CONTROLS ON PASSAGE FORMATION IN POMPEY'S CAVE, ULSTER CO., NEW YORK STATE

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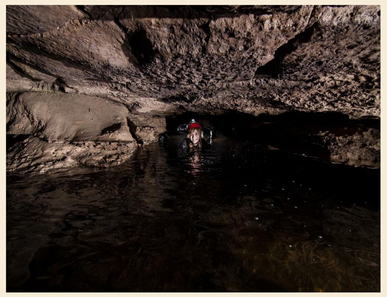
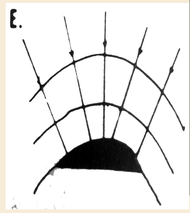
ABSTRACT

Pompey's Cave, the longest cave in Ulster Co., New York, is developed within the limestone of the Glasco Member of the Upper Silurian Rondout Formation, bounded below and above by the dolomitic Rosendale and Whiteport members, respectively. Under normal flow conditions, the cave takes the entire flow of Kripplebush Creek, sinking where the upper contact of the Glasco Member crosses the stream channel, and seemingly resurges where the member again crosses the stream channel due to folding of the strata. A dry streambed developed in the overlying Whiteport Member overlies the cave, carrying water only during higher flow rates. At a gross scale, Pompey's Cave can be split into a downstream and upstream section, split by short passage that constricts water flow between the sections. During high flow rates the upstream portion of the cave floods completely, with water flowing overland down the normally dry streambed and sinking into the lower section of the cave at entrances developed within the streambed. During very high flow rates the lower section of the cave also floods entirely, with water flowing both underground and overland over the entire length of the cave passage.

Revised detailed mapping of the cave indicates multiple controls on passage formation. The main trunk passage of the cave in the downstream section is primarily oriented along the axis of an anticline trending roughly northwest-southeast with few side passages, indicating development along structurally-controlled fractures. The upstream section of the cave also consists of a main trunk section, but with much greater development of smaller side passages with multiple interconnections, indicating initial development associated with similar downstream structure, but with superimposed floodwater maze development as well, probably associated with more frequent flooding events due to the mid-cave restriction. Midstream entrances seem to be developed where parasitic anticlinal folds along the main anticline allow for water to seep into cracks through the overlying dolomite and sink into the underlying limestone, ultimately resulting in roof collapse entrances. Ongoing projects at Pompey's Cave include detailed mapping of small-scale stratigraphic units and structure within the cave along with continued flow measurements at various flow regimes.

Photos clockwise from right:
Downstream- a) Survey crew with monocline hinge, b) slickensides on biostrome, c) biostrome
Upstream-
a) narrow joint-controlled passage, b) joint-controlled passage to Bowles of the Earth, c) crew in passage showing karst jointing in roof and biostrome walls

