Geological Paper GP89-1

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Winnipeg, 1989
*(Speleological Society of Manitoba (SSM))

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GS-19 KARST INVESTIGATIONS IN MANITOBA'S INTERLAKE REGION

by P. Voitovici[1] and W.D. McRitchie

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INTRODUCTION

An appraisal of karst features in Manitoba's Interlake was continued throughout the February-October period by members of the Speleological Society of Manitoba (SSM), in cooperation with individuals from several government agencies including the provincial Geological Services Branch.

Significant new cave discoveries were made in the Gypsumville and Gypsum Lake regions where unique "Cockpit Karst" topography is developed in Jurassic gypsum deposits lying within the Lake St. Martin structure.

Several new caves were also located and mapped in the Grand Rapids Uplands, and over a dozen other occurrences reported from the Southern Interlake, on Peonan Point, and near Mantagao, Spence and Highrock lakes, Fairford, Hodgson and Dallas.

At the time of writing more than 60 new caves have been added to the inventory established in 1988, bringing the total to over 120. Although most fall within the category outlined during the previous year (i.e. less than 100 m in length and 10 m deep), **Labyrinth Cave** east of Gypsum Lake possesses a total corridor length of 189 m and as such represents the longest cave discovered thus far in the province. Over 1km of new passageways were explored during the year (Table GS-19-1).

Following earlier reports of sinkholes in the Gypsumville area (Wallace and Greer, 1927; Brownell, 1931; Bannatyne, 1959; Hoque, 1967), the discovery of extensive underground solution corridors by the SSM is a significant new contribution, opening up a totally virgin area for future exploration and research.

The assistance and guidance provided by Jane and Warren Rawluk of Gypsumville, in gaining information, and access to these areas was especially appreciated, as was the warm hospitality provided on all visits to the region. Thanks also go to Lillian and Len De Lafuente for assisting the search in the Spence Lake region, to Clarence Sinclair who led us to caves near Dallas, and to Chief Ed Anderson and Angus Woodford of Fairford who not only shared a little of their history with us during the February "dig" at the **Snakepit**, but who also improved access to the site making the job that much easier.

As in previous years, a special acknowledgement is also made to the members of the SSM, for their continued efforts and enthusiasm in exploring for, and documenting, Manitoba's underground heritage. G. Sweet made several suggestions which added greater accuracy to the statements made in the report.

The society's activities in the Grand Rapids region complemented other ongoing research including Karst studies by G. Sweet (University of Winnipeg), a study of bat populations and habitats by J. Dubois (Museum of Man and Nature), stratigraphic investigations and drilling by R.K. Bezys (MGSB), and geochemical studies of spring and creek waters and sediments (McRitchie, Report GS-18, this volume).

OUTLINE OF ACTIVITIES

Southern Interlake

Information provided by the residents of the Fairford Indian Reserve pointed to the existence of an extensive underground passageway leading from a sinkhole on the reserve, 3 km to the banks of the Dauphin River. (The sink was also recorded in Baillie's 1950 field notes, as was the local tale of a passageway leading underground to the river.) A snake pit located on the south side of the road through the reserve, opposite the school, was cited to be the entrance, but considerable debris had been thrown into the shaft blocking any access. The shaft was excavated to a depth of 5 m before being abandoned in naturally stratified Holocene infill deposits. At the base, the vertical, joint-controlled shaft opened laterally into a horizontal solution cavity largely plugged with soft sediments, to the point where the open space was only 4 m long and 30-40 cm high (Fig. GS-19-1).

A small cave 300 m to the south of the snake pit, was excavated to a depth of about 3 m, but it also showed no evidence of opening up. Several other sinks reported from this district will be investigated in the future.

Numerous other referrals were received from local residents in the Southern Interlake region including five caves at Highrock Lake, two near the southern end of Peonan Point on Lake Manitoba, one on Spence Lake, two north of Highway 325 east of Ashern, and two southeast of Dallas that were mapped later on in the season. Three additional caves were also found in the St. George Lakes area, northeast of **Window Cave** (Sweet *et al.*, 1988).

Sinkholes reported in the Leifur area (Bannatyne, 1959), 18 km north of Amaranth, are shallow depressions with no evidence of open drain holes nor potential cave entrances.

Gypsumville

A cursory examination of the gypsum deposits at Gypsumville confirmed the existence of extensive solution pits east of the quarry, 3 km north of town. Although previous reports on the area had made reference to these features, only Tyrrell's 1888 report indicated the associated presence of cave entrances, over 40 of which were counted in the first few days of the current exploratory traverses (Fig. GS-19-2).

A systematic mapping program was initiated, and by summer's end over 20 of the caves had been surveyed (Fig. GS-19-3 ,in pocket). The extraordinary concentration of sinkholes in this region is almost unique for gypsum deposits in Canada, the only comparable localities being in Alberta (Tsui and Cruden, 1984), and Newfoundland (Sweet, 1979).

The sinkholes range up to 40 m in diameter and 10 m in depth. Most are funnel-shaped, although vertical-walled solution- grooved shafts also occur. The density of sinkholes is such that only narrow ridges persist between many of the subjacent sinks, the sides of which are generally smooth and till covered. Bedrock is commonly exposed in one or more of the banks and these outcrops form the caprocks to the small cave entrances.

The caves are either long, sinuous, cylindrical "phreatic" tubes, or "vadose" mazes where the passageways follow a complex interconnecting rectilinear pattern controlled by the main joints. The northern end of the **Long Crawl** (Fig. GS-19- 3, #1) exhibits a gradational buildup of relatively recent sediments suggesting a dominantly north to south flow of groundwaters in the main underground channels.

Typically all caves are shallow (2-4 m below the surface) and bottom at about the same level. Some cave ceilings locally break through into the overlying glacial till. The gypsum lithologies vary widely, and a water table control on the solution appears more likely than preferred solution of a more soluble layer. Brownell(1931) reports that "quarry operations carried out after the water table was lowered about 9 feet revealed horizontal water channels in the gypsum". It is conceivable therefore that (in the quarry area at least) the abandonment of the caves by the water was a man- induced phenomena. At the present time all of the caves are totally dry except for minor water accumulating from the melting of ice plugs that encircle the entranceways until late May. Strong airdrafts are present in many caves indicating a widespread interconnecting complex of underground cavities.

Although the gypsum beds are essentially flat lying, numerous open asymmetrical folds are present (see Bannatyne, 1959, and Wardlaw *et al.*, 1969, for a discussion of these features) and locally these structures appear to influence the degree and form of cave development. Some of the larger chambers appear to have resisted incasion or breakdown because of the natural stability of roof slabs braced, and arched on either side of an anticlinal closure.

[1]Speleological Society of Manitoba (SSM)

Table GS-19-1
CAVES, SINKHOLES AND TRENCHES IN THE INTERLAKE REGION, STATUS OF INVESTIGATIONS FOR DISCOVERIES MADE DURING 1989

Cave Name	Unconfirmed Report	Located	Sketched	Mapped	Excavation Required	L (Metres)	D
GRAND RAPIDS:							
Ice Organ	....	xxxx	....	xxxx	....	36.0	8.6
Mouldy-moth (Microwave #3)	....	xxxx	....	xxxx	....	12.5	3.4
Cliff Cave	....	xxxx	xxxx	....	....	10.0	7.0
Drop-in	....	xxxx	xxxx	....	....	11.0	2.4
Chain	....	xxxx	....	....	....	3.5	2.0
Lookout Crevice	....	xxxx	....	....	....	43.0	5.0
Wet Memory	....	xxxx	....	....	....	2.0	1.0
Skull trench	....	xxxx	....	....	....	15.0	5.0
					Subtotal	133.0	
GYPSUMVILLE:							
Crystal Kingdom	....	xxxx	....	xxxx	....	19.5	1.5
Long Crawl	....	xxxx	....	xxxx	....	125.5	3.0
Octopus	....	xxxx	....	xxxx	....	46.0	1.2
Log Barricade	....	xxxx	xxxx	....	....	-	-
Short Crawl	....	xxxx	....	xxxx	....	23.0	1.4
Moth's Cellar	....	xxxx	....	xxxx	....	23.5	2.0
Jaws	....	xxxx	....	xxxx	....	16.0	1.5
Snuggy Crawl	....	xxxx	....	xxxx	....	19.0	1.5
Honeypot	....	xxxx	....	xxxx	....	37.0	1.8
Bear's Den	....	xxxx	....	....	....	14.0	0.5
Too-tight	....	xxxx	....	xxxx	....	-	-
Iceslide	....	xxxx	....	xxxx	....	38.0	1.5
Maze	....	xxxx	....	xxxx	....	76.5	1.2
Small Maze	....	xxxx	....	xxxx	....	31.0	1.0
Vertebrae	....	xxxx	....	xxxx	....	23.0	0.5
Spike	....	xxxx	....	xxxx	....	16.5	0.5
"Y"	....	xxxx	....	xxxx	....	33.0	1.4
Chamber	....	xxxx	....	xxxx	....	55.0	1.4
Tunnel	....	xxxx	....	xxxx	....	7.0	1.0
Transverse	....	xxxx	....	xxxx	....	14.0	0.5
Steepsink	....	xxxx	xxxx	....	....	-	-
Cliff	....	xxxx	xxxx	....	....	-	-
Slab	....	xxxx	....	xxxx	....	16.5	3.6
Bear Den	....	xxxx	....	xxxx	....	14.0	0.5
Nine foot pole	....	xxxx	....	xxxx	....	12.5	1.8
					Subtotal	660.5	
GYPSUM LAKE EAST:							
Stormcloud	....	xxxx	....	....	....	-	-
Phantom Bear	....	xxxx	xxxx	....	....	39.5	5.5
Labyrinth	....	xxxx	....	xxxx	....	189.0	4.8
Zig-zag	....	xxxx	xxxx	....	....	24.5	-
Meander	....	xxxx	....	....	....	-	-
Crystal Palace	....	xxxx	....	....	....	-	-
Dusty	....	xxxx	....	....	....	15.0	2.0
					Subtotal	268.0	
FAIRFORD:							
Snakepit	....	xxxx	....	xxxx	....	18.3	4.8
Cockpit	....	xxxx	....	....	....	3.0	1.5
Baillie's pit	....	....	....	....	....	-	-
					Subtotal	21.3	
DALLAS:							
Doug's Den	....	xxxx	....	xxxx	....	10.5	4.5
Clarence's Cave	....	xxxx	....	xxxx	....	11.0	4.0
					Subtotal	21.5	

