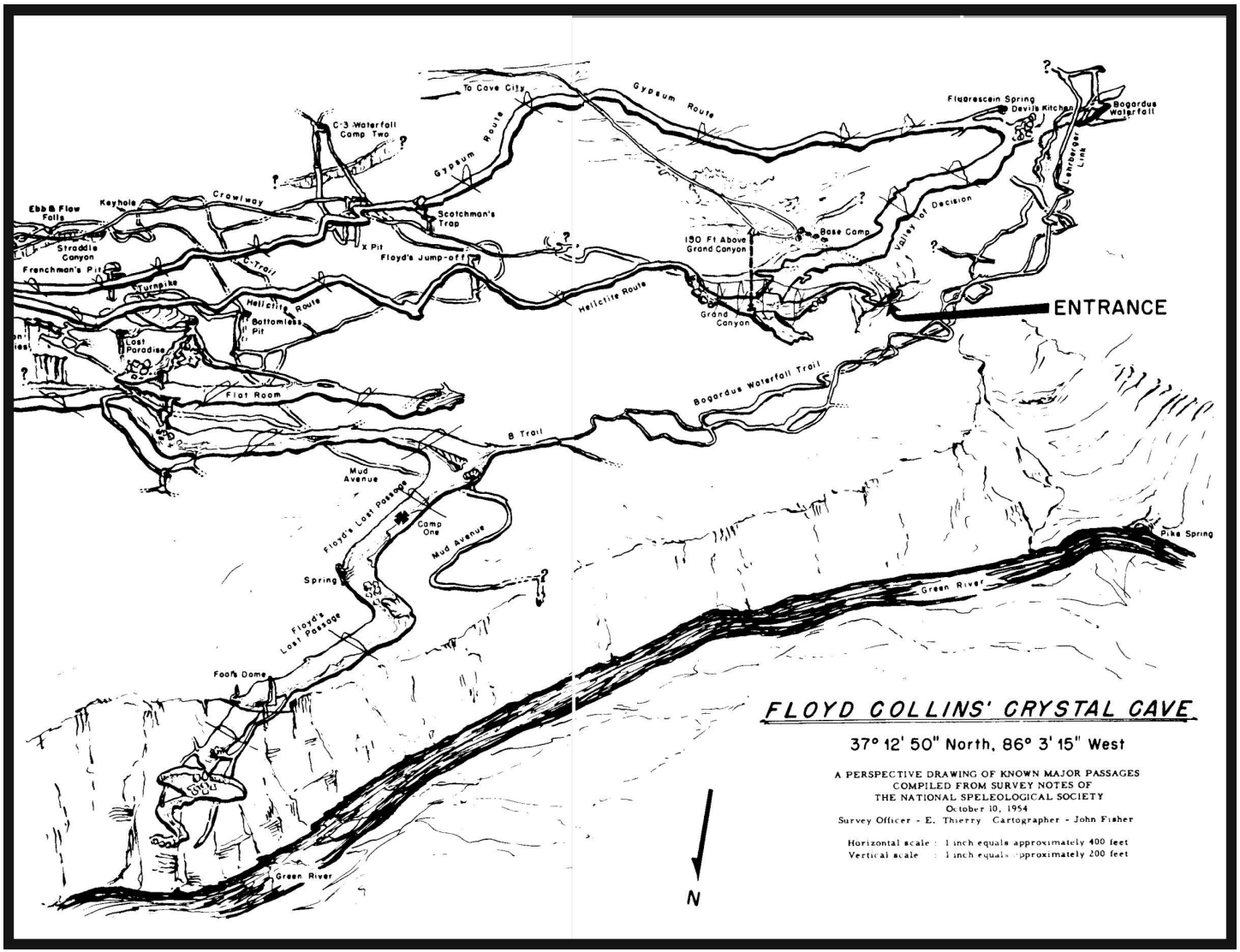
