Two early basal-amniote fossil trackways in eolian dune sandstone in the Pennsylvanian Manakacha Formation in the Supai Group of the Grand Canyon and multiple reptile trackways in the Permian Hermit Shale show that these formations cannot have been deposited by Noah's flood

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Introduction

Basal-amniotes are very early members of an evolutionary tree of four-legged animals (reptiles) that reproduce by eggs, like modern-day turtles (Rowland et al., 2020). They are among the first animals that evolved from amphibians and which moved from wet, swampy areas and began to colonize continental interiors as early as 314 million years ago.

Geologic relationships of the Manakacha Formation

The trackways were found near the Bright Angel Trail in the Grand Canyon (**Figure 1**).

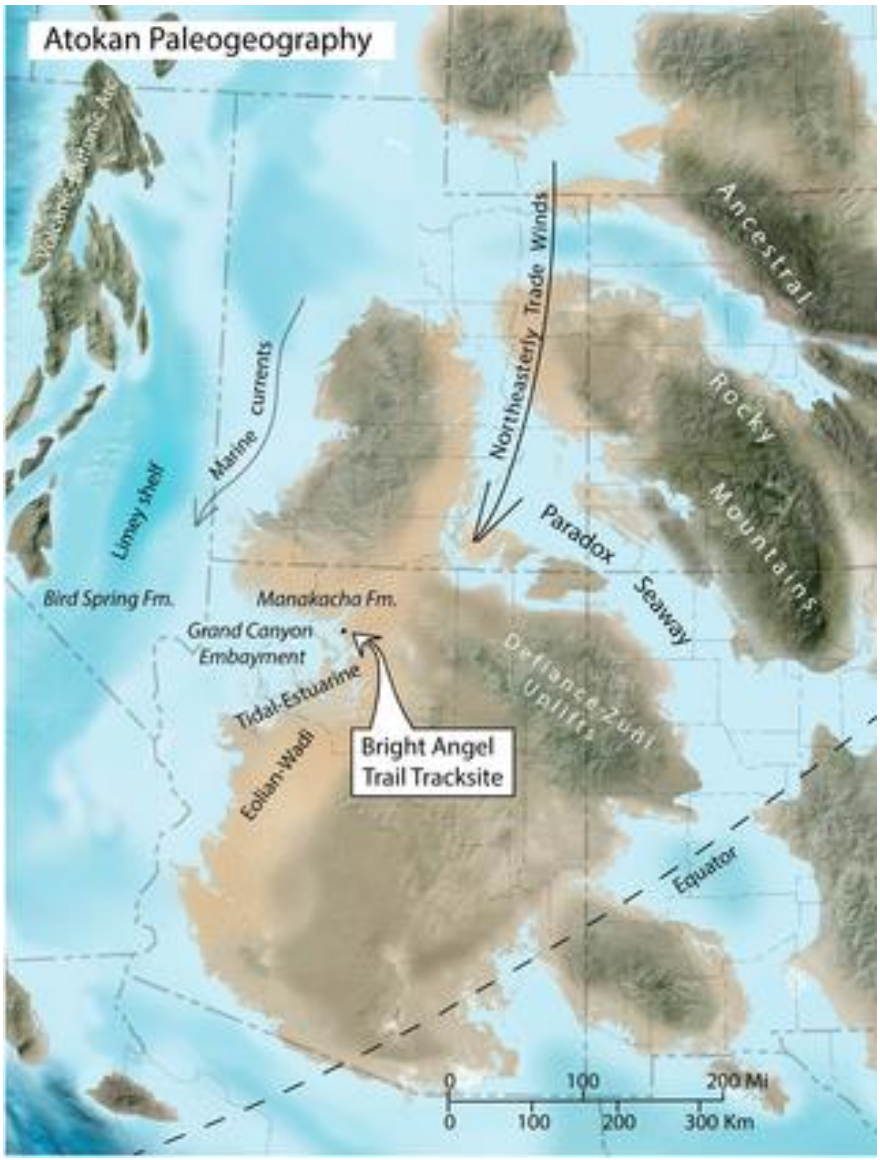

Figure 1. Location of two trackways near the Bright Angel Trail in the Grand Canyon, general environmental conditions for trade winds blowing from the northeast to the southwest, and areal distribution of the Pennsylvanian Supai Group of sandstones that contains the trackways in the Manakacha Formation (Rowland et al., 2020).