TABLE GS-19-1
CAVES, SINKHOLES AND TRENCHES IN THE INTERLAKE REGION, STATUS OF INVESTIGATIONS FOR DISCOVERIES MADE DURING 1989

Cave Name	Unconfirmed Report	Located	Sketched	Mapped	Excavation Required	L	D
						(Metres)	
SPENCE LAKE:							
The Tomb	....	xxxx	....	xxxx	....	13.5	1.8
					Subtotal	13.5	
HODGSON:							
#1	....	xxxx	....	....	....	-	-
#2	....	xxxx	....	....	....	-	-
#3	....	xxxx	....	....	....	-	-
					Overall Total	1117.8	

Others reported from Mafeking(1), Highrock (5), Peonan Point (2), Mantagao (3), Ashern Road east (2), and Vidir (1).

Gypsum Lake east

Other gypsum occurrences were identified in earlier descriptions of the region east of Gypsum Lake (Brownell, 1931). Eugene Syrotiuk, a hunter in the region, reported seeing caves and shafts during his ventures into the area. Accordingly, several visits were made to this relatively remote and poorly documented sector of the Lake St. Martin structure (Fig. GS-19-4).

The region proved to contain even more striking examples of "Cockpit Karst" than those observed north of Gypsumville, with relief ranging up to 15 m and sinkholes commonly several tens of metres in diameter, with local mega-sinks over 100 m across. Shafts with vertical solution-grooved walls are present but are more rare than the typical funnel-shaped dolines. This summer's inspection has covered only a small fraction of the area, much of which is covered by dense undergrowth of hazelnut and alder with a canopy of mature poplar spotted with spruce clumps.

Six of the larger caves (Fig. GS-19-5) were examined in some detail, and once again excellent examples of both rectilinear "vadose", and tube-like "phreatic" passageways were documented (Figs. GS-19-6 and GS-19-7). No speleothems were recorded, but unique globular masses of gypsum in the roof of **Stormcloud Cave** (Fig. GS-19-8) are thought to represent a peculiar form of diagenetic nodule development referred to as "chicken wire texture", rather than "cave clouds" (Hill and Forti, 1986), which owe their origins to precipitation . Most caves again appear to bottom at about the same level (4-5 m below the surface) and a water table control on solutioning appears to have been the principal influence in the area. None of the caves examined thus far contain evidence of recently flowing water. Small static pools are fairly common, and **Labyrinth Cave** (Fig. GS-19-9) contains extensive passageways (Muddy Lane) floored by water-saturated gypsum mud (gypsite). Good sections of thinly inter-layered red and white gypsum strata can also be observed in this cave, as can repeated small scale asymmetrical folds with a consistent sense of asymmetry (Fig. GS-19-10).

Crystal Palace contains fine displays of hexagonal ice pendants until well into July. The inner section of this cave is particularly dangerous and unstable with widespread indications of recent breakdown.

The large low entrance chamber is accessed through a vertical opening at the base of a 2.5 m deep, steep-walled, funnel- shaped doline. The chamber is approximately circular, 10-15 m in diameter and over 2 m high near its centre. A narrow ice- floored curvilinear passageway leads radially to the north and east. Halfway along this crawlway (6 m), a striking frozen waterfall of crenellated ice "flowstone" (Fig. GS-19- 11) is overshadowed by 1-1.5 m long ice stalactites. On the opposite (left) wall and roof the first display of nested, euhedral, hexagonal ice crystals (up to 8 cm individuals) forms a particularly photogenic display(see Fig. GS-19-12). High and to the left of the crawlway an overhanging ledge opens back into a broad low chamber containing an even more spectacular display of ice formations. The chamber is reached by continuing along the crawlway for another 6 m and then branching left (under a breakdown slab precariously perched on top of a small crumbly and soft looking chockstone) into the main room, which has been named Breakdown Chamber. This chamber has a central 1.5 m high pillar of layered buff gypsum. To the left of the pillar a 1.5 m high chamber stretches back 6-8 m towards the upper lip of the passage containing the crawlway. The ceiling and walls of the chamber are carpeted with a delicate, filamentous fretwork of large, euhedral, hexagonal ice crystals. The basal coating of crystals is 5-10 cm thick and generally of even thickness. Locally the surface is broken by bushlike outgrowths of ice crystals up to 20 cm in diameter, and more rare skeletal pendants that hang 40 cm down from the ceiling with perfectly formed (15 cm) ice crystals jutting perpendicularly from the main stem.

North and west of the pillar the room extends into a long 2 m high corridor lined and walled with chaotic breakdown blocks with extremely fresh surfaces indicating recent incasion (Fig. GS-19-13). This passageway continues for 7-8 m and thence another 15 m under a particularly shaky looking chockstone. Another arm of the cave is passable for 6-8 m in the opposite direction, with narrow extensions 10m beyond this.

Meander Cave, and **Zig-zag** (Fig. GS-19-14a) exhibit narrow rectilinear passageways with incised meanders stacked at numerous levels. Cave popcorn is abundant in **Meander Cave. Phantom-Bear Cave** (Fig. GS-19-14b) possesses two entrances and a large low chamber almost 15m in diameter.

During a late October visit to the area, bats were observed in **Stormcloud, Crystal Palace, Meander** and the **Long Crawl**.

Further work is planned east of Gypsum Lake, however, activities are currently on hold pending receipt of leaf-free and pre-snow aerial photography that will be used to assist the process of surveying the location of the caves in this densely vegetated region.

Grand Rapids

Geological Services Branch work in the Grand Rapids region gave increased emphasis to water and sediment sampling (see report GS-18, this volume), the main objective being to search for indications of lead and zinc mineralization in the subsurface. Samples are also being submitted for tritium analysis which will provide additional information on the underground residency times of the water emerging from the springs at the base of the Silurian escarpment.

Reconnaissance traverses aimed at finding new caves had only marginal success. Only four caves of note were discovered. **Ice Organ, Mouldy-Moth** (Fig. GS-19-15a and GS-19-16a), **Cliff** and **Drop-in**, as well as several other solution features, e.g. trenches, crevice caves and small solution cavities such as **Wet Memory Cave** and **Chain Cave**, both less than 5 m in depth. **Firecamp** and **Ice Cave** (Figs. GS-19-15b and 16b) were described more fully by Sweet *et al.* (1988).

During the traversing and sampling programs observations were made regarding drainage patterns and processes in the region. Although of a superficial nature, these records and impressions are presented as a supplement to more detailed and extensive accounts of the district's hydrology being prepared by G. Sweet as a Doctoral Thesis at McMaster University.