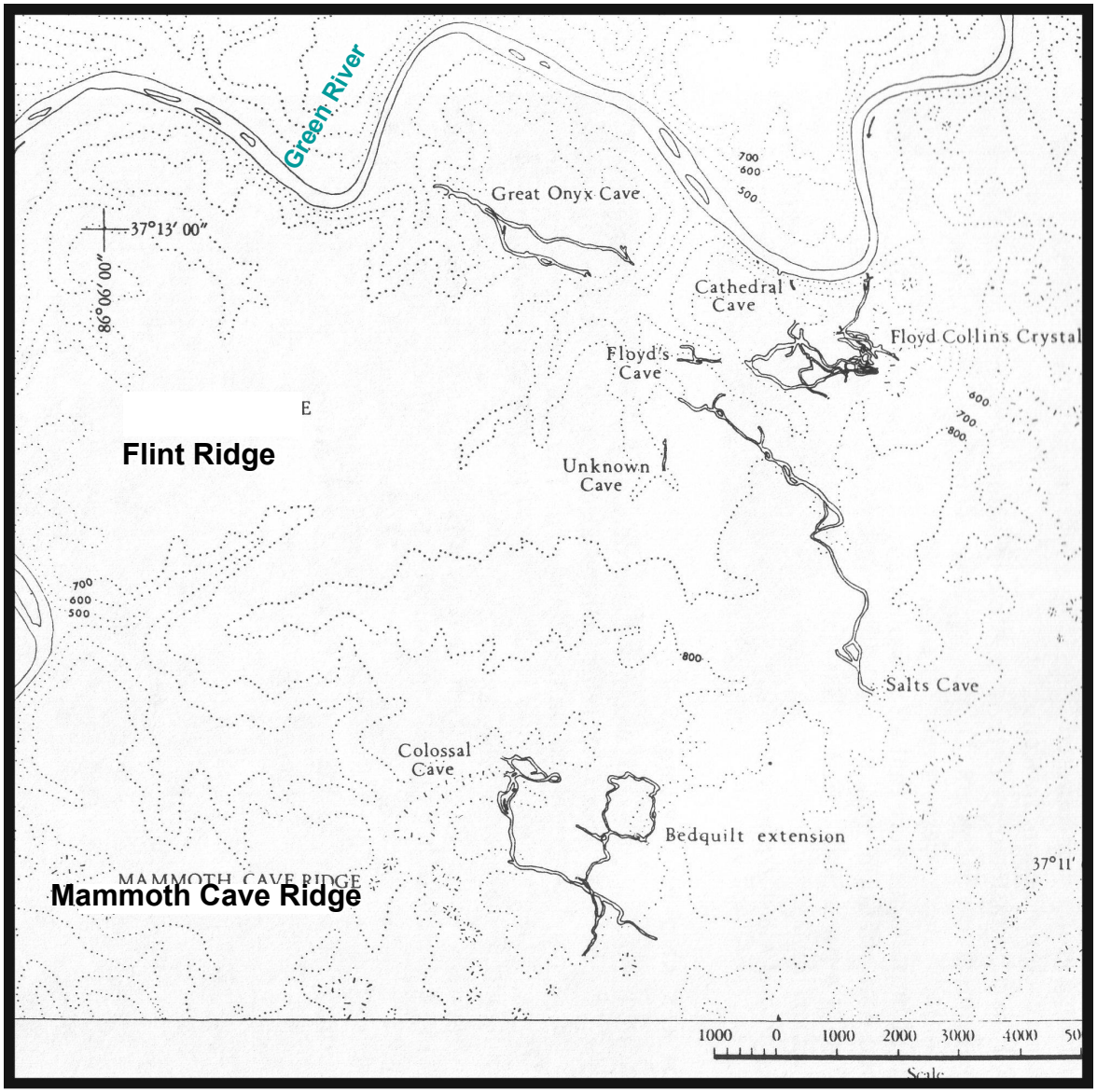
Why do we map caves?