The trackways occur in the Manakacha Formation (**Figure 2**) which is part of the Pennsylvanian Supai Group that is exposed in the Grand Canyon (**Figures 3** and **4**).

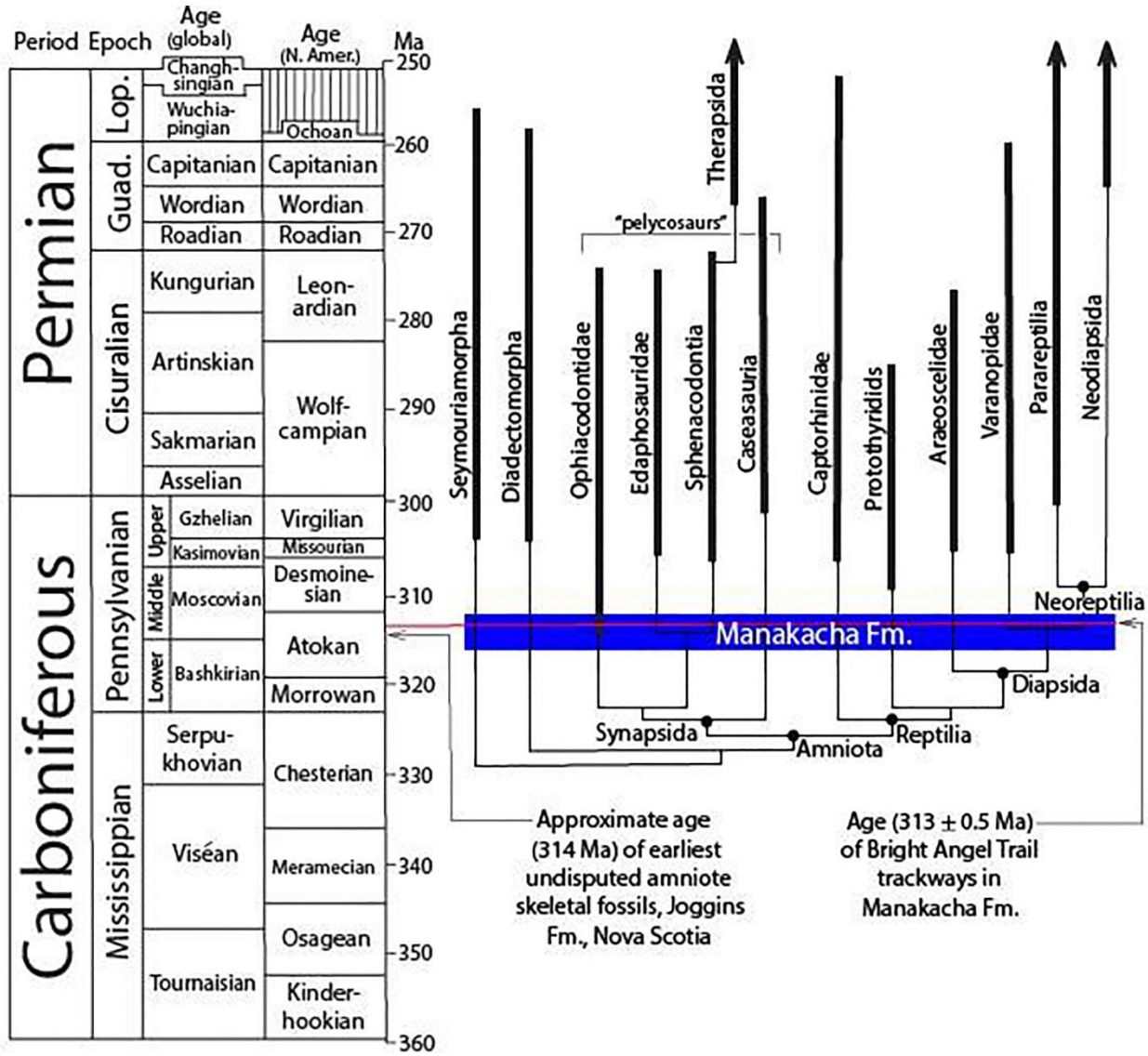

Figure 2. Stratigraphic position of the 313 +/- 0.5 million year old Manakacha Formation and of the early *Amniota* at the bottom of the evolutionary tree (Rowland et al., 2020).