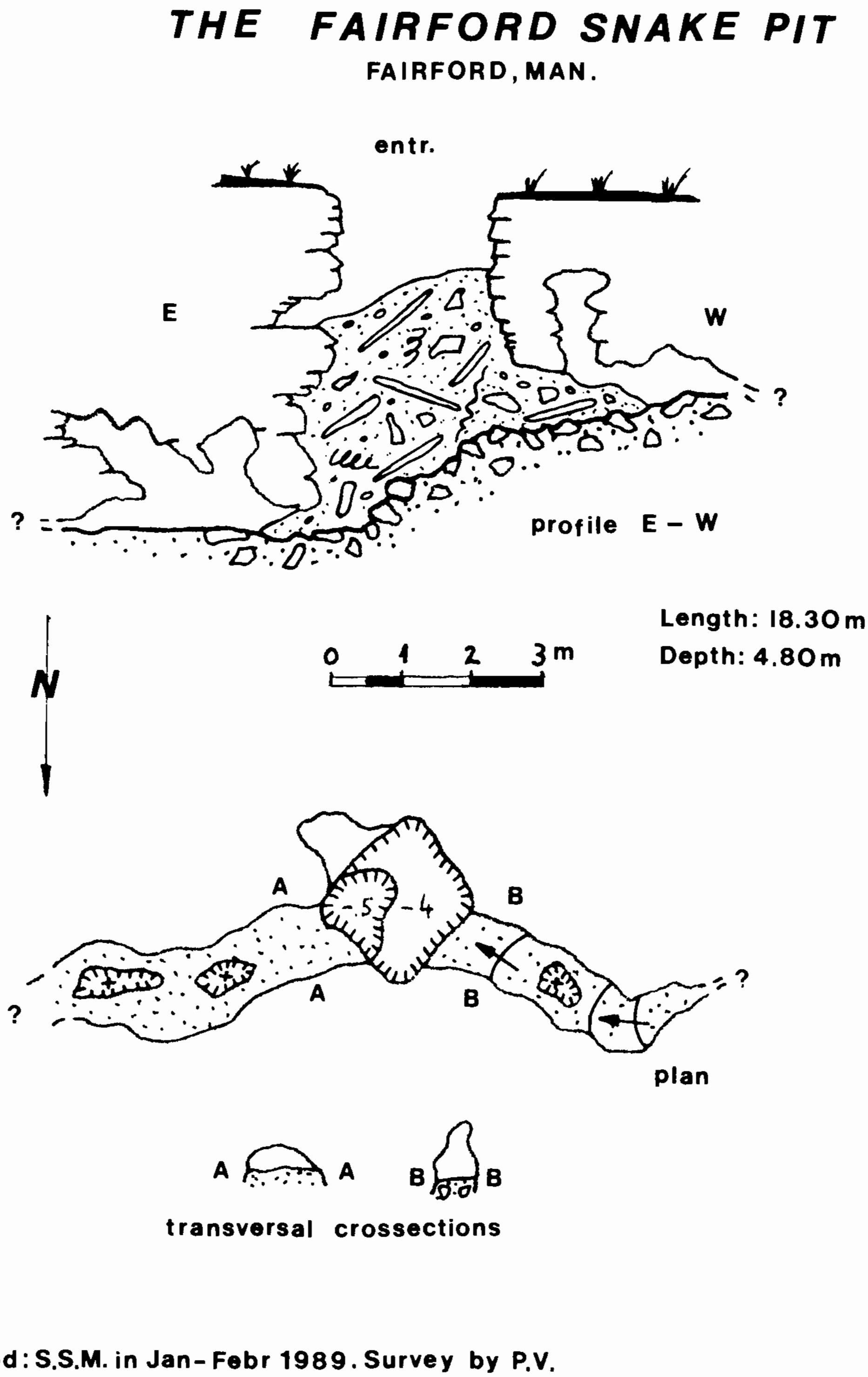


Figure GS-19-1: Fairford Snake pit (map).

Figure GS-19-2: Typical sinkhole, gypsum bedrock exposure, and cave entrance, Gypsumville north-guarry region.

The marked contrast between the dendritic surface drainage typical of the Ordovician coastal plane, and the virtual absence of an organized drainage system on the Silurian Uplands is a feature worthy of note.

North and west of Buffalo Lake the Uplands are characterized by extensive flat dolomitic pavement. Small, 1-2 m relief, scarps face east and northeast between Grand Rapids and Little Limestone Lake, and north, from Little Limestone Lake to Moose Lake. The monotony of the tableland is broken by scattered subround to elliptical and locally elongate clay- based perched lakes most of which possess broad sedge-lined margins reflecting their shallow nature as well as marked seasonal fluctuations in water level. By late spring many lakes that were filled with spring run-off have drained internally leaving dry sedge-lined depressions spotted by clumps of willow. Only a few of the larger lakes exhibit outflow drainage, and these persist throughout the ice-free season (e.g. Bracken, William, Buffalo and Eating Point lakes). The remainder appear to drain internally as a result of seepage through the underlying surficial sediments.

Elsewhere in the region elliptical depressions and more rare dry valleys, are lined with sedge and bordered by willows, with willow clumps scattered variously around across their surface. Isolated groves of tall poplar tend to cluster around the margins particularly in association with low spots or prominent dolines. The diameter of depressions ranges up to 500 m, and typically most are rimmed by a small escarpment 1-3 m high.

Close examination of the (polje-like) depressed areas commonly reveals second order drain holes up to 5 m in depth and 5-10 m in diameter. In late spring the drain holes exhibit evidence of active water flow either as radial runnels or concentric water lines in their clay-lined banks, or as flattened sedge carpets converging radially into the maw of the drain. Those drain holes deep enough to expose the underlying bedrock typically reveal a prominent open joint system variously enlarged into an active vadose passageway. All gradations are observed from shallow grass-lined hollows, through funnel-shaped depressions with actively slumping clay and till banks, to sporadic depressions in which the underlying bedrock is exposed in ledges or small shelves opening to cavities in the bedrock below (Fig. GS-19-17). Clay and till veneers in the floors of the depressions range up to 3 m in thickness, but many were observed to be less than 1 m. This is in marked contrast to the bare dolomite pavement that prevails over much of the region.

Periodic ponding of water (especially in early spring and during storm overload situations) is also evidenced by rapid changes in water levels observed in some caves (4 m in two weeks), as well as relict "scum lines" recording peak levels 5 m above the dry cave floors (**Moosearm Pit**, in *Sweet et al.*, 1988).

At the outflow points along the base of the Silurian escarpment similar evidence is seen of periodic fluctuations in drainage rates and flows. Exsurgent springs (Jennings, 1985) form a continuous and prolific series of drainage points from Grand Rapids north to Williams River. Most represent groundwater seepage zones (10-200 m wide) scattered along the foot of the escarpment 20-30 m below the base of the persistent cliffs of the Moose Lake Formation (see Bannatyne, 1988). Locally the flow is concentrated into prominent brooks 1-3 m wide, with dolomite shingle-lined beds, crossing local subround (10-40 m wide) fen-pools and outwash pans, also lined with dolomite shingle and marly mud. Dry channels and runnels emerging up to 10 m above the June level of seepage and flow, point to periodic overloads that are in keeping with the complementary surges interpreted in the lakes, sinks and caves of the upland plateau.

All springs observed thus far at the base of the escarpment have been diffuse, or weakly channeled upwellings from thickly vegetated hillsides, the immediate foundations of which appear to be beach shingle rather than bedrock. This constant association of bedrock escarpment and masking sub- parallel Agassiz beach ridges may mean that most emergence points are choked with dolomite shingle, making them inaccessible without some degree of excavation.

The relatively stable and continuous nature of the dendritic drainage system on the coastal plain, with sinuous meandering channels that hold their water throughout the ice-free season, points either to an even and widespread veneer of impermeable clays throughout this region, or to a water table in the uplands whose saturation surface lies close to or above the elevation of the coastal plain.

It seems possible that the uplands were once covered with lacustrine clay and till and that much of this was removed during the late shoaling stages of Lake Agassiz, and redeposited into the karst depressions on the plateau, or onto the coastal plain. This would have laid bare the Silurian bedrock on the uplands thereby facilitating percolation in this region in contrast to surface drainage across the coastal plain.

Further work is planned to obtain accurate elevations on the exsurgent points to see whether they are consistently at the same stratigraphic level or whether they are regionally discordant and controlled by a relatively constant water table. Drill logs from holes to the west (Bezys, report GS- 20, this volume) suggest that impermeable beds (argillaceous dolomite) may exist in the Stonewall or Stony Mountain Formations close to the contact of the Ordovician and Silurian. If this is the case then the points of emergence may well be related to an aquitard in the dolomites, that constrains the relatively robust flow of the subsurface waters, creating the springs at the base of the escarpment (Fig. GS-19-18).

