**LANDSCAPE RESPONSES TO EARTHQUAKE-INDUCED LIQUEFACTION IN AN ANCIENT DESERT DUNE ENVIRONMENT: SOFT-SEDIMENT DEFORMATION FEATURES OF THE EARLY JURASSIC NAVAJO SANDSTONE**

Modern environmental changes can provide insights into the effects of ancient events. For example, modern-day liquefaction events can offer analogues to past events. The following figures illustrate examples of liquefaction and its effects on modern sand dunes, which can inform interpretations of ancient deposits.

### 1. Slope Failure

Buckled Foreland, Big Coyote Buttes, Arizona

Closed Basin, West Canyon, Arizona

### 2. Subsidence

Interdune Subsidence, Glen Canyon Dam, Arizona

Subsidence Basins, Glen Canyon Dam, Arizona

### 3. Sediment Eruption

Interdune Subsidence, Glen Canyon Dam, Arizona

Large-Scale Sediment Eruption, Glen Canyon Dam, Arizona

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**Abstract**

Modern environments provide many insights into interpreting ancient deposits, but ancient deposits themselves preserve records of a broader range of environmental conditions and event characteristics than are currently observable on Earth. In contrast to the paucity of earthquake records from modern dune fields, for example, earthquake-induced liquefaction events are represented in the stratigraphic architecture of the Early Jurassic Navajo Sandstone, the Colorado Plateau. A minority percentage of these preserved distinct indicators of topographic changes; these changes occur as a result of seismic shaking, structural failure of subsurface sediments, and hydraulic changes driven by the equilibrium of transient fluid pressures. They include minor dune slip ramps, as commonly occur in modern dunes in wet climates, and sand boils similar to those documented from clay-cored sand dunes in various modern earthquake zones, but they range into much more extensive features, including. Substrate-scale dune collapse complexes; rapid fall zones, 20 m depressions formed by surface subsidence; and voluminous sediment outflows.

The contrast in the richness of this ancient record and the sparse documentation from modern dune environments certainly reflects differing environmental conditions; however, differences in the observational perspective—both physical and temporal—available on modern dune versus ancient deposits may also be important. Perhaps a broader range of features is yet to be discovered in the accumulation of cross-sections available from modern dune fields—and from the field's emerging documentation of extra-terrestrial settings. In support of this continuing exploration, a surveying of Navajo Sandstone outcrop architectures, representing earthquake-induced modification of desert sand dune landscapes, is presented here.

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**References**

