Transgression/Regression in the Grand Canyon

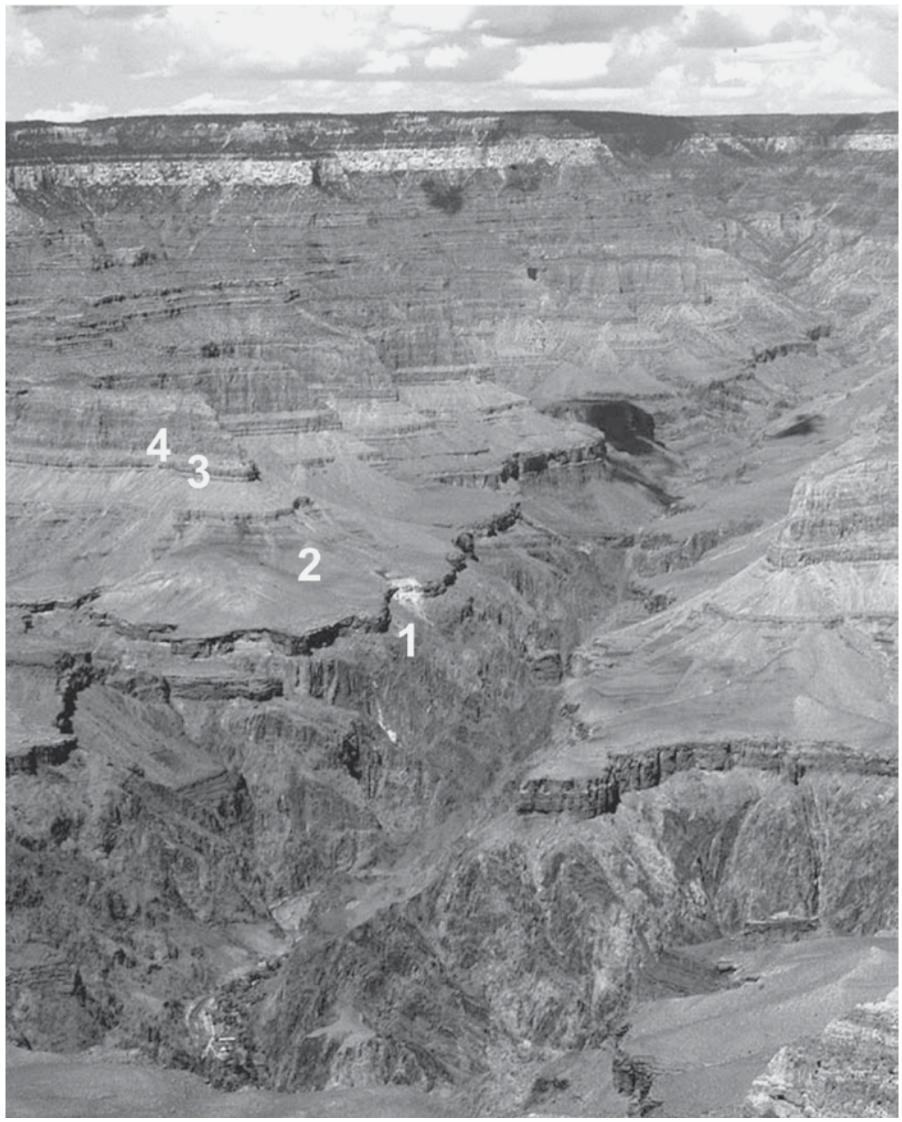

Figure 1. Overview of Grand Canyon showing Cambrian strata in context. 1 = Vishnu Schist, 2 = Tapeats Sandstone, 3 = Bright Angel Shale, 4 = Mauve Limestone. http://thevibe.socialvibe.com/wp-content/uploads/2009/01/arizona-grand-canyon-vista.jpg (accessed December 2010).

One of the most difficult problems in addressing questions is overcoming preconceived notions. This is true of the biologist who considers only evolutionary mechanisms, the sedimentologist who considers only present-day rates of erosion and deposition, or the Flood geologist who adheres only to one Flood model. Far too often, the most difficult part of dealing with any data is to let it speak for itself. This problem is illustrated by the relationship between the Tapeats Sandstone (Barnhart, 2012) and the transgression/regression of the Flood.

The Tapeats is a widespread, flat-lying sandstone deposited on the surface of the angular Great Unconformity in Arizona, and is thus the lowermost Paleozoic stratum in the Grand Canyon sequence (Figure 1). McKee (1945) proposed that it was deposited by a transgressive sea moving inland from the southwest, with sand being brought to the marine front by rivers flowing from the northeast. This basic concept was reiterated by Hereford (1977) and Rose (2006). Berthault (2004) took a slightly different view when he suggested an erosional transgressive invasion of water from the southwest, followed by deposition by the regressing current (analogous to a wave running up the shoreline and then receding).