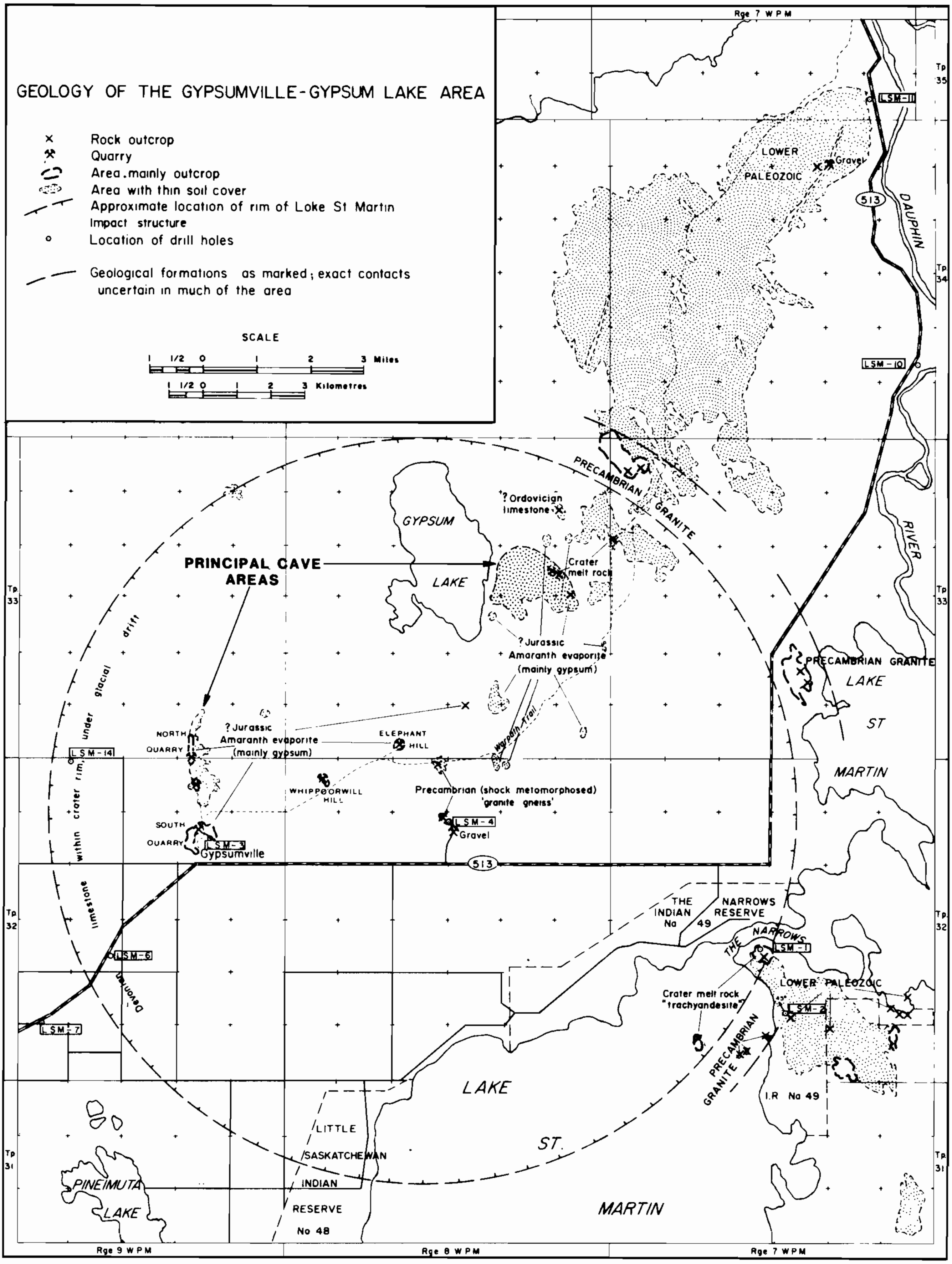
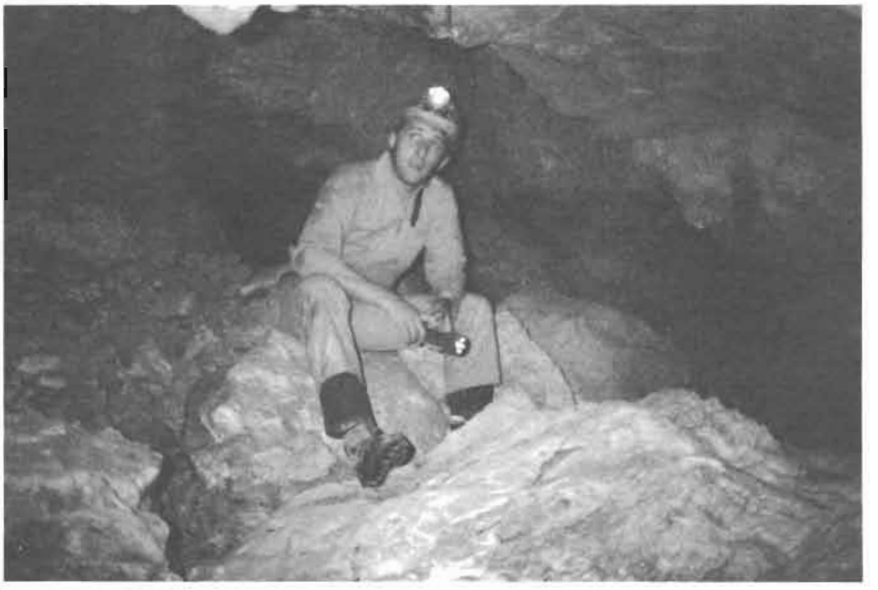


Figure GS-19-4: Principal areas containing gypsum caves, Lake St. Martin Structure (modified after McCabe and Bannatyne, 1970).

Figure GS-19-5: Main chamber of Stormcloud Cave, east of Gypsum Lake.



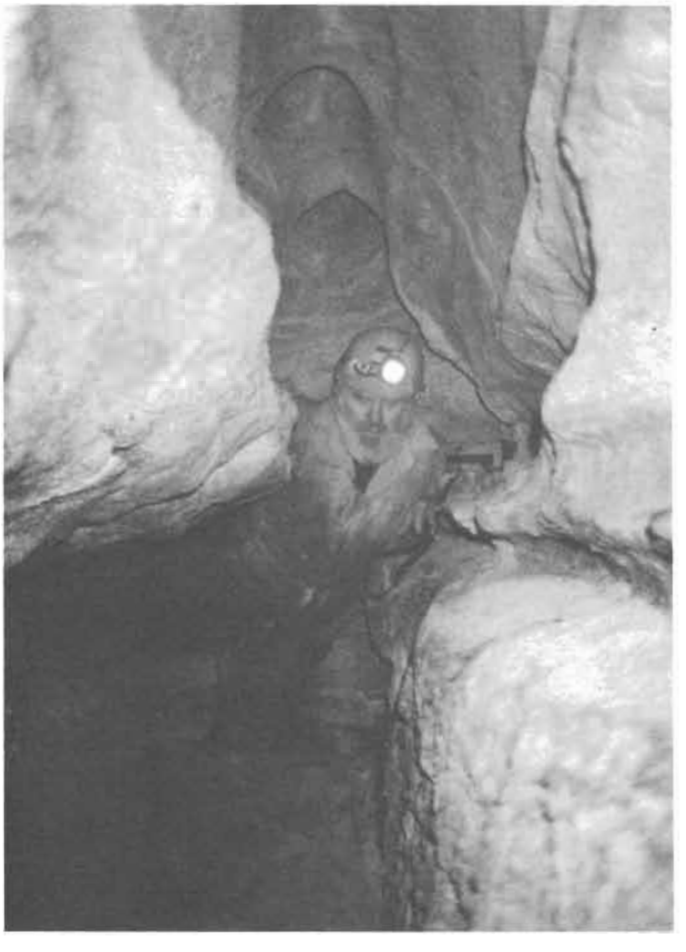


Figure GS-19-6: Negotiating the first bend in Zig-zag Cave. Note solution pockets in ceiling.

Figure GS-19-7: *Phreatic tube (The Subway) in Labyrinth Cave, east of Gypsum Lake. Height 50 cm.*

Figure GS-19-8: *Chicken net texture in ceiling of Stormcloud Cave, east of Gypsum Lake.*

