

Alluvial Terrace Deposition and Soil Formation in Keet Seel Canyon, Navajo National Monument

Amy Schott and Gregory Luna Golya,
National Park Service



Introduction

Keet Seel Canyon, part of the Tsegi Canyon system in northeastern Arizona, contains several alluvial terraces deposited in repeated cycles of erosion and deposition in the Mid- to Late Holocene. Previous studies have correlated timing of deposition of alluvial terraces and subsequent arroyo formation from the Tsegi Canyon system to that of washes on nearby Black Mesa, suggesting widespread, climatically-driven arroyo formation (Hack 1942, 1954).

Keet Seel Canyon is the site of the well-preserved Keet Seel Pueblo, located in Navajo National Monument. Previous work has found that

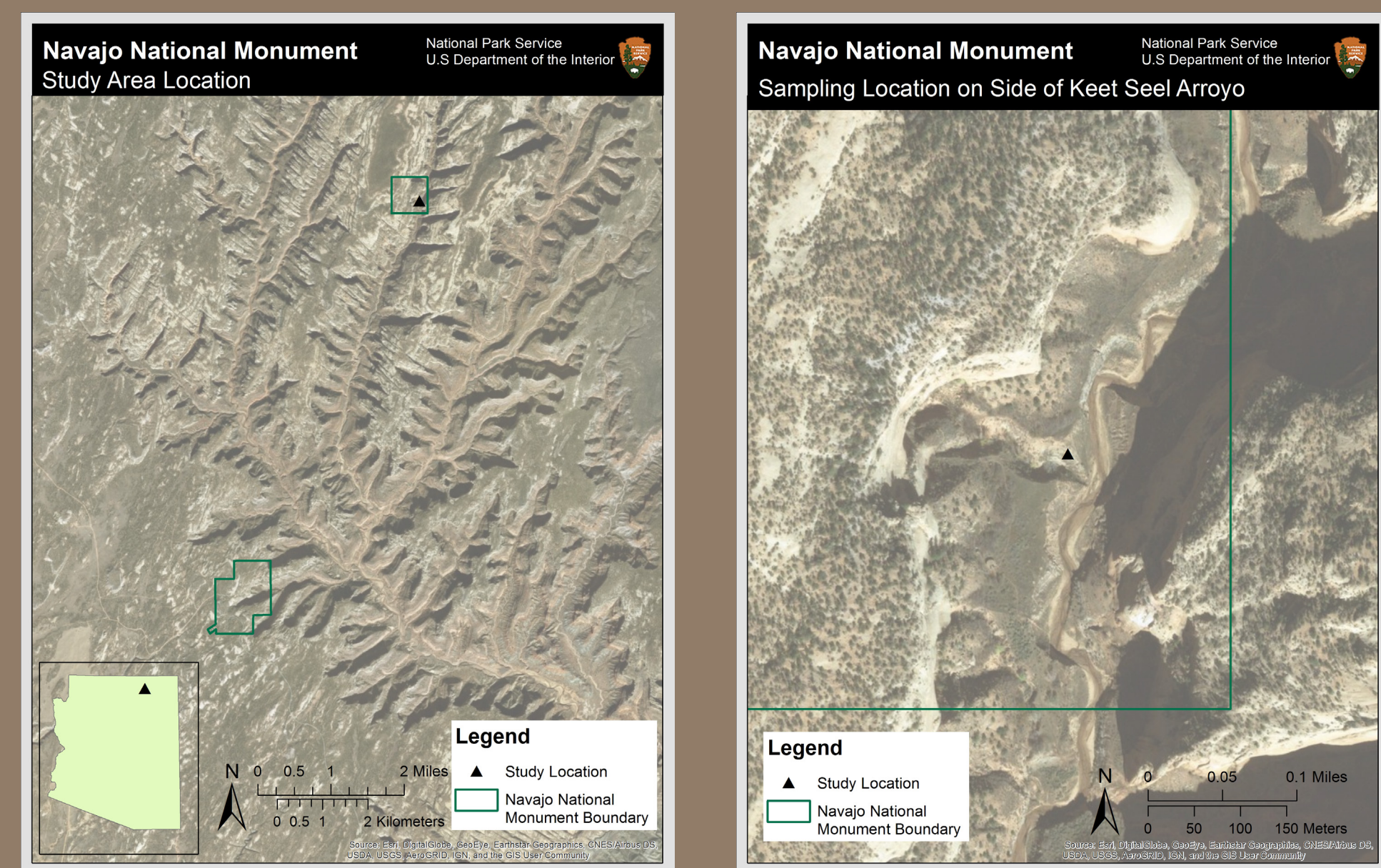


From left: 1) Keet Seel Pueblo is located above a small tributary wash that connects to Keet Seel Wash. 2) Keet Seel Wash has downcut into the alluvial terrace, forming an arroyo, whose walls reveal cycles of erosion, soil formation, and deposition. 3) Previous work by Hack (1941) had correlated terraces in Tsegi Canyon with Holocene age terraces on Black Mesa. Shown here is a Naha-age terrace (A.D. 1450-1900) 4) Buried soils in Keet Seel Canyon reveal multiple episodes of deposition and stabilization.

Study Area

Keet Seel Canyon is part of the Tsegi Canyon system in northern Arizona. The perennial Keet Seel wash has downcut through alluvial deposits in the canyon system, forming steep-sided arroyos.

At least two alluvial terraces have been identified in lower Tsegi Canyon, which Hack (1942) termed the Tsegi and Naha terraces, after similar deposits on Black Mesa.



Methods

- Soil geomorphic descriptions of a sequence of buried soils exposed in the arroyo directly in front of Keet Seel Pueblo, thought to correlate to the Tsegi-age terrace
- Radiocarbon dating of organic matter and macrobotanicals from buried soils