Many Flood geologists think this transgression marks the onset of the Flood. But we must be careful to assess the evidence. What about the Great Unconformity? This surface was formed by a major erosional event across the region. Barnhart (2011b) illustrates that it had to be a very rapid event, followed quickly by deposition of the basal Tapeats Sandstone. Another datum is the existence of small monadnocks on an otherwise nearly perfect peneplain (Rose, 2006). These occur in a linear trend from central Arizona through the eastern Grand Canyon (see Figure 2 of

Barnhart, 2012). They were attributed to the upthrusting of the Shinumo Quartzite of the Unkar Group by Hendricks and Stevenson (2003) because the quartzite is more resistant than the crystalline basement. But since some of the monadnocks are composed of other lithologies, erosional resistance may have had little to do with their formation. Some are composed of the soft Hakatai Shale, Garnet area (see figure 23 of Barnhart, 2012); the Vishnu Schist with intrusive Zoroaster Granite, east of Pipe Creek (see figure 7 of McKee, 1945); and Zoroaster Granite , Zoroaster Canyon (see figure 3 of Rose, 2006). Furthermore, Oard (2011, p. 113) noted that equal erosion of hard and soft material was a common characteristic of large planation surfaces: "such a feature requires a strong current of water." Unfortunately, the monadnocks below the Tapeats provide no information on paleocurrent direction of this "strong current of water."

However, evidence from the overlying Tapeats is abundant (Barnhart, 2012). The current depositing the Tapeats was from the northeast (Figure 2); see also Hereford (1977; see figure 6). Mathematical calculations—based on clast size, bedforms, and current velocities—suggest a flow depth of from less than one meter up to about 2.3 meters (Barnhart, 2012) and a paleoslope of 0.0014 to 0.0025, that is, only 0.08 degrees to 0.14 degrees, or essentially a flat surface. Given the widespread occurrence of the Tapeats, we must explain how a very shallow current over a flat surface over a large area could have maintained its energy. It is possible that it may have been a hyperpycnal flow, a submerged turbidity current (Lamb et al., 2010), gaining kinetic energy by gravity flow down from nearby highlands. The problem lies in the absence of evidence for the proposed highlands. The monadnocks are too low and too scattered to provide such energy. They did not even pose a substantial barrier to deflect the path of the current (see figure 3 of Barnhart, 2012).

With no evidence of adjacent highlands, the evidence of flow direction is found only in the paleocurrent indicators of the Tapeats. We cannot be sure of the direction of the current that eroded the basement or the origin of the body of water that supplied the sand. While it might be convenient to believe the Tapeats sand was deposited from the northeast into a rising body of water transgressing from the southwest, or the current transgressing from the southwest reversed and deposited the sand, or the eroding current was the leading edge of the Flood current transgressing from the northeast that later deposited the sand, these are all speculative. The only evidence now recognized is that the Tapeats sand was transported in a current from the northeast over a large, flat plain in very shallow, yet energetic, water. It might have coincided with a transgression or a regression of the sea, but that too is speculation.

This is one of the problems facing geological interpretation. We did not observe these past events; unlike modern situations, like Hurricane Katrina in New Orleans (Barnhart, 2011b), where depositional parameters were observed and could be related directly to sedimentary deposits, that information is not yet available for the sequence of events forming the Great Unconformity and the Tapeats Sandstone.

Models are good, but we must be careful to remember that they are only models. A correct model can lead to fruitful discoveries, but an incorrect model can lead in the wrong direction and obscure valid data, hindering research. Accepted wisdom is not always correct; catastrophism was rejected a priori by uniformitarians for much of the

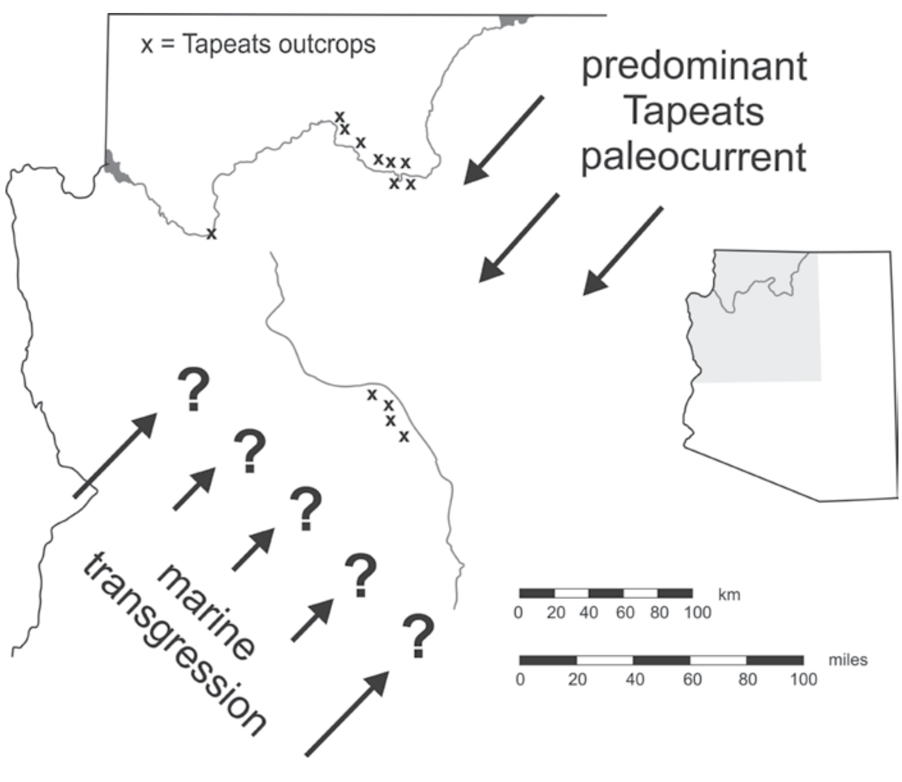

Figure 2. Known paleocurrent direction for Tapeats Sandstone and possible direction of marine transgression from southwest. X = selected Tapeats outcrops. Modified from Barnhart (2012).

history of geology. We must be careful not to repeat the errors of those we seek to correct.

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