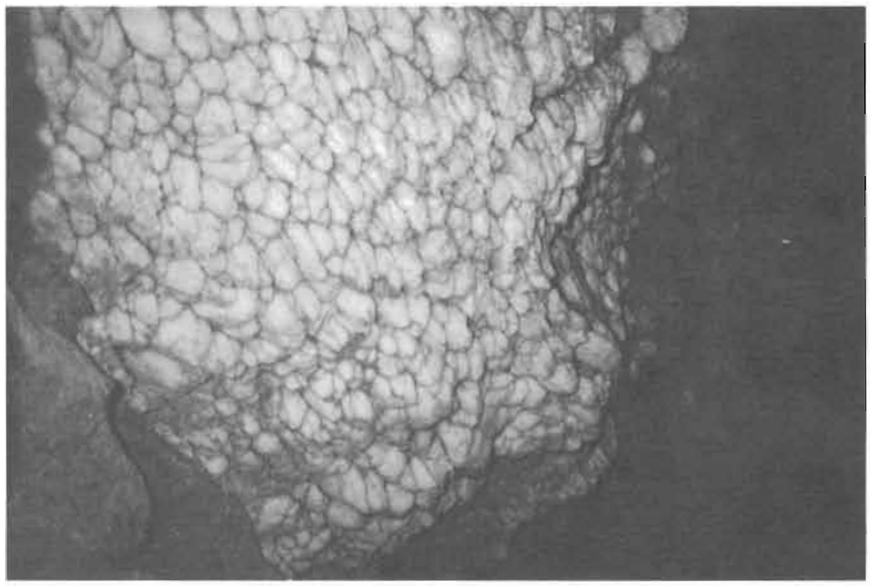


Figure GS-19-10: *Asymmetrical folds in gypsum layers within Labyrinth Cave.*

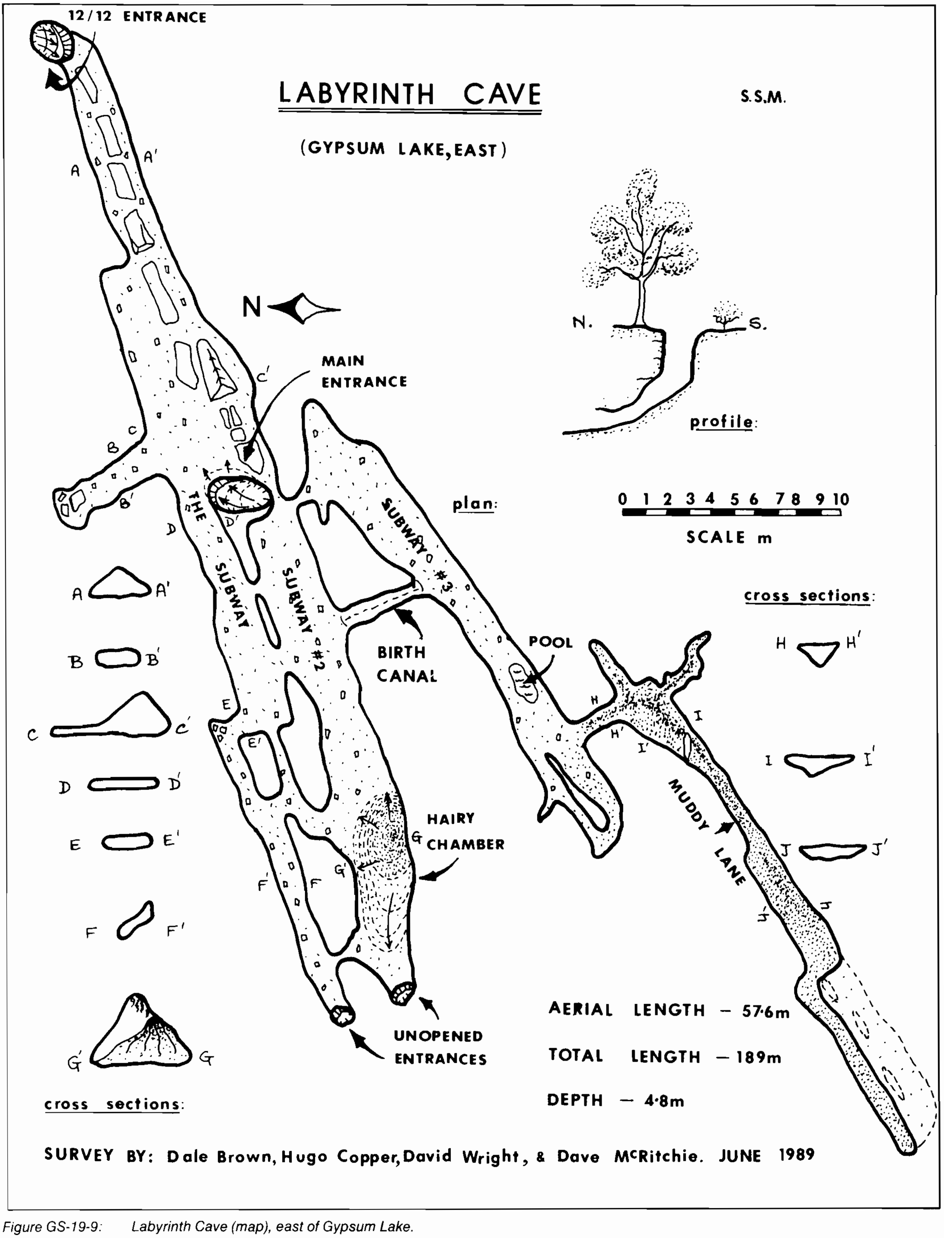


Figure GS-19-9: Labyrinth Cave (map), east of Gypsum Lake.

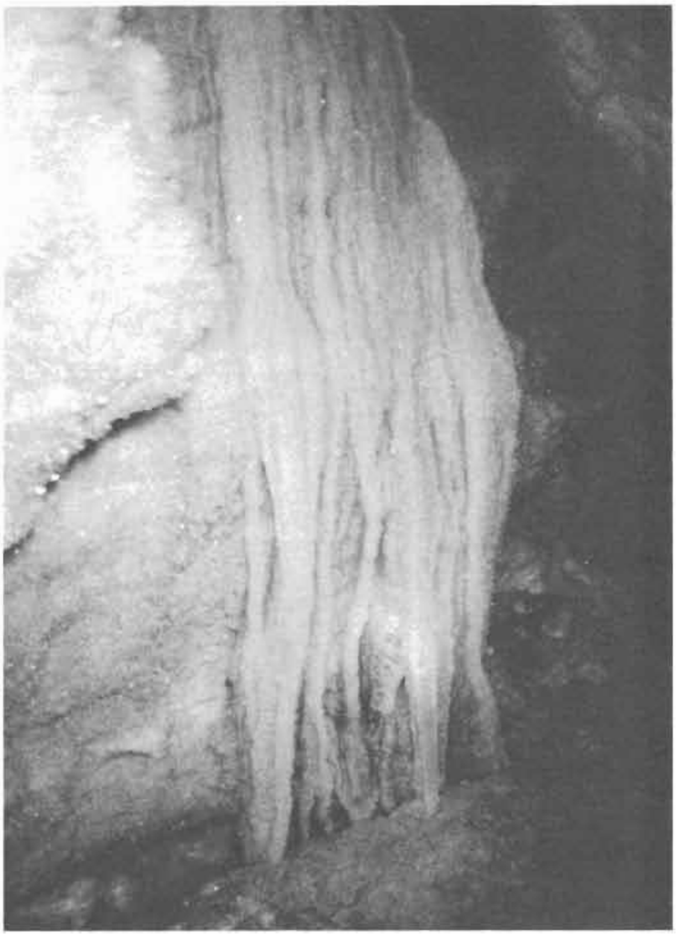
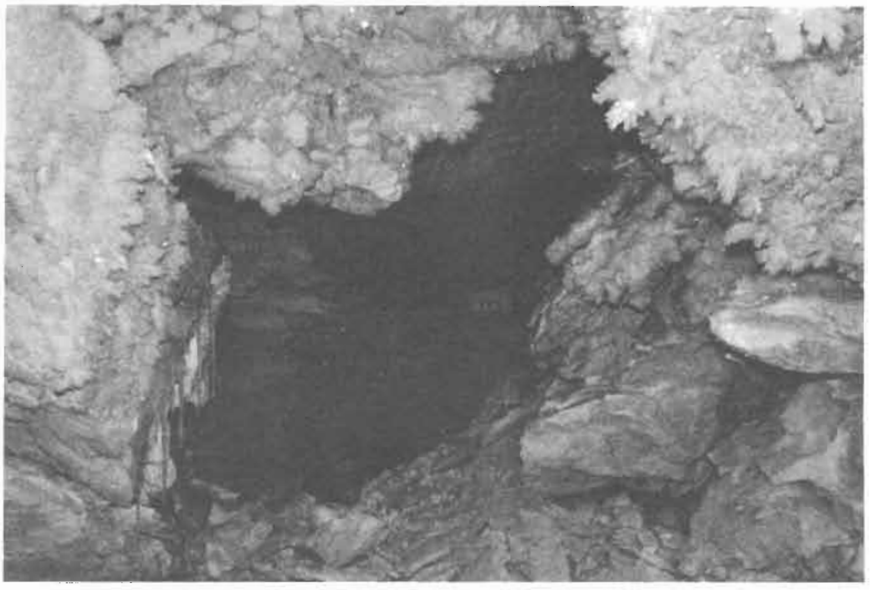


Figure GS-19-11: *Crenellated ice flowstone waterfall in Crystal Palace crawlway, east of Gypsum Lake.*

Figure GS-19-12: *Euhedral, hexagonal ice crystals and pendants in Octopus Cave similar to those in Crystal Palace, east of Gypsum Lake. (Photo Dave Fox, SSM).*

Figure GS-19-13: *Breakdown blocks and ice crystals leading to inner chamber of Crystal Palace. (Photo J. Rawluk, SSM.)*



ADDENDUM

In late October, close to 40 additional cave entrances were discovered in gypsum bedrock during exploratory traverses south and east of Gypsum Lake.

In most respects the caves resemble, in size and geometry, those described in the "north quarry" and "Labyrinth" areas. However, the maze of interconnecting corridors in the Catacombs south of Gypsum Lake, promises to yield passage lengths far in excess of the 189 m measured in Labyrinth; and Fold Cavern near the northern limit of the gypsum outcrop belt exhibits the highest (3 m) and most spacious chamber yet observed in the region as well as the greatest depth of room development below the surface (8-9 m).

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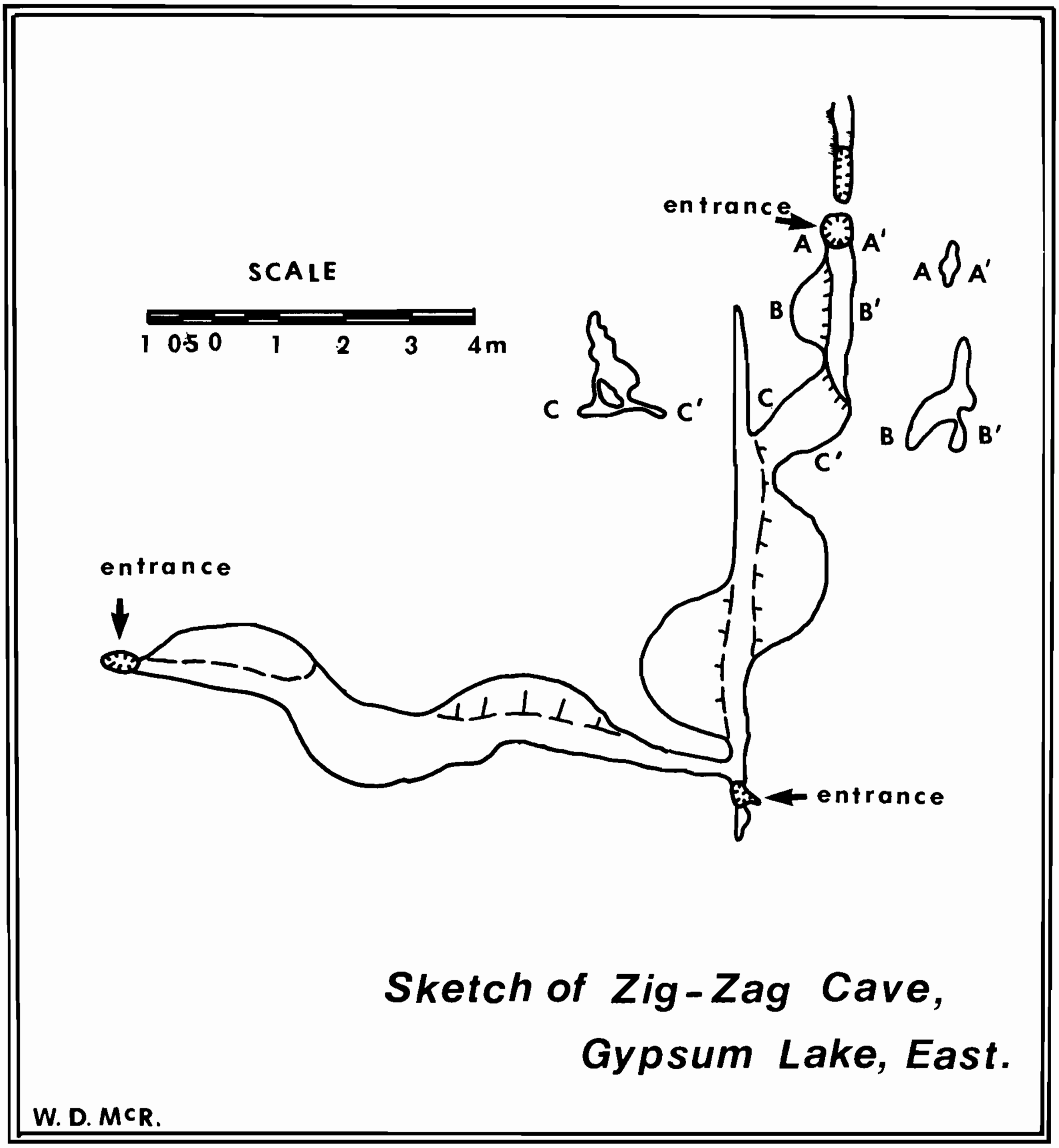

