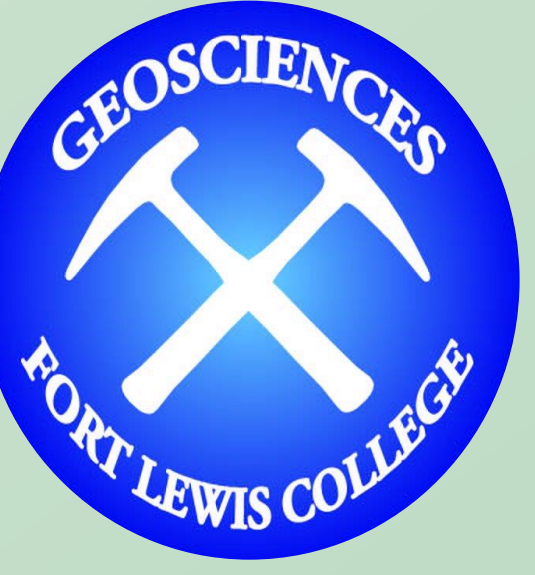


¹⁴C age on wood from an alluvial ferricrete: preliminary, short-term incision rate estimate for Prospect Gulch, San Juan County, CO



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Abstract

A log encased in ferricrete 88.5 cm above the modern thalweg of Prospect Gulch yielded four possible radiocarbon dates, with the most probable (at 33.9%) being 1710.5 ± 14.5 . An incision rate of 280 cm/ky was estimated. The incision rate for the Gunnison River basin is 253 cm/ky. Possible features that support our slightly higher incision rate are:

- Bedrock is made up of highly fractured volcanic rock
- Mining has stripped the drainage basin of vegetation
- Bowl-like catchment upstream
- Concave stream profile, with 30° slope at our site
- First-order tributary
- High elevation and precipitation events

Introduction

Prospect Gulch (figure 1)

- About 5 miles north of Silverton
- Wood sample was found in a ferricrete at the mouth of Prospect Gulch, a first-order tributary to Cement Creek

Alluvial Ferricrete

- A duricrust formed from the oxidation of percolating iron salt solutions within a stream
- Iron from oxidized pyrite and iron-rich acid drainage developed in the area throughout the Holocene (Vincent et al. 2007)

Radiocarbon Dating

- When organic material (like wood) dies, half of the ¹⁴C in the cells will decay back to nitrogen within 5730 years

Results

Incision Rates

- The radiocarbon data (figure 2) provided the following range of possible dates with respective probabilities: 1710.5 ± 14.5 (33.9%), 1824.5 ± 11.5 (25.0%), 1885 ± 9 (21.3%), and 1910 ± 4 (13.9%)
- The incision rate derived from the quotient of the distance from the bottom of the log to the thalweg (88.5 cm) over the difference of the most probable date (1710.5 ± 14.5) to the present was 280 cm/ky
- A report by the US Dept. of Energy (1987) provides a comparative value for average incision rates for the upper Colorado and Gunnison River basins of 253 cm/ky (100 in/ky), and a value for the average rate for the US of 6.4 cm/ky (2.5 in/ky)

