A SPELEOGENIC ORIGIN FOR FIVE-COLUMN ROCK, WISCONSIN?

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Five-Column Rock is among the most impressive of several notable fragile rock formations in southwestern Wisconsin's unglaciated Driftless Area. Consisting of a basal sandstone plinth, a set of columns enclosing "windows", and a tabular dolostone summit, the entire structure is over 6 m high. The Rock has not been previously studied in detail, and its origin has only generally been ascribed to weathering and eolian processes. Closer examination suggests that the feature originated as a phreatic cave developed in carbonate rocks transitional between the underlying Cambrian sandstone and the overlying Ordovician dolostones. The morphology of the feature, its stratigraphic context and its relationship to extant cave passage in the adjoining interfluvial ridge all point to a speleogenic origin, which may have broader significance for the development of similar features throughout the region.

Five-Column Rock (Fig. 1), a tabular prominence on the western flank of the Kickapoo River Valley in Vernon County, is an enduring icon of the Driftless Area of southwestern Wisconsin—a fragile rock formation in a unique region of some 39000km² that was spared the ravages of Pleistocene glaciation. It was featured in Lawrence Martin's classic treatise on the geomorphology of Wisconsin (three editions: 1916, 1932, 1965) and also appeared in an early 20th Century edition of the State of Wisconsin Blue Book, the official arbiter of state significance (Larson 1991). Moreover, it is the subject of a 1991 limited (135) edition pencil print series by the local artist Brian L. Larson, whose family once owned the land on which the Rock is situated (Fig. 2), and it is a well-known, if unadvertised spot for regional sightseers.

Five-Column Rock has been the subject of little geomorphological attention. It was attributed by Martin (1965) to "...weathering and wind work..." but our investigations suggest that its origin may be speleogenic, at least in part.

Figure 1. Five-Column Rock, looking northeast; main ridge to right of photograph.

Figure 2. Five-Column Rock, pencil print, Larson (1991).

LOCATION AND DESCRIPTION

Five-Column Rock, also known locally as Table Rock, is located ~3 km west of Readstown, Vernon County, Wisconsin (Fig. 3). It is the northernmost remnant of a promontory or residual interfluvial ridge extending into the southern margins of the valley of Sherry Creek, a west bank tributary of the Kickapoo River (Fig. 3). The Rock is separated from the main body of the ridge by a downward-tapering defile, which presumably reflects the location of a broadly east-west trending structural discontinuity such as a joint or fault.

The interfluvial ridge and Five-Column Rock itself are aligned near north-south (340°). Ridge side slopes on either side of the rock are roughly 32° (west) and 36° (east) degrees, with the northern extremity of the ridge declining to 7° beyond

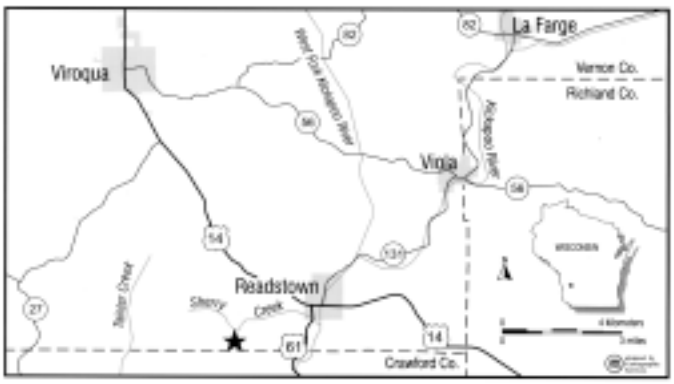

Figure 3. Location of Five-Column Rock.

Figure 4. Adjacent cave from Five-Column Rock, looking south.

the rock itself. The elevation of the base of the rock is at 262m above msl.