Figure GS-19-14a: Sketch map of Zig-zag Cave, east of Gypsum Lake.

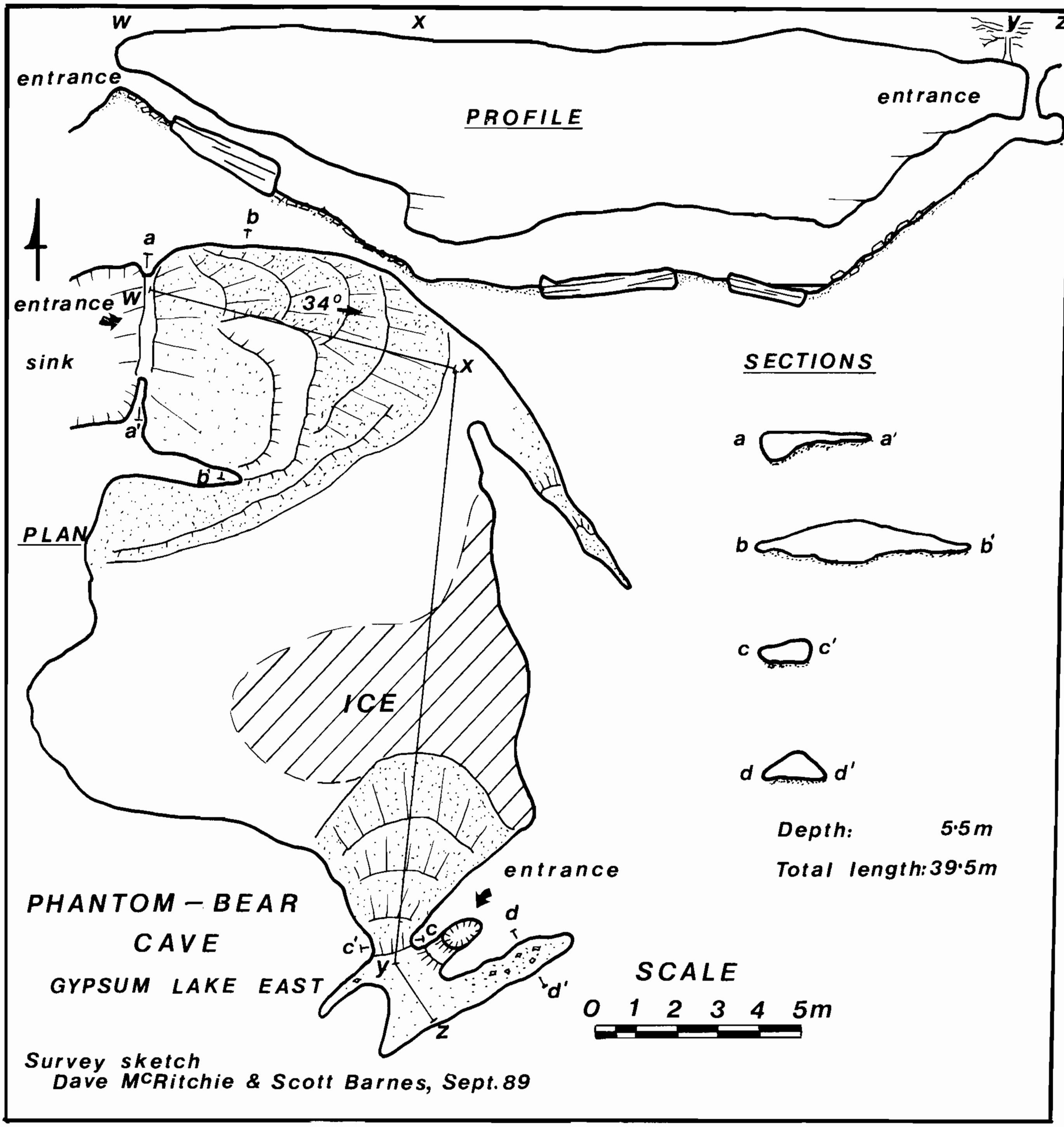

Figure GS-19-14b: Sketch map of Phantom-Beaver Cave, east of Gypsum Lake.

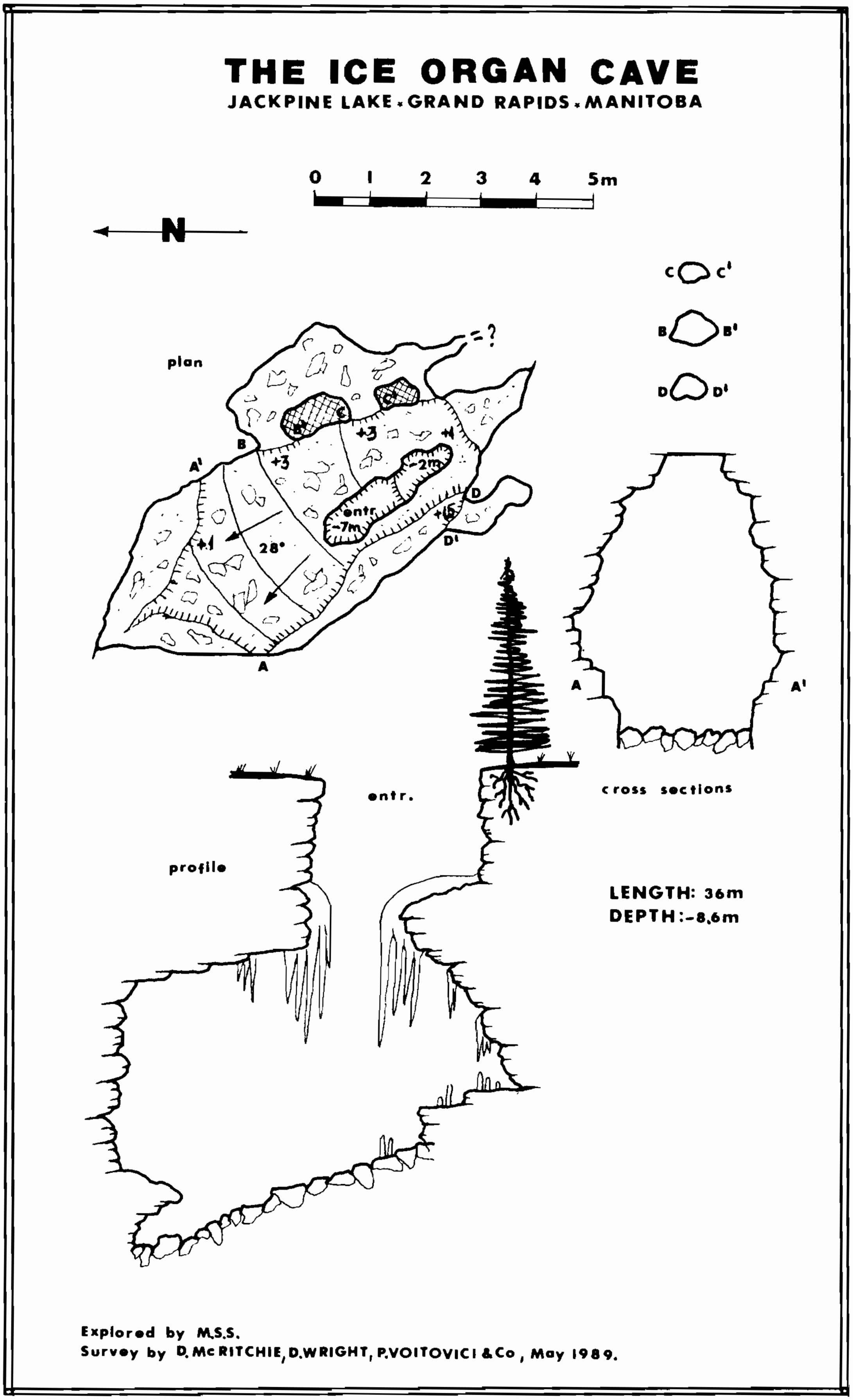

Figure GS-19-15a: Map of Ice-organ Cave, southwest of Jackpine Lake, Grand Rapids Uplands.