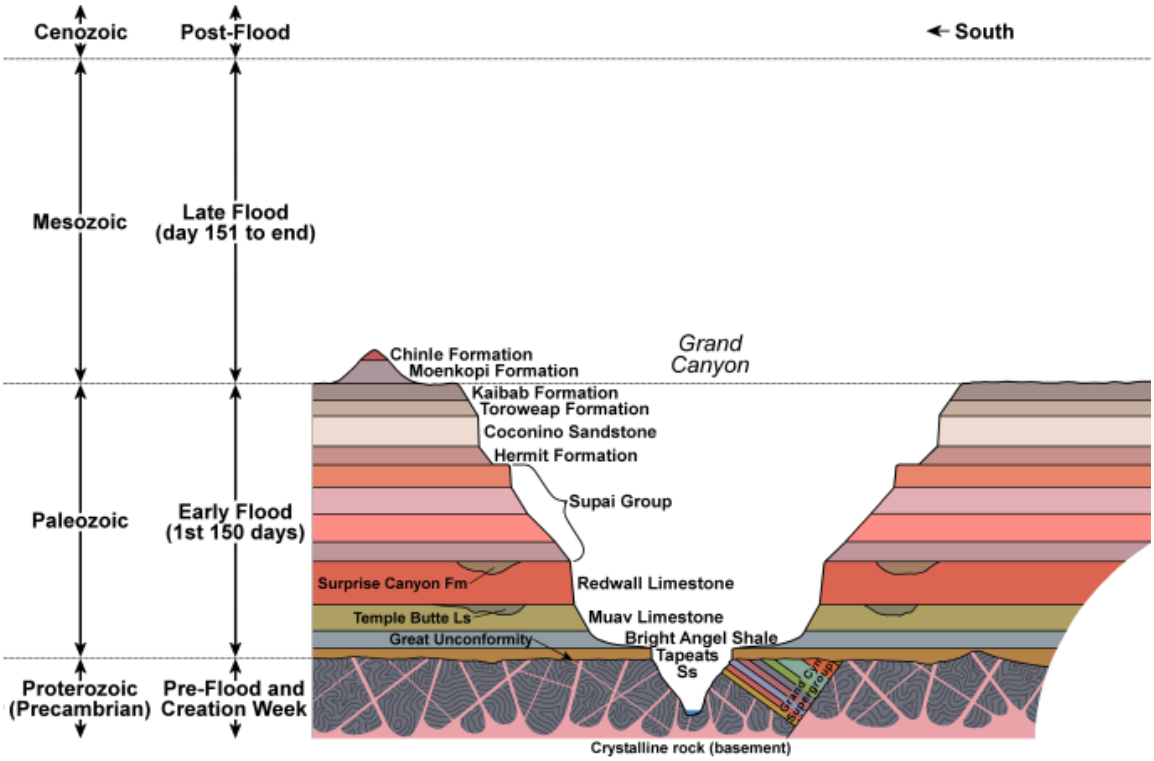

Figure 3. Stratigraphic position of the Supai Group of Pennsylvanian age (four middle orange and lavender layers) which are said to have been deposited in the first 150 days of Noah's flood by young-Earth creationists in their flood geology model and in which the Manakacha Formation occurs. Source of image: Hill et al., 2016.

Figure 4. The Supai Group of red sandstone layers (lower part of image) overlain by the Hermit Shale (reddish brown layers) and the Coconino Sandstone (middle white layer) and the Kaibab Limestone (top white layer). Source of photo: James St. John, Ohio State University, Newark.

The Manakacha Formation consists of coastal sand dunes which were occasionally overridden by muds washed in by tides or wadi flooding from the sea. An artist's conception (**Figure 5**) shows an amniote climbing a dune by moving up laterally at an angle of about 20 degrees to reduce the steepness of the dune face.

