The Colorado Plateau region experienced 500 My of subsidence and deposition below sea level as part of its geological history. Existing constraints include:

1. Late Tertiary regional extension (post 30 Ma) associated with the demise of Laramide flat slab, partial removal of plateau lithosphere & replacement with hot asthenosphere (Spencer, 1996).
2. Mid-Tertiary buoyancy addition (40-30 Ma) contributing to the region's thermal evolution.

The clumped isotope thermometer independently measures the temperature of water from which the carbonate grew, potentially enabling the effects of elevation, climate, and seasonality to be distinguished. This method is unique paleo-elevation information and can be related to the sample's modeled thermal history following the position of inner gorge.

Fossils are vulnerable to resetting, fine-grained matrix (37°C) of carbonates within the plausible Earth-surface range, suggesting that though fossils are vulnerable to resetting, high-quality climatic information is preserved.

Temperature bands indicate growth of ostracods and planktonic foraminifera. Epoxy bands indicate growth of gastropods and barnacles. Most samples represent reasonable Earth surface permeability modification due to calcite growth during diagenesis.

Modern surface water temperatures depend strongly on elevation, but the relationship is complicated in temperate regions like the Colorado Plateau. Modern surface water temperatures range:

- Lake Mead: 1190-1200 m, 1900 m modern elevation: 1900 m, tropical lakes (proxy for hot, humid Mid-Miocene climate) 6-6.5 Ma, 30°C.
- Edge of the Colorado Plateau area lakes: 1198-1216 yr, 2.0°C.
- Walker, Stillwater, Rim Gravels: 34°C.
- Basin & Range: 29°C.
- Salton Sea: 1198-1216 yr, 2.0°C.

What materials potentially access paleo-elevation information?

- Apatite samples from arkose & volcanic cobble (1882 m).
- Apatite samples from Paleozoic-clast conglomerate (1850 m).
- Granitic cobble (1850 m).
- Limestone beds (15 cm to 0.5 cm wide) within 250 m of contact.
- Horse Spring Fm (6 Ma).
- Colorado River sediments (48-55 Ma).
- Westwater Fm (14 Ma).
- Bouse Fm (37C).
- Bidahochi Fm (~1790 m), Hualapai, ~6 Ma (tufa, marl).