

## Research Question

The purpose of this study was to decipher the geomorphic history, origin and processes of the entrenched meanders of Halls Creek Narrows incised into the sloping limb of the Waterpocket Fold monocline and propose a hypothesis for how this unique geomorphic feature was formed.

## Introduction

Halls Creek Narrows is a meandering slot canyon incised into the sloping limb of the Waterpocket Fold monocline.

Halls Creek:

- Is a strike valley drainage system developed along the Waterpocket Fold
- Presently follows the Carmel / Navajo Fm contact
- Departs from the strike valley and flows for ~2km through the entrenched meanders of Halls Creek Narrows.



Figure 1. Aerial view of an entrenched meander, Halls Creek Narrows. (Photo by F. Lanting)

Figure 2. Inside Halls Creek Narrows. (Photo by R. Kenny)

## Background

- Waterpocket Fold produced from Laramide uplift of the Colorado Plateau
- Overlying, flat-lying strata were draped along the fold and dip sharply down along the fold axis
- Conjugate jointing in the Navajo and the other lithologic units display well-documented internal Riedel shear structure geometries (Ahlgren et al, 2000; Roznovsky, 2001)
- Jurassic stratigraphy in the study area (see Fig. 3)
- Entrenched meanders are common throughout Colorado Plateau with many flowing against bedrock dip (Harden, 1990)
- Mass wasting and debris flow deposits are abundant along Halls Creek (Driscoll, 2012)

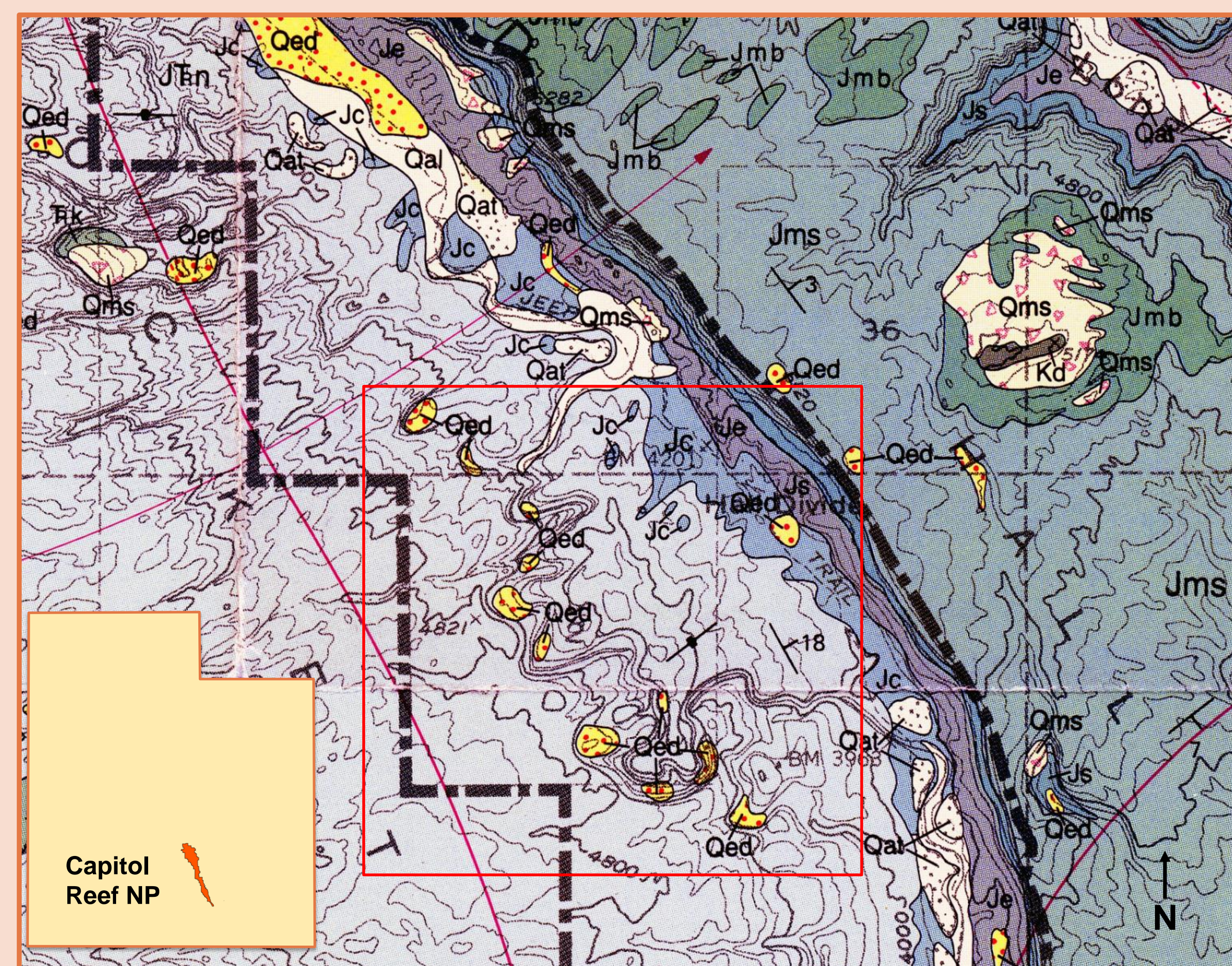


Figure 3. Geologic map of study area, Deer Creek Quadrangle, Capitol Reef National Park, UT (Driscoll, 2012).



Figure 4. Digital elevation model with draped hillshade.



Figure 5. Looking south along Halls Creek strike valley.