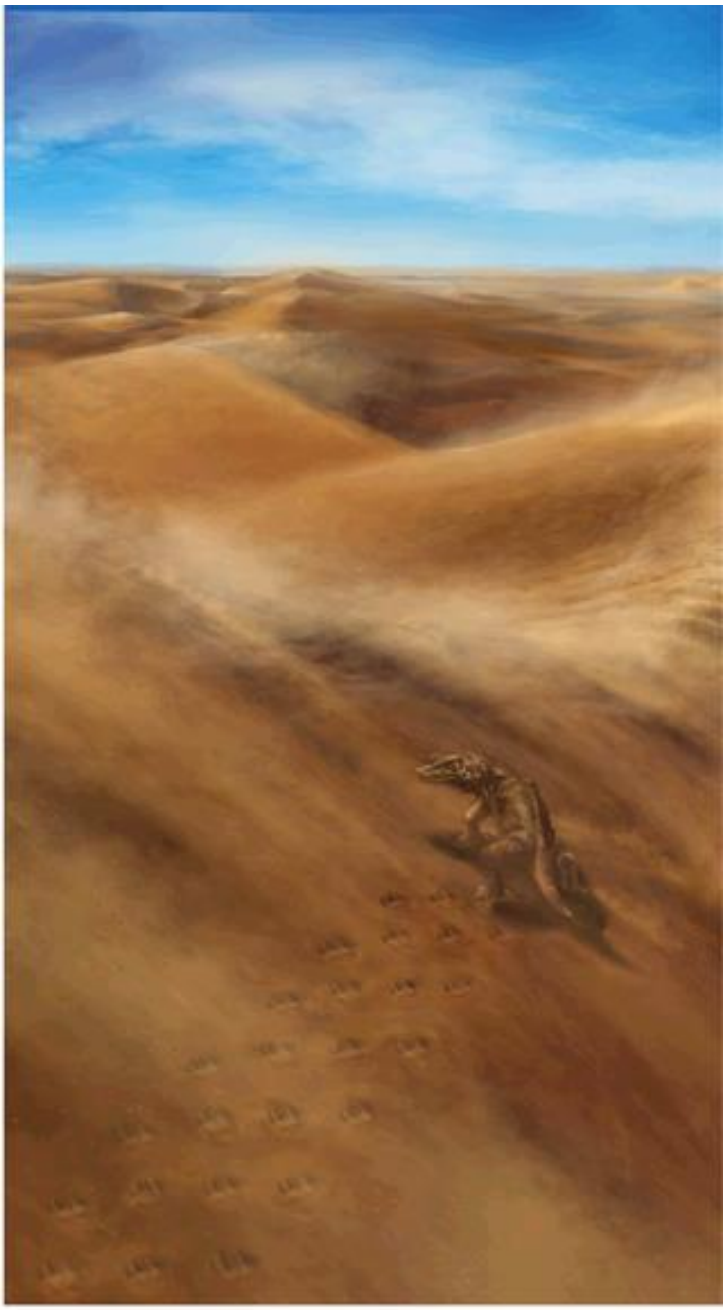

Figure 5. Artist conception of an amniote climbing laterally along the face of a dune and leaving a trackway (Rowland et al., 2020).

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Figure 6 shows the stratigraphy of the rock exposure where the two trackways were found.