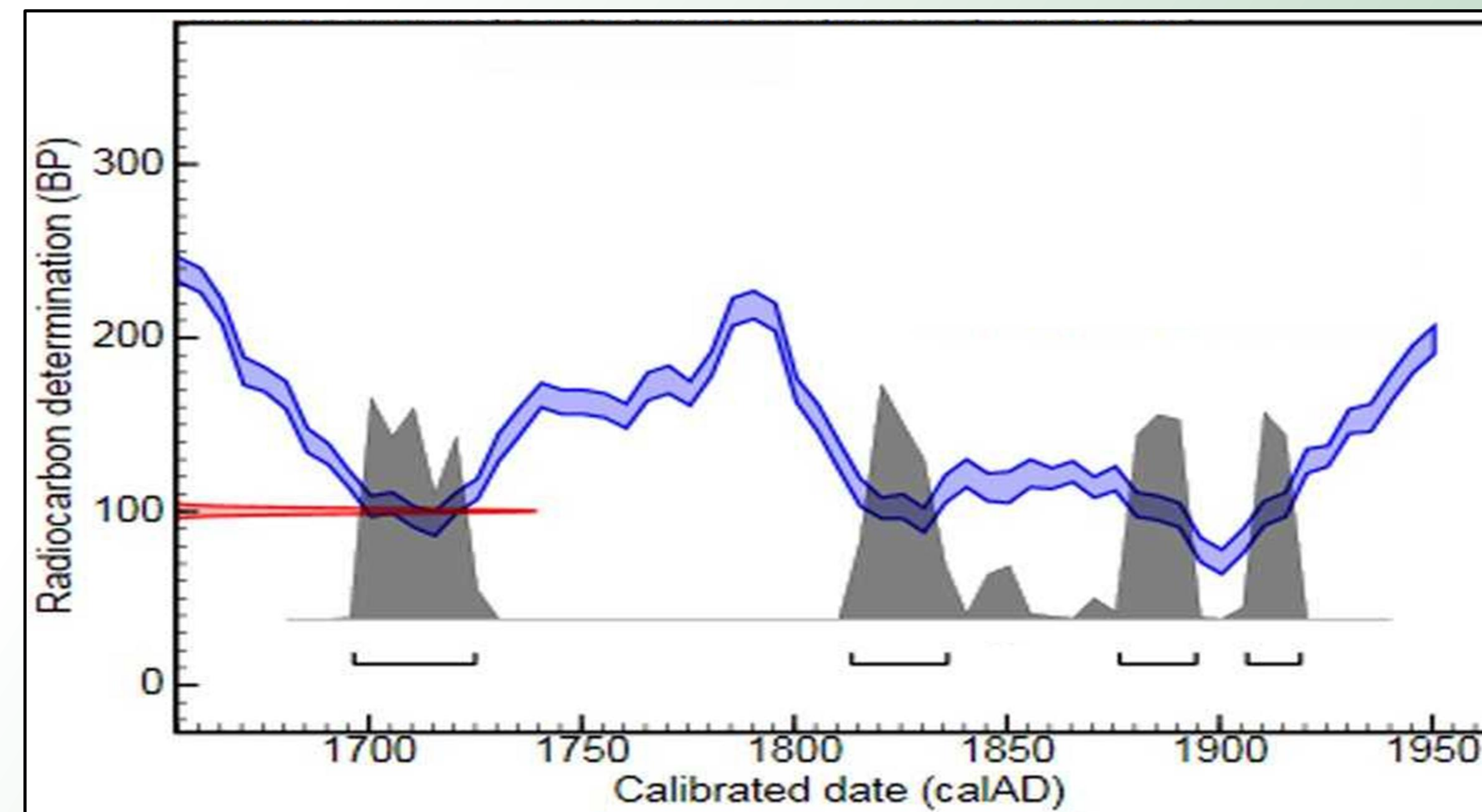


Figure 2. Radiocarbon graph showing peaks over dates of possible sample age

Geologic Setting

- The drainage basin to Prospect Gulch is 1.2 mi², starts at the peak of Red Mountain 3, and includes a bowl-like catchment. A mine localized within the basin stripped the area of vegetation increasing runoff (figure 3)
- The gulch bedrock is made up of highly fractured volcanic rock, including the Burns Formation and the lower Henson Formation (Burbank and Luedke 1964) (figure 4)
- Prospect Gulch is one of the first, farthest north, and largest tributaries in the Animas River watershed, which feeds into the San Juan River, and eventually, Colorado River
- The stream profile of Prospect Gulch is concave with an average slope of 30° at our site

Weather

- The region experiences high precipitation events during the summer (monsoons) (114 cm/yr) and winter (94 cm/yr), and stream discharge reaches its highest levels during spring (snowmelt) and summer (McDougal 2006)

Discussion

¹⁴C forms when cosmic rays interact with nitrogen, removing a proton. When living matter dies, the ¹⁴C within it decays back to nitrogen. The half-life of ¹⁴C (5730 years) is used to date events in recent geologic history using dead organic matter (Dickins 2005). Three possible phenomena that can affect C14 data are cyclic variations in abundance of ¹⁴C, the Suess Effect, deVries Effect, and the Bomb Spike. Furthermore, thalweg levels change with each flood event.