Results

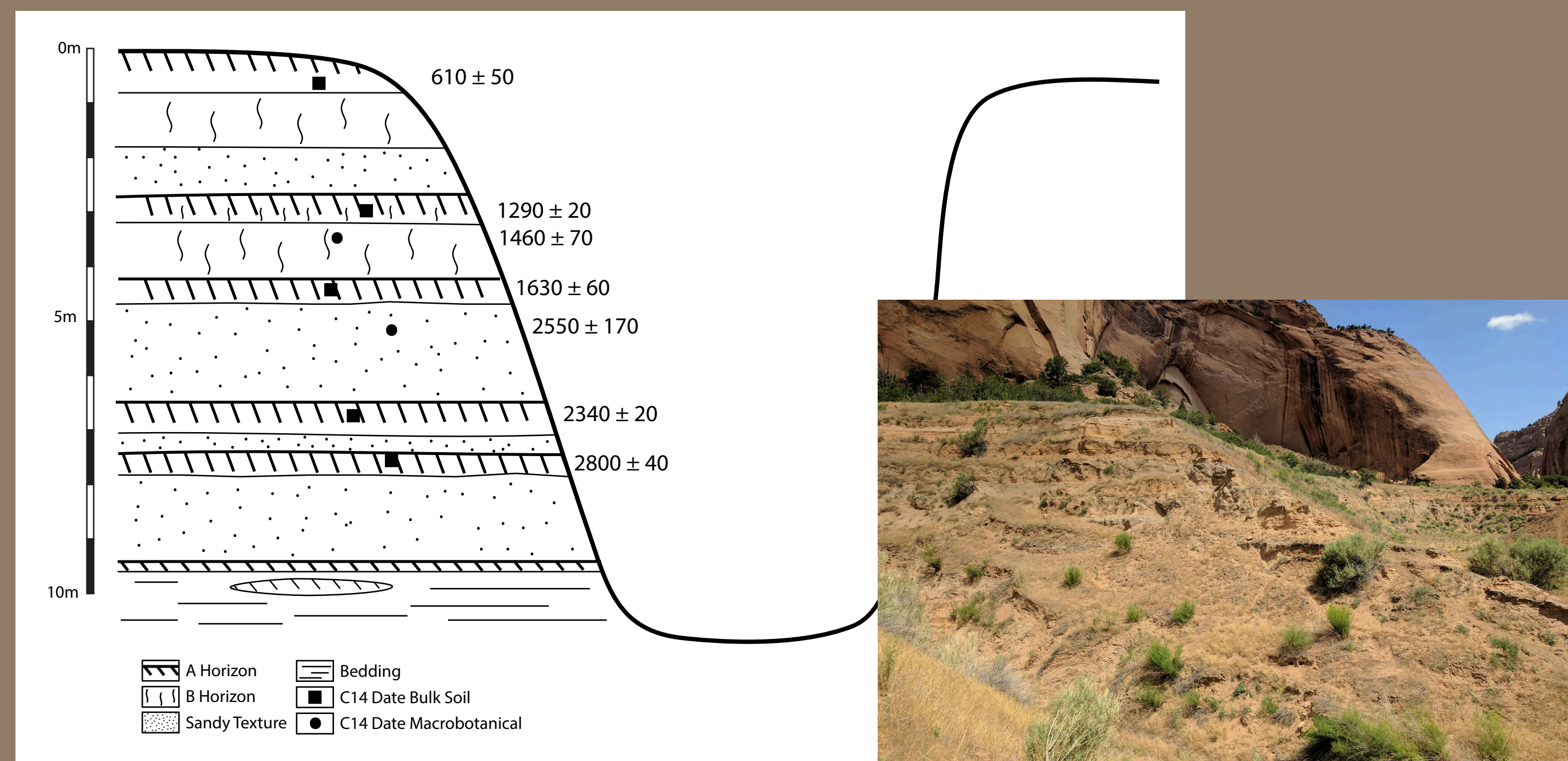


Diagram and photo of terrace sampled in this study. All dates listed as cal yr BP.

Correlation with previous work



Haynes sampled the exposure to the left of this talus slope; it is still unclear how the recorded dates relate to the debris flow and soils here.

- Buried sequence of five weakly developed soil horizons
 - Soils show dark, organic-matter rich A-horizons that are poorly developed, over C horizons or B horizons with minimal soil development
 - Radiocarbon dates are consistent with in-situ material (not likely younger organic matter)
 - Deposition between >2800 BP to <600 BP (850 B.C. to A.D. 1340)
- Previous work by Haynes (2006) described a debris flow across the canyon, and reported a few dates from both terraces, on either side of the canyon. His dates from the older terrace are between 3744±38 and 3700±30, and dates from the younger terrace are between 231±32 to 104±63. These fall within previous ranges for both terraces., though offer little to understand the depositional sequence.
- More work is needed to determine how the debris flow corresponds to dated deposits: Haynes dated deposits to the left of a talus slope that covers any contact between a sequence of soils over the debris flow, and the younger terrace.

Discussion

- Dates presented here for the deposition of the terrace in front of Keet Seel Pueblo agree with earlier work that dates the deposition of the Tsegi-age terrace in the Tsegi Canyon system to >5000-600 cal yr BP (3000 B.C.-A.D. 1350) followed by widespread downcutting between 1300-1340 A.D.
 - The timing of downcutting in Keet Seel Canyon was consistent with that of the greater Tsegi Canyon system, and that the landscape in Keet Seel Canyon was a stable floodplain in front of the Keet Seel Pueblo until that time.
 - Soil geomorphic data demonstrates that the terrace formed by rapid deposition of alluvial sediment
- followed by brief periods of stability and weak soil formation. The sequence of buried soils is very similar to a sequence of buried soils that have been documented on similar-age alluvial terraces on Black Mesa (E. Karlstrom 1988), further supporting models of a regional, climatic control on terrace deposition.
- A maize sample dated to 1460±70 cal BP presents additional evidence for very early use of the canyon during the Basketmaker period (1000 B.C.- A.D. 500). Sites of Basketmaker age are known for the region, but have only been dated in few locations in Keet Seel Canyon.

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