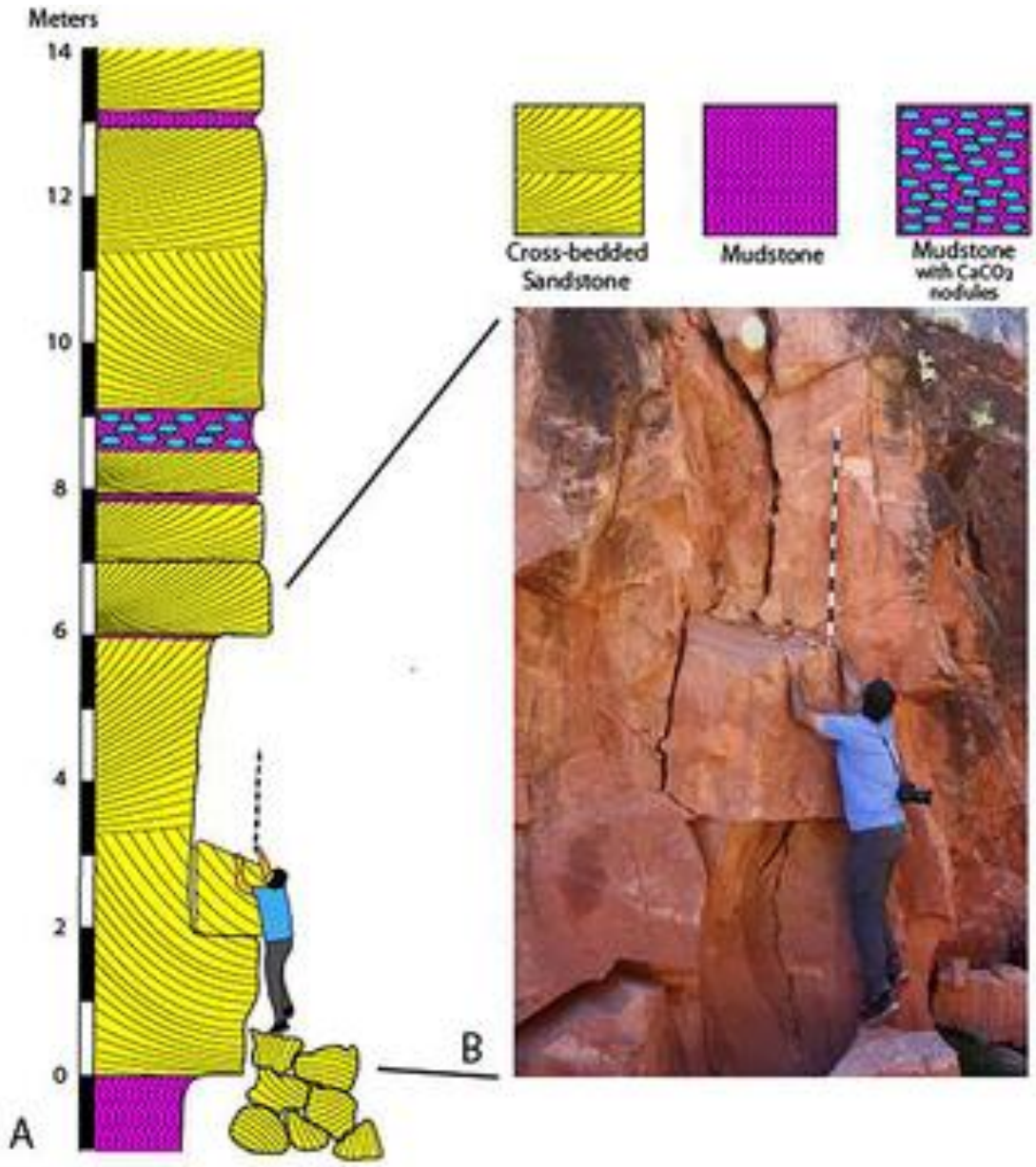

Figure 6. Stratigraphic column and photograph of a geologist examining the rock exposure where the two trackways were found. Measuring stick shows 10 cm intervals (Rowland et al., 2020).

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Images of the two trackways are shown in **Figures 7** and **8**.