Our estimated incision rate (280 cm/ky) for Prospect Gulch is slightly higher than that of local incision rates (253 cm/ky). Prospect Gulch has many characteristics that support our conclusion. The largest, first-order tributary to Cement Creek, Prospect Gulch has both a large mining complex and a bowl-like structure upstream, with a concave stream profile. Rock types at our site consist of the Burns Formation (fractured tuff breccias, and rhyodacite), and the average slope is 30°. Monsoons and high spring runoff characterize the area, adding to a higher incision rate.



Figure 3. Satellite image of Prospect Gulch drainage basin

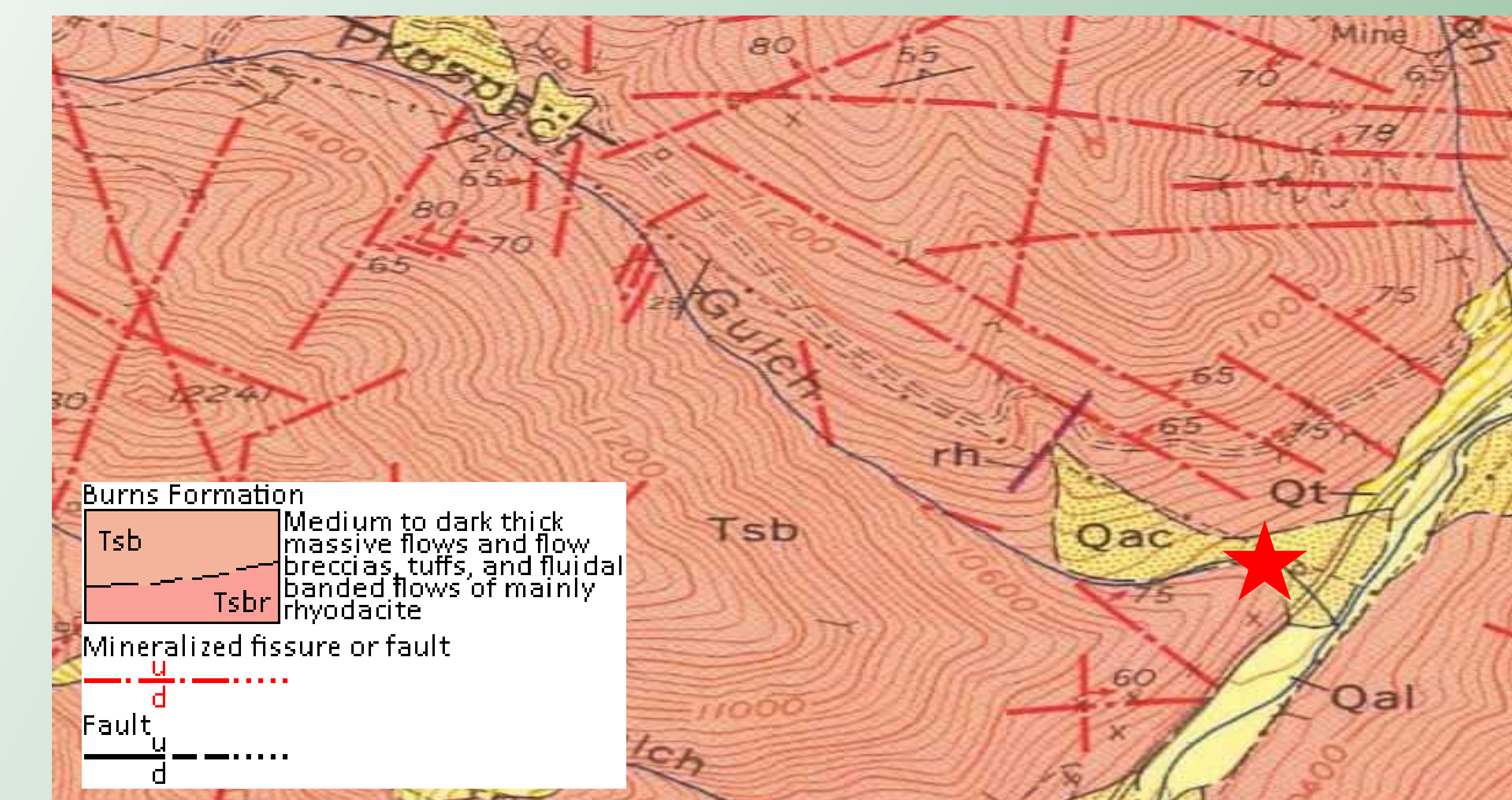


Figure 4. Geologic map of Prospect Gulch rock type and structures

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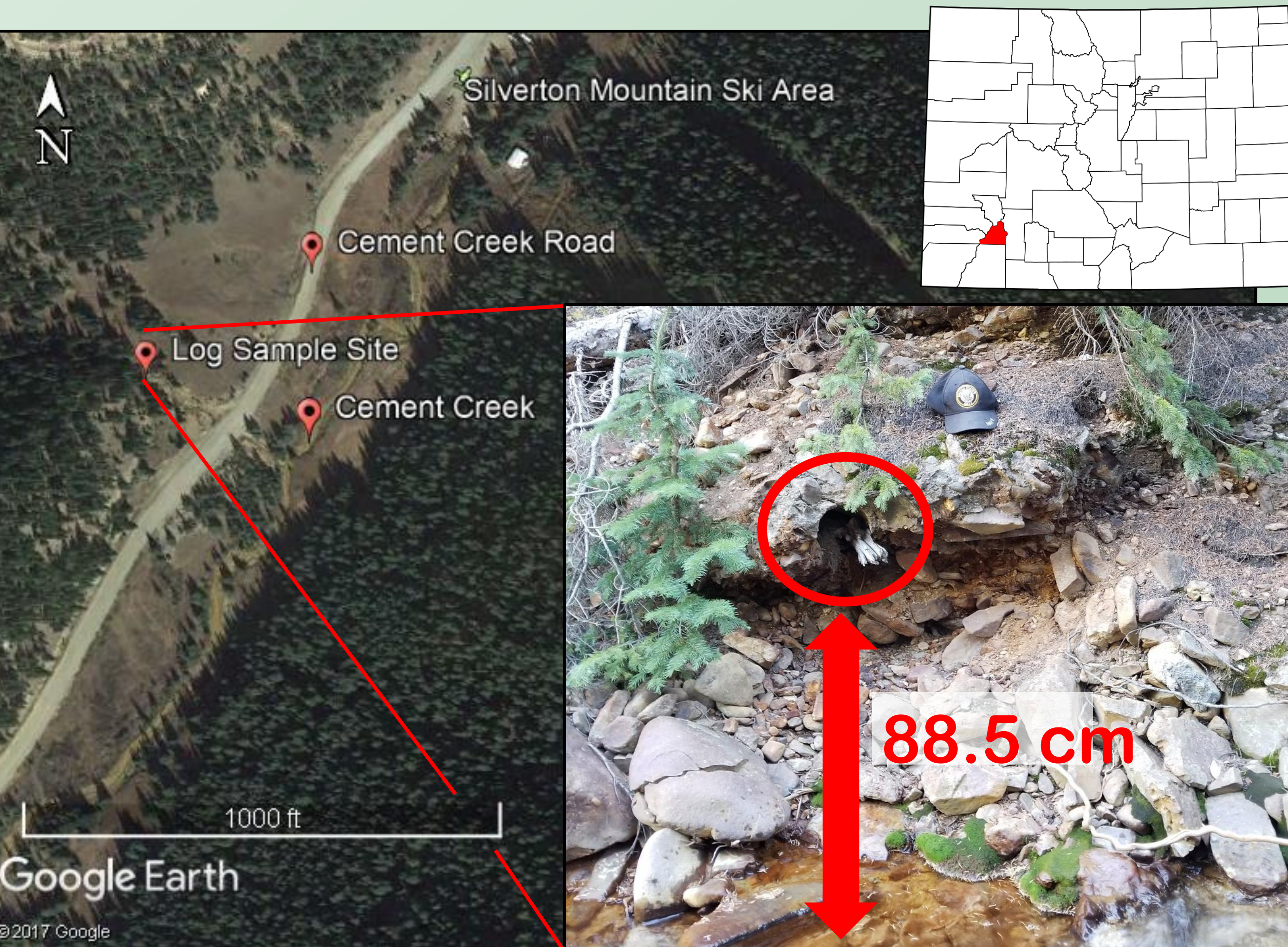


Figure 1. Map of log sample site including inset image of distance between log and thalweg