The rock has three distinct components: a basal plinth, a set of columns enclosing "windows", and an entablature, or tabular summit (Fig. 1 & 2). The basal plinth tapers upwards, is ~2.0 m tall, 8.8 m long, 4.0 m wide and 21.0 m in circumference. It is an extension of the main ridge rock mass, here about 3.4 m wide and 3.2 m thick, and it extends northward beyond Five Column Rock for another 7.5m. By contrast, the entablature is ~ 3.0 m thick, also tapering upwards from 7.1 to 6.8 m long and from 4.7 to 2.0 m in width. The Rock is separated from the main mass of the interfluvial ridge to the south by a distance of ~0.2 m at plinth level and 2.4 m at table level.

The interior dimensions of the space described by the columns between the base and the table are ~1.3 m high, and a maximum of 5.0 m long and 2.5 m wide, giving an enclosed volume of ~16 m³. The name Five Column Rock is actually a misnomer, since there are currently seven columns, with heights ranging from 0.7 m to 1.8 m (Table 1). The columns themselves are vase- or hourglass-shaped, tapering inward from their extremities (points A & C) to a minimal circumference (B) at an elevation describing a northeastward-dipping (035° orientation) plane inclined at ~3° (Table 1). The seven "windows" described by the columns range from 0.25 m to 2.7 m high and from 0.2 m to 2.65 m wide, each individual window being of similar height and width (Table 1).

Table 1. Column and Window Measurements (in meters).

Column	Aspect	Circumference			Total Height	Height A to B	Height B to C
		Basal A	Minimum B	Upper C			
1	180°S	3.3	0.8	1.3	1.5	1.3	0.2
2	232°SW	3.5	1.3	2.4	0.7	0.5	0.2
3	322°NW	1.0	0.8	0.9	0.7	0.5	0.2
4	0°N	2.5	2.3	2.6	0.7	0.6	0.1
5	70°NE	5.5	2.9	4.0	1.7	0.6	1.1
6	128°SE	5.5	1.6	2.6	1.8	1.5	0.3
7	178°SE	3.2	1.9	2.7	1.7	1.1	0.6

Window	Apect	Width	Height
1	South	2.7	2.65
2	West	1.2	1.2
3	West	0.6	0.6
4	Northwest	0.25	0.2
5	Northeast	0.4	0.35
6	East	1.85	1.8
7	Southeast	0.62	1.6

Aspect is from base of column or window facing outward.

Vegetation on the slopes below the rock consists of mixed hardwood tree species together with assorted shrubs and grasses. The basal plinth itself is essentially unvegetated, but the upper table surface supports a limited assemblage of mosses, lichens, grasses and stunted shrubs of Eastern Red Cedar (*Juniperus virginiana*).

GEOLOGICAL AND GEOMORPHOLOGICAL CONTEXT

Five-Column Rock formed within the transitional strata between the Upper Cambrian Jordan Sandstone and the Oneota Formation of the Lower Ordovician Prairie du Chien Group (Paull & Paull 1977; Wisconsin Geological & Natural History Survey 1970).

The basal plinth is composed of cross-bedded, well-sorted, medium-grained, white- to buff-colored sandstone of the Jordan Formation. By contrast, the tabular summit is formed in medium-textured, light gray-colored, sandy dolostone of the Oneota Formation. The columns are transitional, formed in calcareous sandstones and glauconitic siltstones, probably representing the Sunset Point Member of the lower Prairie du Chien Group. This transition represents the marine transgression between the Jordan and the Oneota, and the sequence within the Rock is characteristic (Davis 1970; Raash 1935).

The Jordan Formation is typically composed of quartz sandstones, locally dolomitic and hosting some small caves (Cronon 1980). The Oneota Formation, in which many southwestern Wisconsin caves are developed (Day *et al.* 1989), is typically composed of dolostones, which are of variable color and locally sandy, cherty and shaley (Clayton & Attig, 1990; Day 1979, 1984; Wisconsin Geological & Natural History Survey 1970). The transitional Sunset Point Member, largely

a calcareous sandstone, has not previously been identified as a locus of cave development.

Karst is a significant component of the landscape of southwestern Wisconsin's Driftless Area, with a wide array of dry valleys, sinkholes, caves and springs (Day *et al.* 1989). Although dissolution of the dolostone is sluggish (Day 1984), the absence of direct Pleistocene glaciation (Mickelson *et al.* 1982) has permitted the continued existence of residual karst and other landscape features including such fragile formations as Five-Column Rock itself.

