

Appendix 20

Poorly Known Origin of Flared Slopes and Tafoni

Inselbergs sometimes have flared slopes and tafoni. They are rather enigmatic. It is difficult to know whether they are from erosion that happened during the Genesis Flood or whether they are from post-Flood weathering.

Flared Slopes

A flared slope is an unusual concave overhang generally seen at the base of some inselbergs.¹ They are impressively developed on the inselbergs of Eyre Peninsula, South Australia.² Twidale noticed them on Ayers Rock.³ They are also found at the “Silent City of Rocks” in south-central Idaho (Figure A20.1). Some inselbergs have two flares, one at the base and another higher up.⁴ Horizontal benches or notches, similar to flared slopes, are also occasionally seen on inselbergs.² For example, mid-slope benches on the inselbergs of the Bohemian Massif, Central Europe, are at nearly the same elevation forming a ribbon-like feature.⁵



Figure A20.1. Flared slope from Camp Rock, “Silent City of Rocks,” south-central Idaho.

¹ Twidale, C.R., 1982. *Granite Landforms*, Elsevier Scientific Publishing Company, New York, NY, pp. 243–258.

² Twidale, C.R. and J.A. Bourne, 1975. Episodic exposure of inselbergs. *GSA Bulletin* 86:1,473–1,481.

³ Twidale, C.R., 1978. On the origin of Ayers Rock, Central Australia. *Zeitschrift für Geomorphologie N. F.* 31:177–206.

⁴ Twidale, Ref. 1, pp. 54, 145.

⁵ Migoń, P., 1997. The geological control, origin and significance of inselbergs in the Sudetes, NE Bohemian Massif, Central Europe. *Zeitschrift für Geomorphologie N.F.* 41:45–66.

The cause of flared slopes is not well known. Twidale postulated flared slopes and benches formed from weathering in the sediments surrounding the inselberg.⁶ Twidale pointed to the discovery in South Australia of a small, supposedly developing flared slope just below the surface of the sediments that surrounds two inselbergs. If this origination were true, why are there very few flared slopes above the base, since the rock that once surrounded the bornhardt has slowly weathered downward, according to uniformitarian ideas? Instead, it appears the flared slopes are evidence for the rapid formation of inselbergs and a lack of the millions of years of time with the basal flares being post-Flood weathering features. Another unlikely possibility is that the flared slope could be a very late Flood feature where the last bit of water erosion took place at the base of the inselberg.

Tafoni

A more common feature associated with inselbergs is tafoni which are relatively shallow caverns and hollows. They are partially enclosed through the preservation of a visor or overhang on the outside surface of the inselberg (Figure A20.2). Tafoni are a weathering feature of granular rocks and are commonly found in granitic inselbergs.⁷ Tafoni are not unique to inselbergs and are found throughout the world from deserts to coastal environments.⁸

The intriguing aspect of tafoni is that they are often horizontal and found on steep slopes, especially at the base of the inselberg.⁹ Sometimes flared slopes merge with tafoni,^{2,10} suggesting a common origin. Tafoni are sometimes case-hardened by a chemical coating that makes its surface resistant to further weathering.⁷

Many of the tafoni on inselbergs do not appear to be deepening today,¹¹ partly because of case hardening. So, it is questionable whether they are still developing. Other researchers, however, claim tafoni deepening is continuing today¹² Emil Silvestru, a creation science expert on karst, suggests they could be formed in rock that allows water to be locally absorbed, then weakened by freeze-thaw weathering, and abraded by wind.¹³

The origin of tafoni is another geomorphological enigma.^{12,14,15} And as a result, there are many hypotheses. One hypothesis submits tafoni were formed from the flaking off of small sheets of granite up to 0.6 inch (1 to 15 mm) thick by way of moisture fluctuations.¹⁶ Some researchers believe tafoni formed along sub-horizontal joints or other rock weaknesses that are

⁶ Twidale, Ref. 1, pp. 247–256.

⁷ Twidale, Ref. 1, pp. 280–300.

⁸ Huinink, H.P., L. Pel, and K. Kopinga, 2004. Simulating the growth of tafoni. *Earth Surface Processes and Landforms* 29:1,225–1,233.

⁹ Thomas, M.F., 1978. The study of inselbergs. *Zeitschrift für Geomorphologie N.F.* 31:17.

¹⁰ Twidale, Ref. 1, p. 291.

¹¹ Martini, I.P., 1978. Tafoni weathering, with examples from Tuscany, Italy. *Zeitschrift für Geomorphologie N. F.* 22:44–67.

¹² McBride, E.F. and M.D. Picard, 2000. Origin and development of tafoni in Tunnel Spring Tuff, Crystal Peak, Utah, USA. *Earth Surface Processes and Landforms* 25:869–879.

¹³ Emil Silvestru, personal communication.

¹⁴ Bradley, W.C., J.T. Hutton, and C.R. Twidale, 1978. Role of salts in development of granitic tafoni, South Australia. *Journal of Geology* 86:647–654.

¹⁵ Hejl, E., 2005. A pictorial study of tafoni development form the 2nd millennium BC. *Geomorphology* 64:87–95.

¹⁶ Dragovich, D., 1967. Flaking, a weathering process operating on cavernous rock surfaces. *GSA Bulletin* 78:801–804.

exploited by weathering processes,¹⁷ but the greatest mystery is what determines *where* they form.¹²



Figure A20.2. Tafoni from a large talus boulder at the base of the Twin Sisters bornhardt, "Silent City of Rocks," south-central Idaho.

Another popular idea today is salt weathering.^{8,12,14} One problem with this hypothesis is the

¹⁷ Thomas, Ref. 9, p. 17.

origin of the salt. Most of the sites that have been studied are too far inland. Bradley *et al.* suggested the salt originates within the granite itself, especially as fluid trapped in small pore spaces within the granite.¹⁴ The problem with this is the concentration of salt within the granite seems to be too low to cause tafoni.¹⁸ Another difficulty is how salt attacks granite is poorly understood.¹⁹

The origin and maintenance of the overhang is also difficult to explain,²⁰ especially since there is no evidence that they owe their origin to case hardening.¹²

Thomas suggested tafoni could be formed by a stream or river that once flowed along the edge and undercut the inselberg.²¹ Unfortunately, few streams are observed around inselbergs today. Whether or not tafoni are deepening today, could the initial recess be a relict of a past climate, environment, or process? Maybe tafoni are products of the unique climate of the post-Flood Ice Age with heavy, acid rain, which would occur early in the Ice Age.²² Such a conclusion may be contrary to the uniformitarian paradigm, but seems to be demanded by the facts.

¹⁸ Bradley *et al.*, Ref. 14, p. 653.

¹⁹ Huinink *et al.*, Ref. 8, p. 1,228.

²⁰ Twidale, Ref. 1, p. 297.

²¹ Thomas, M.F., 1994. *Geomorphology in the Tropics: A Study of Weathering and Denudation in Low Latitudes*, John Wiley & Sons, New York, NY, p. 341.

²² Oard, M. J., 2004. *Frozen In Time: The Woolly Mammoth, the Ice Age, and the Biblical Key to Their Secrets*. Master Books, Green Forest, AR.