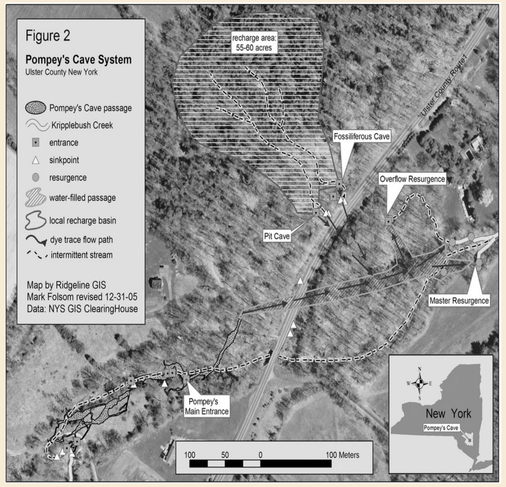




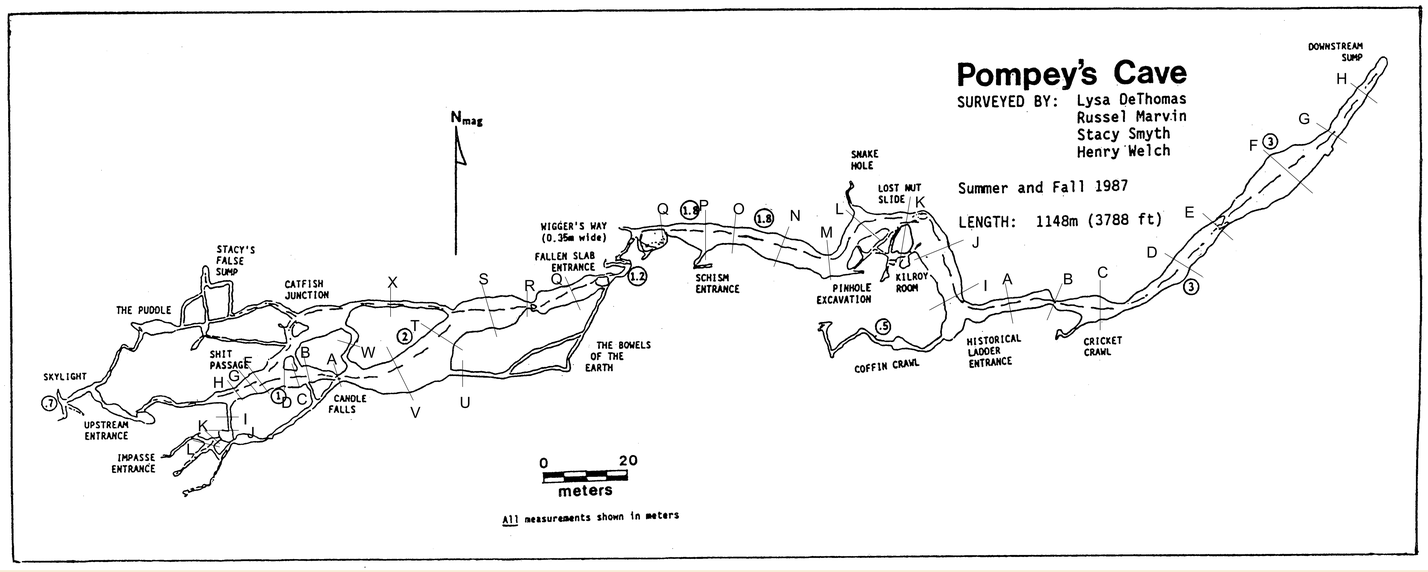
Idealized sketch demonstrating cave formation from weathering of antiformal karst units. Taken from *Egemeier, SJ. 1969; Origin of caves in Eastern New York as Related to Unconfined Groundwater Flow, Bulletin of National Speleological Society. v. 31, n.4.p. 97-111*

Upstream Section	Station	Average	A	B	C	D	E	F	G	H	I	J	K	L	Q	R	S	T	U	V
	Total Area	41	85	91	39	54	20	23	9	39	20	12	5	22	67	38	66	64	5	76
Downstream Section	Station	Average	A	B	C	D	E	F	G	H	I	J	L	M	N	O	P	Q	R	
	Total Area	92	82	58	103	75	136	235	92	31	140	104	102	81	109	78	113	4	21	

Passage Cross-sectional areas calculated through 8-point cross-sections. Areas in square feet.



Location Map for Pompey's Cave; Cave passages shown in relation to recharge and resurgence areas.



INTERPRETATION

The ratio of average cross-sectional area in the the upstream section to the downstream section is 1:2.2. For every passage less than one meter wide in the downstream section, there appears to be five equally narrow passages in the upstream section. In the downstream stream section, a monocline hinge overlying a biostrome allows for the formation of large trunk passages. The presence of slickensides on the biostrome surface suggests that the monocline hinge was folded over the biostrome unit. The transition from upstream to downstream is marked by a 0.35 meter wide passage, Wigger's Way, which restricts upstream flow from entering the downstream section. Pressurized backflooding in the upstream section caused by the constriction at Wigger's Way forces water into joints, creating narrow, maze-like passages and causes flooding of the stream bed above the overlying Whiteport Member.

FUTURE WORK

Further structural analysis is needed to understand the controls on the pinch at Wigger's Way. It is hypothesized that a fold anomaly exists in this location. One possibility is that the crest of a plunging antiform lies above Wigger's Way, constricting the passage of water. Though its hinge lies below the land surface, its crest lies above Wiggers Way preventing the flow of water through the Glasco Member.

Flow analyses at varying flow regimes are also planned to determine what levels of flow result in the flooding of the various passages within the cave.

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