The geomorphic landscape of the Five-Column Rock area is dominated by a mature dendritic drainage system dissecting a series of gently-dipping cuestas (Paull & Paull 1977). Relative relief varies generally between 50 and 100 m, with relatively narrow and steep-sided interfluvial ridges separating valleys whose bases have been infilled with successive sequences of alluvial sediment. For a more complete discussion of this fluvial landscape, the reader is referred to Faulkner (1998).

A SPELEOGENIC ORIGIN?

The overall morphology of Five-Column Rock is entirely consistent with a speleogenic origin. The space between the plinth and the entablature appears to be a remnant portion, albeit subsequently modified, of a cave as defined by recognized authorities (Ford & Williams 1989; Gillieson 1996; White 1988). Geologically, the Rock is formed within a carbonate formation transitional between the underlying Jordan sandstone and the overlying Oneota dolostone, and, geomorphologically, other caves in southwestern Wisconsin have developed adjacent to carbonate-sandstone transitional contacts (Cronon 1980; Day *et al.* 1989). Regionally, many of the springs that characterize southwestern Wisconsin debouch close to the Prairie du Chien-Jordan contact (Day *et al.* 1989; Kemp & Day 1998).

Speleologically, the interior confines of the Rock are very similar to those in other regional caves, with a broadly tubular cross profile, suggestive of initial development under phreatic conditions, and a corbelled ceiling, indicative of upward-tapering breakdown of thin carbonate beds.

Perhaps the most convincing evidence for a speleogenic origin is the relationship between Five-Column Rock itself and the rest of the interfluvial ridge of which it is an extension. The west flank of the ridge proper in the immediate vicinity actually contains a small cave passage, some 8.6 m long with average height and width of 0.4 m and 1.5 m (Fig. 4). Moreover, this cave is at approximately the same elevation as the interior of the Rock and generally follows the same 340° orientation. The orientation of the cave and of the Rock itself are generally consistent with the regional pattern of cave passage orientations (Terlau & Day 1997) which are suggestive of a regional underground karst plumbing system draining towards the south and west (P. Day, 1998, personal communication). Where the cave abuts the near-vertical western rock face of the ridge, "windows" into the cave have developed between intact rock pedestals, providing a striking similarity to the windows and columns of Five-Column Rock itself.

DISCUSSION AND CONCLUSIONS

Five-Column Rock has a speleogenic origin. The void within Five-Column Rock is essentially a modified northern, possibly "upstream" extension of the cave passage in the interfluvial ridge, now dismembered by the defile between the Rock and the main body of the ridge. Following exposure as a result of fluvial dissection of the landscape surface, the Prairie du Chien dolostone has provided a durable cap rock to preserve this speleogenic feature. Eolian and fluvial processes have subsequently modified the original remnant cave passage, particularly the former passage floor, which shows evidence of spalling and has clearly been severely degraded by visitors climbing up the sandstone plinth.

Fragile rock formations such as Five-Column Rock are not uncommon features in southwestern Wisconsin's Driftless Area (Martin 1965; Paull & Paull 1977) and the probable speleogenic origin of the Rock suggests that other of these features may also have developed from cave remnants. Like the Rock itself, the origin of these features has previously been ascribed to fluvial, aeolian and/or periglacial processes, but speleogenesis may well have been involved. Two significant natural bridges in the area may also have a similar origin (Paull & Paull 1977).

The probable speleogenic origin of Five-Column Rock may also relate to the development of other sandstone and sandstone-carbonate contact caves in southwestern Wisconsin (Deckert 1980). Of the over 250 caves catalogued in the state "A high percentage...are small erosional caves in sandstone..." (Cronon 1980: 106). This study suggests that these caves, hitherto largely ignored, may actually be of true speleogenic origin, and may be of wider geomorphological and hydrological significance than previously recognized. Although caves in the Oneota Formation are widespread, and caves within the Jordan sandstone have been recorded, there has been little recognition of cave development within the transitional Sunset Point Member, which may be an important locus of speleogenesis.

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