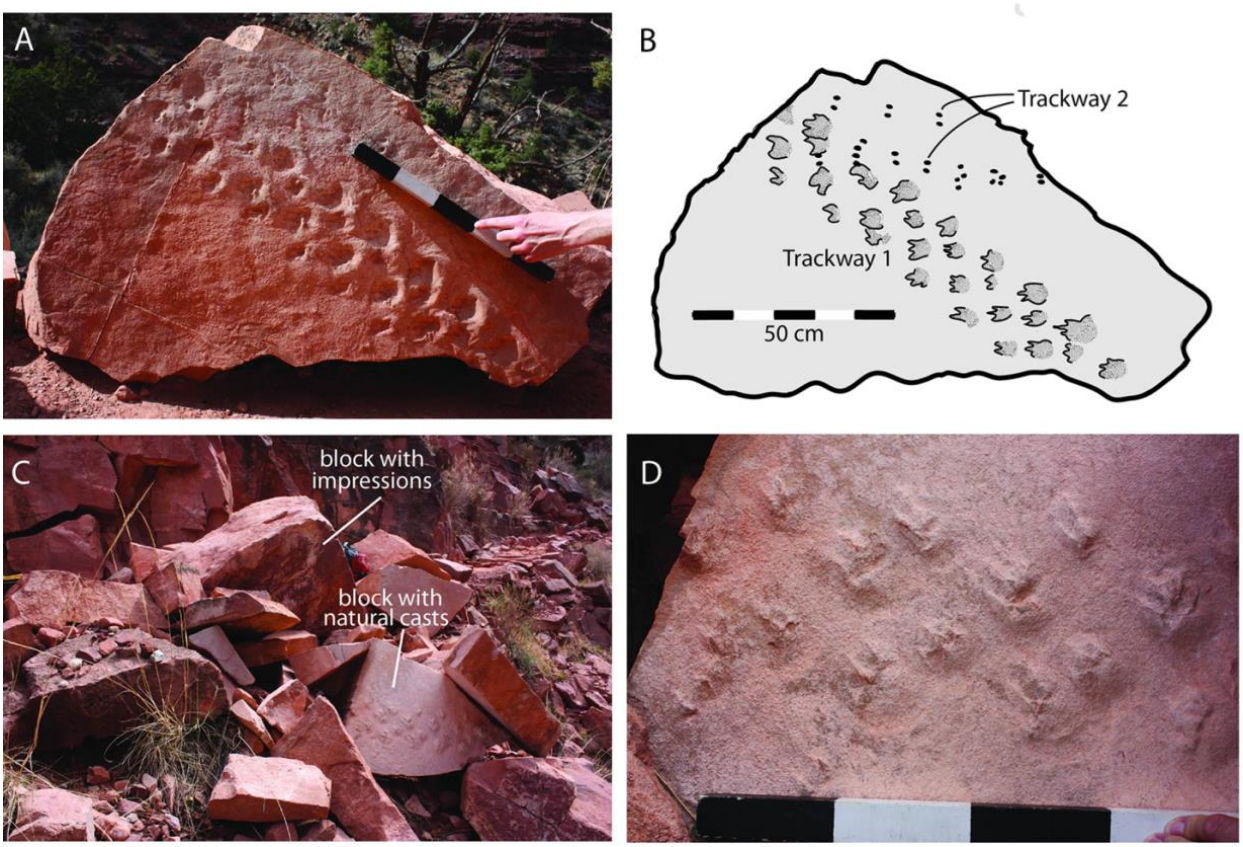

Figure 7. Images of two trackways in the Manakacha Formation (Rowland et al., 2020).

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Figure 8. Trackway of an amniote in the Manakacha Formation (Rowland et al., 2020).

One trackway shows deeper impressions than the other that shows only claw marks. Both show a distinctive, side-ways, drifting, foot-pattern in which the animal moved both the hind leg and fore leg forward on its same side in lockstep positions before moving the hind leg and fore leg on the other side forward.

Opposition to young-Earth creationist flood geology model in the Manakacha Formation

The occurrence of these two trackways presents evidence that this Manakacha Formation in the Supai Group of sandstones in the Grand Canyon ***cannot*** have been deposited during Noah's Flood. The young-Earth creationist flood model proposes that these sandstone layers, 600-700 ft (180-210 m) thick, were rapidly deposited in less than a month's time by water moving at tsunami speeds. But at such speeds, the foot prints would have been wiped out by fast-moving water and sand, and

there is no evidence that the animal was swimming in water while moving diagonally up a dune face or running to escape the flood waters.

Microscopic thin sections (Rowland et al., 2020) show that the Manakacha Formation contains tiny grains of magnetite or ilmenite that would oxidize to red hematite which would make the exposed sandstone layers in the Grand Canyon in the Supai Group have a red color (**Figure 4**). The occurrence of hematite indicates that these sandstone layers were deposited exposed to oxygen in the air and not underwater as would be the case for the young-Earth creationist flood geology model.

Opposition to young-Earth creationist flood geology model in the Hermit Shale

The Hermit Shale is not strictly composed of shale but also contains siltstones and sandstones **(Figure 9)**, and it also contains similar footprints of reptiles of different younger species. These are reported near the Hermit Trail where the Hermit Shale overlies the Supai Group sandstones in the Supai Group and occurs below the Coconino Sandstone (**Figure 4** and **9**) (Gilman, 1926, 1927).