Mapping Guess What Cave, Jackson Co., Alabama
Photo: Alan Cressler

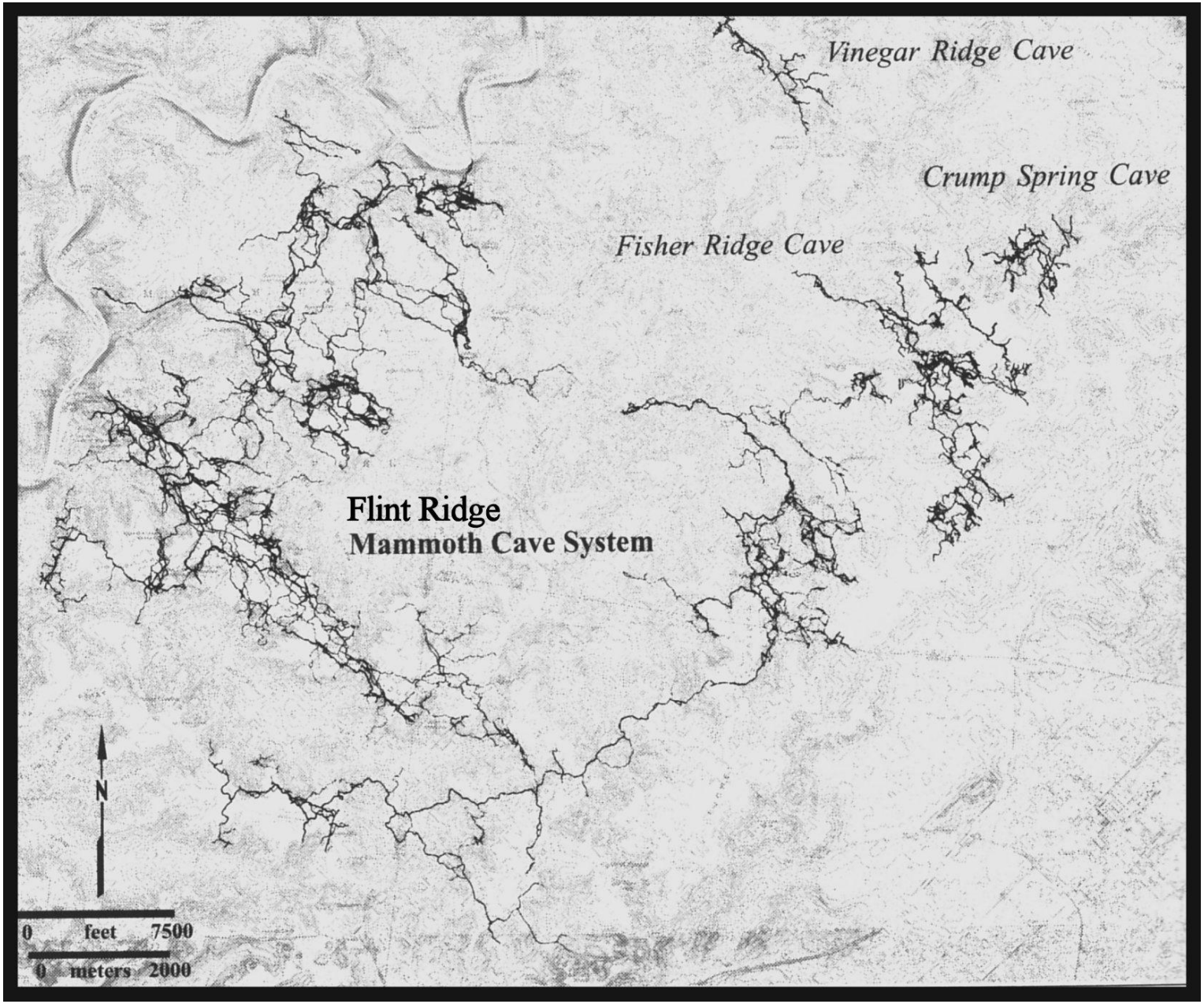
Where does the cave go? (what is its lateral and vertical extent)?
What is the spatial relationship of cave passages to each other?