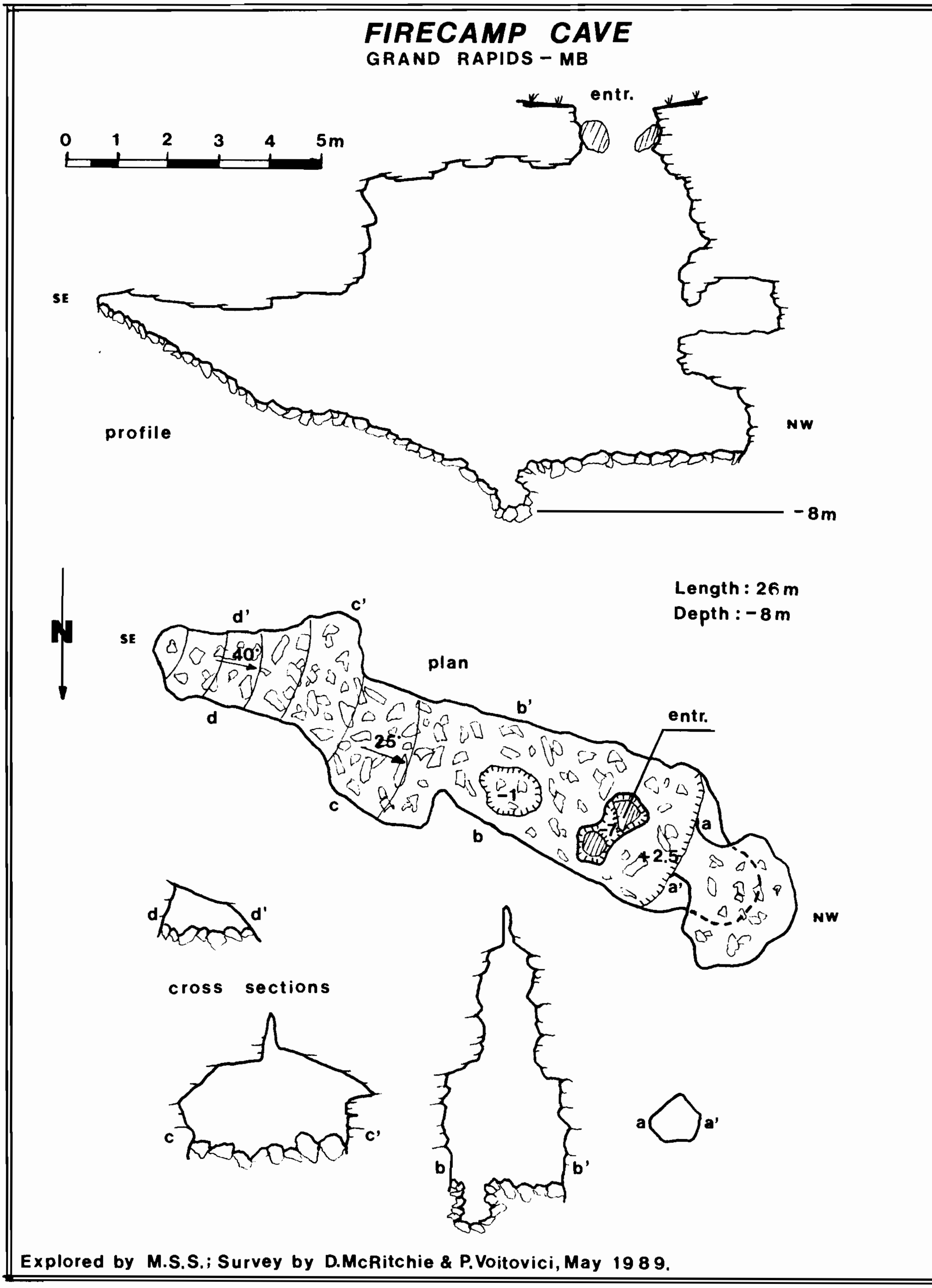

Figure GS-19-15b: Map of Firecamp Cave, Grand Rapids Uplands.

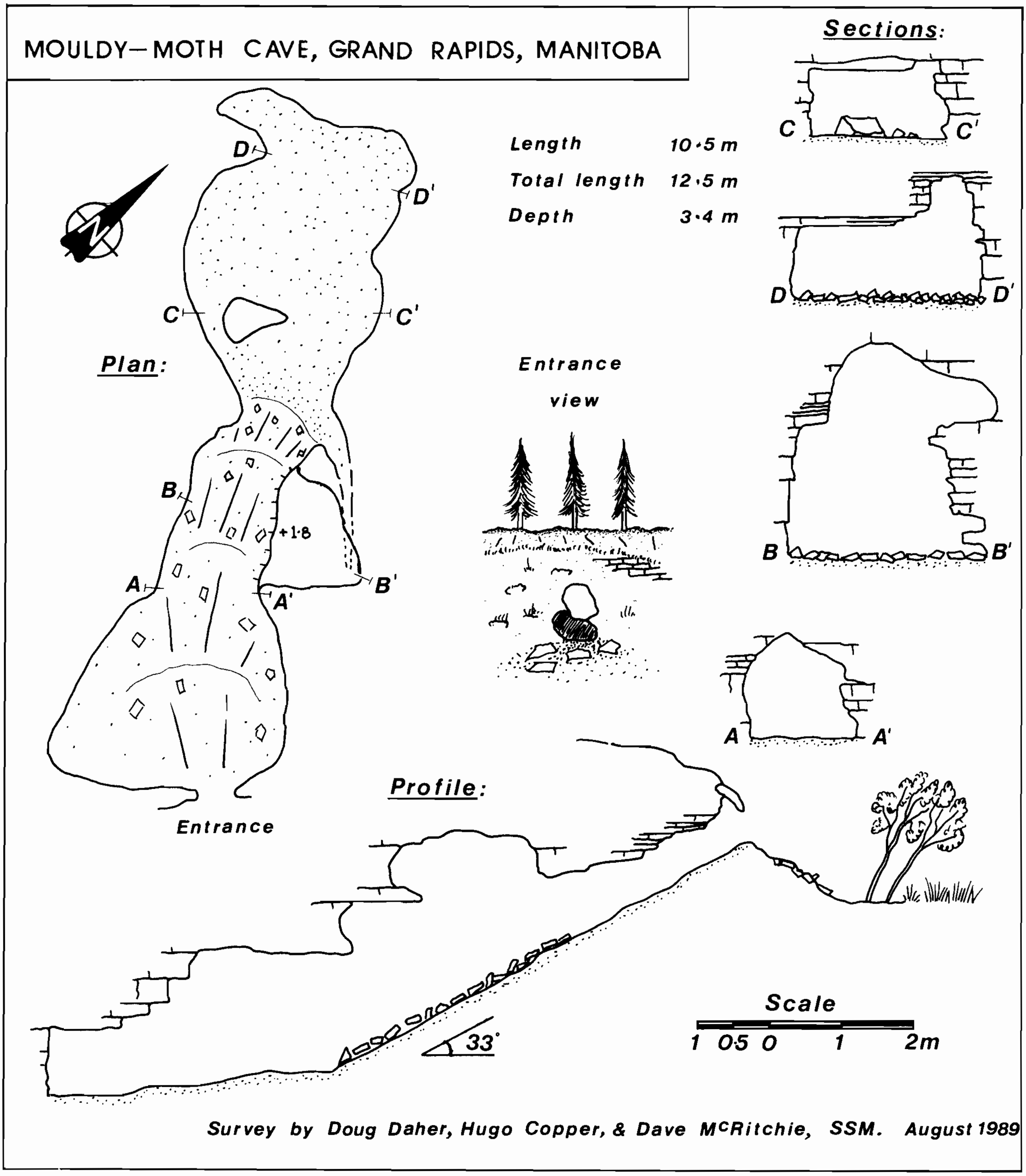

Figure GS-19-16a: Map of Mouldy-Moth Cave, Grand Rapids Uplands.