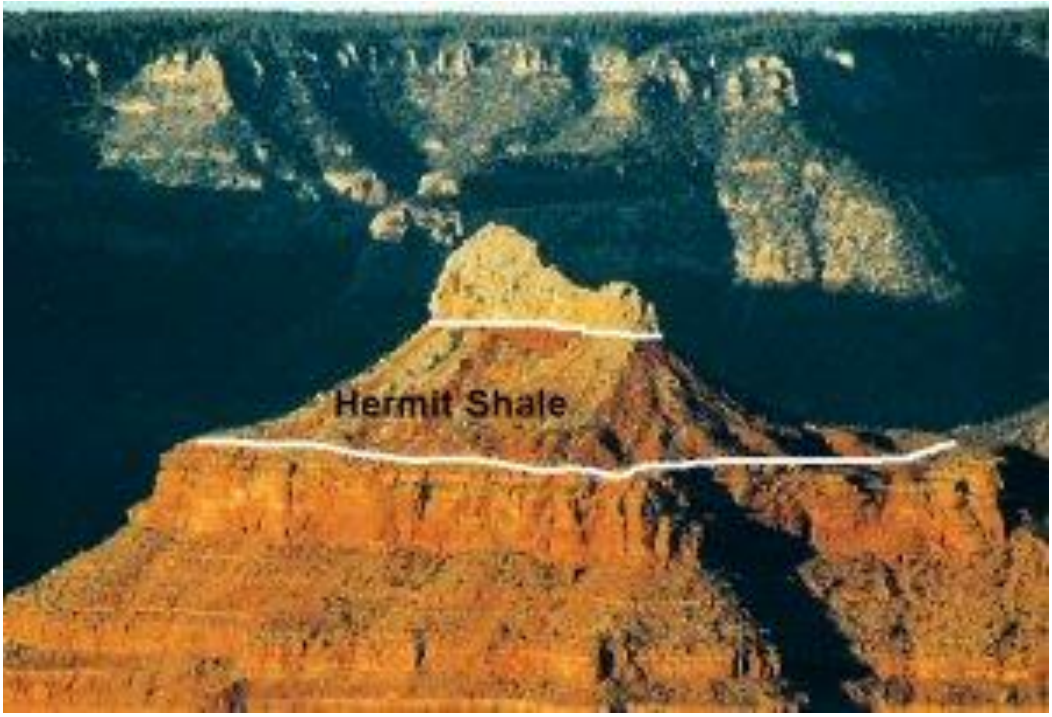

Figure 9. Photo of Isis Temple showing the Hermit Shale overlying the Supai Group sandstones and underlying the Coconino Sandstone. Source: Google search Hermit Shale raindrops.

In the Grand Canyon, the Hermit Shale is 100 ft (30 m) thick in the eastern part of the Grand Canyon but thickens to as much as 900 feet (270 m) thick outside the canyon. Because these footprints are found at many different levels in the Hermit Shale, this extended positioning up the stratigraphic column of the footprints is also evidence that both the reptiles in the Manakacha Sandstone and the Hermit Shale ***cannot*** result from burial of the reptiles during Noah's flood. How can these reptiles, who are land creatures and who need oxygen, be walking underwater in such a short time (likely less than a month) while the muds are being deposited in the Hermit Shale in the same locality at higher and higher levels of the layers of mud in the young-Earth creationist flood geology model? Also, wouldn't the rushing flood waters destroy these foot prints in mud that must have been deposited by slow settling of clay particles in nearly still water?

Furthermore, the Hermit Shale contains mud cracks and raindrop imprints that prove that the Hermit Shale layers were often exposed to air, drying and shrinking the muds, as well as allowing raindrops to fall on exposed muds that could not have happened if its layers were deposited underwater by Noah's flood (Google search: Hermit Shale raindrops). Also, its red color, like the red sandstones in the Supai Group, is due to the oxidation of tiny grains of magnetite and ilmenite to hematite that were exposed to air containing oxygen. Moreover, many types of worm burrows occur in the layers in the Hermit Shale, and the animals that made these burrows had to have been buried periodically by storm deposited muds that would have cut off their oxygen supply and killed them so that new colonies of such creatures would have to start over again. Such repeated recolonization in many layers of the Hermit Shale on top of each other, which occur in its 100 to 900 foot thicknesses, could not have happened in the short time of less than a month in the young-Earth creationist flood geology model. Burrowing animals do not reproduce or recolonize that fast.

References

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Hill, C., et al., (editors), 2016. The Grand Canyon − Monument to an ancient Earth – Can Noah's flood explain the Grand Canyon? *Kregel Publications*, 239 p.

Rowland, S. M., Caputo, M. V., and Jensen, Z. A., 2020, Early adaptation to eolian sand dunes by basal amniotes is documented in two Pennsylvania Grand Canyon Trackways, *PLOS ONE*, v. 15, issue 8.