Figure 6. The entrance to the Narrows, looking south; note the greater than 90 degree bend that Halls Creek takes (top) and elevation profile A-B (bottom)

## Hypotheses

- **Superposed meanders:**
  - Inherited meanders from higher, now eroded alluvial surfaces were superimposed on the underlying strata.
  - Occur where the fold limb has a gentler dip
  - Possibly set up in the Pleistocene when pluvial conditions would have increased rates of incision
  - Possible controlling variables of incised meanders include channel gradient, drainage area, average bedrock erodibility, and bedrock structure (Harden, 1990).
  - Because incised meanders are clearly able to modify their geometry in response to changes in bedrock erodibility, the correlations between the conjugate jointing resulting from deformation, tributary drainage outlets, and the preferential erosion/channel formation along these fractures can thus dovetail with the idea of superposition.
- **And mass wasting diverted creek up-dip:**
  - There is evidence of colluvial deposits in divide, but whether this was sufficient to divert the creek up-dip into Narrows is uncertain.
- **Or the creek was diverted because it encountered more-resistant bedrock:**
  - Some change in lithology could be sufficient to direct the creek up-dip into the Narrows
- **Or the creek never reached the divide and has maintained its course through the Narrows since incision began:**
  - Perhaps because of the gentler dip at this location on monocline, the creek never migrated further down dip at the Narrows, and other geomorphic processes account for the erosion of strike valley through Halls Divide

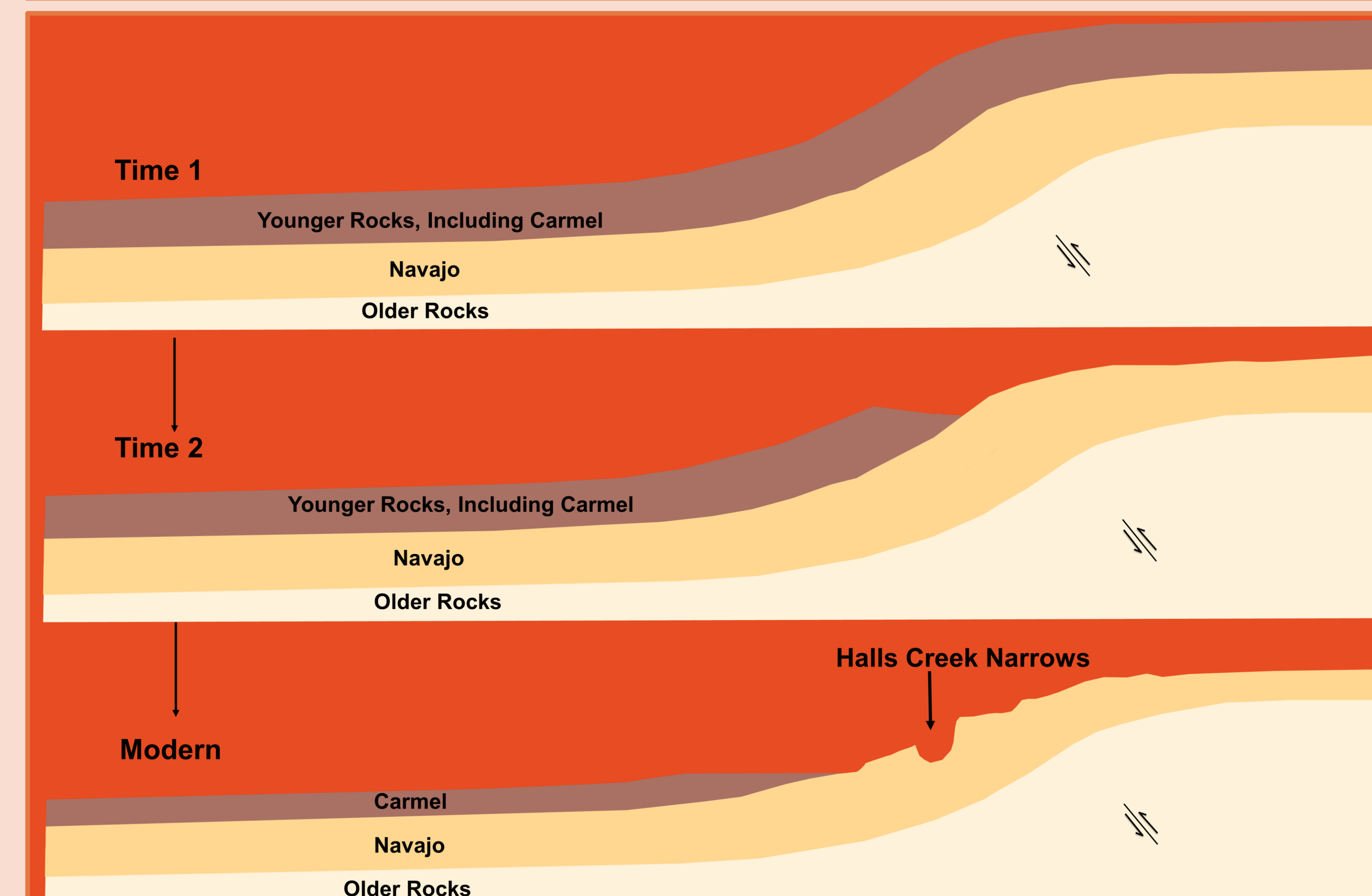


Figure 7. Development of Halls Creek strike valley and Halls Creek Narrows over time; cross-section, looking south.

## Take Away Points

- Halls Creek Narrows has a multi-genetic geomorphic history:
- Superposition and entrenchment of meanders with structural and lithological controls
  - Diversion of Halls Creek into the sloping limb of Waterpocket Fold

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