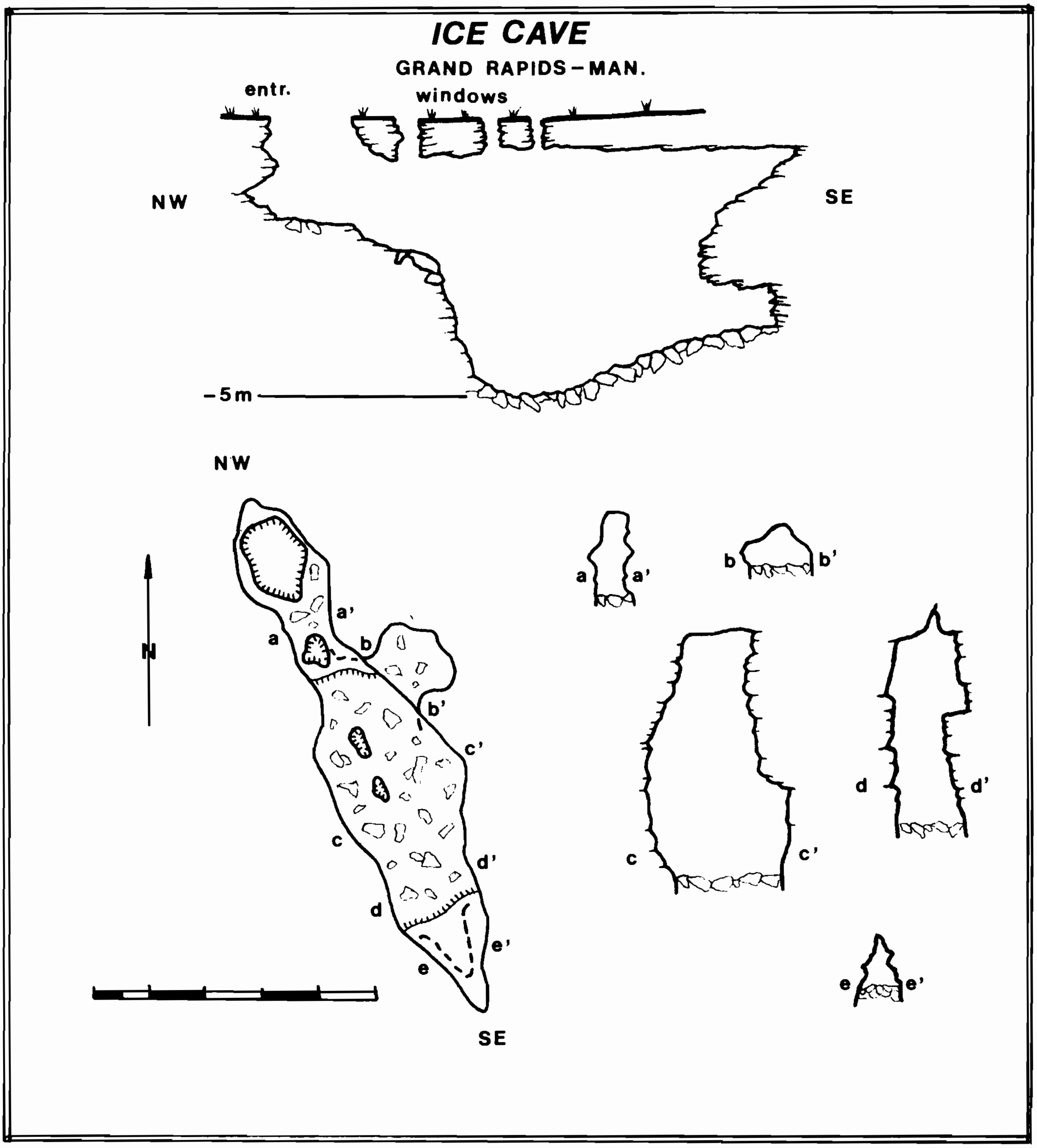

Figure GS-19-16b: Map of Ice Cave, Grand Rapids Uplands.

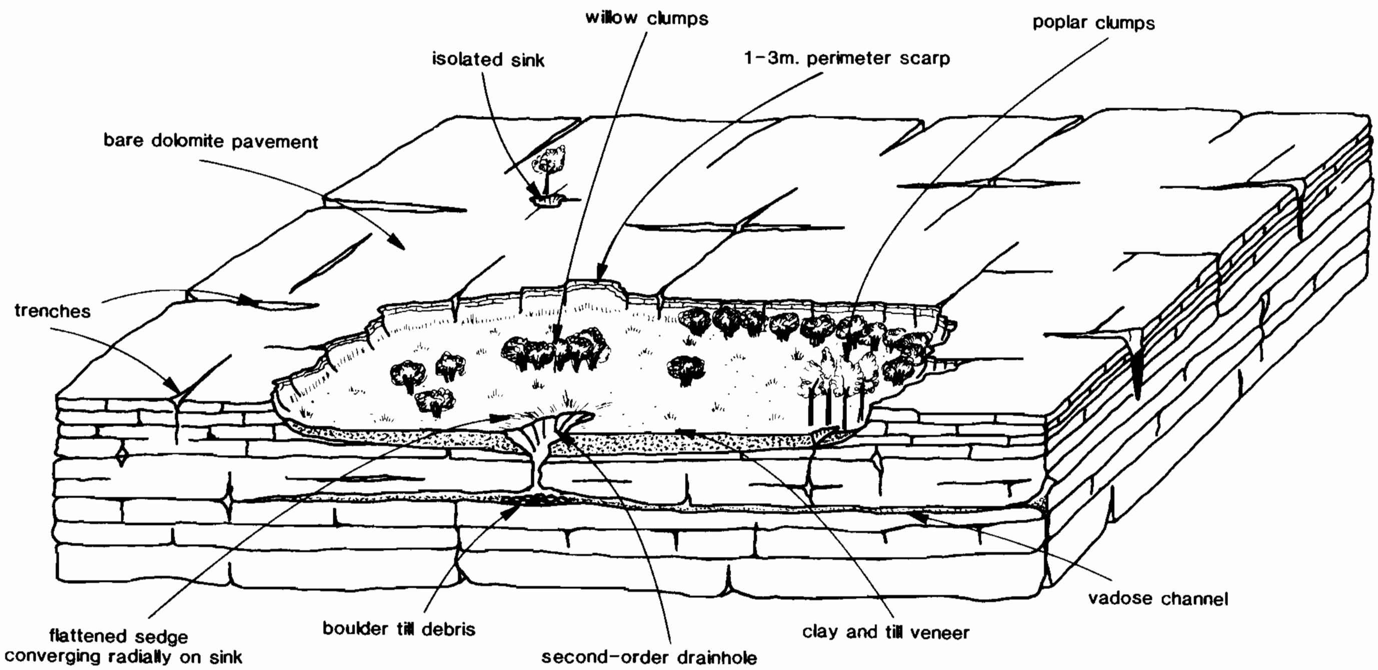

Figure GS-19-17: Sketch of regional depression and secondary drain hole together with associated features common in the Grand Rapids Uplands.

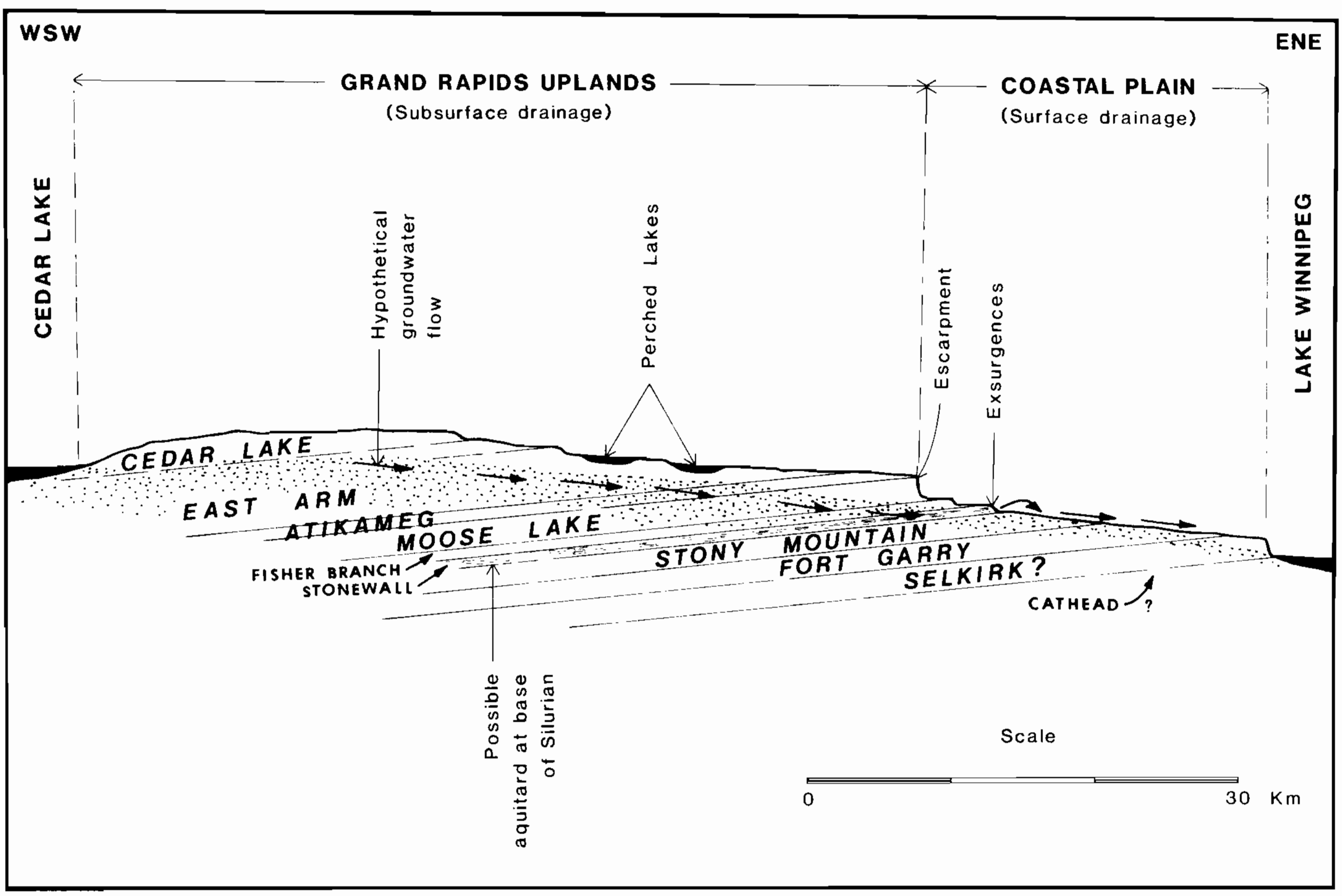

Figure GS-19-18: Possible groundwater configuration, Grand Rapids Uplands and neighbouring coastal plain.