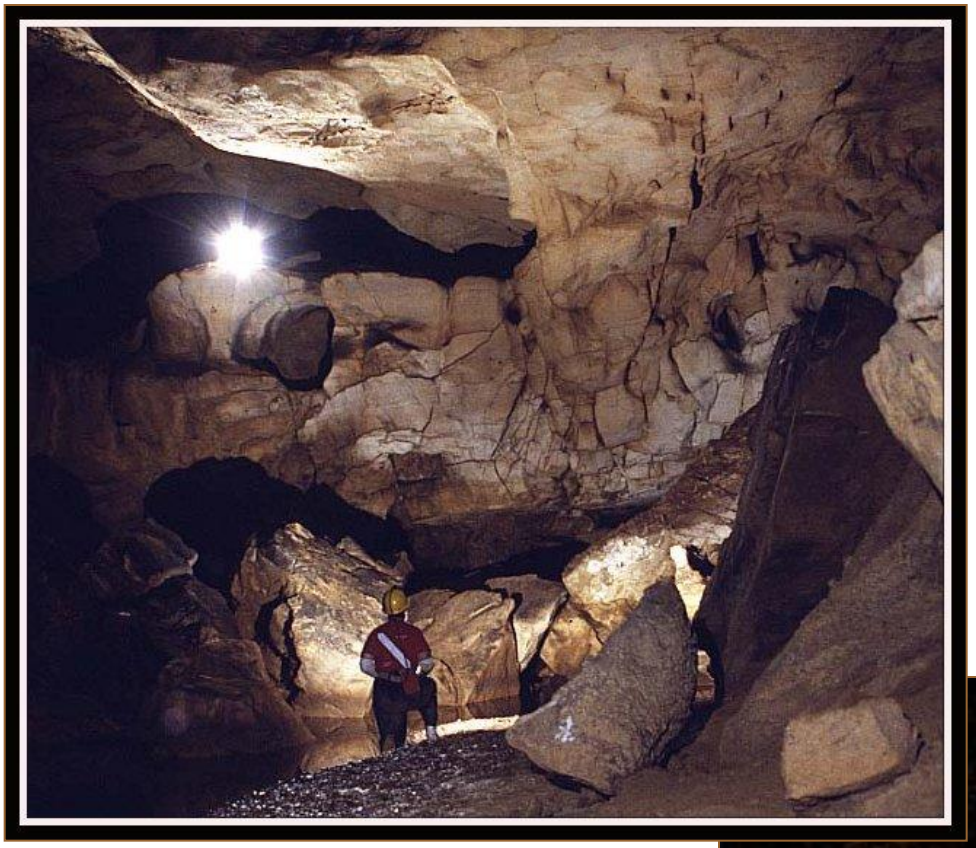


Where do caves lie with respect to the surface and to specific surface features?

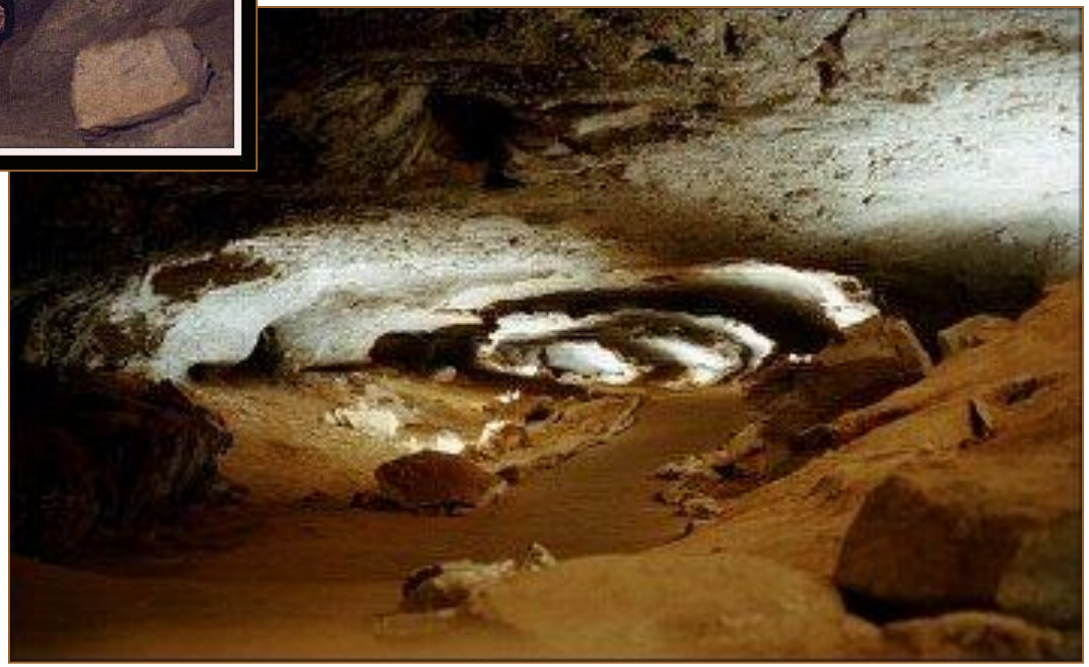


How do area caves relate to one another?





What are the dimensions and shapes of passages?



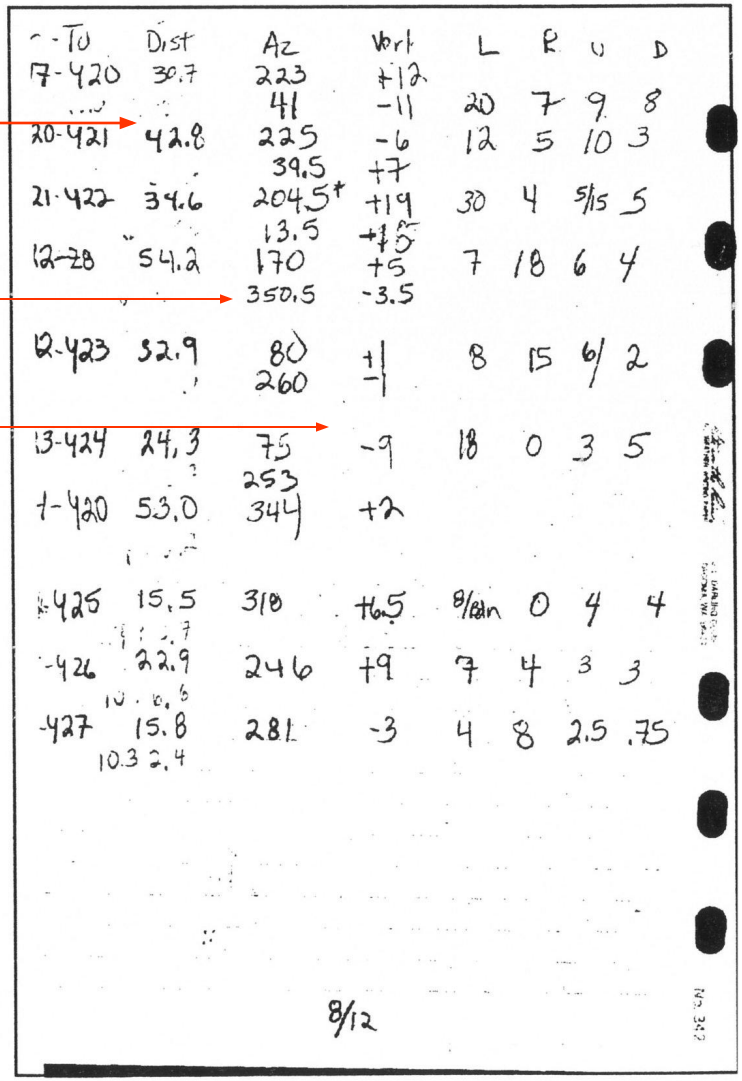
These questions can be answered with the following data:

1. Measured distance (using fiberglass tapes or laser rangefinders)

2. Bearing or azimuth (with a compass)

3. Inclination (with an inclinometer)

4. Surface surveys or GPS locations that tie cave survey to surface benchmarks



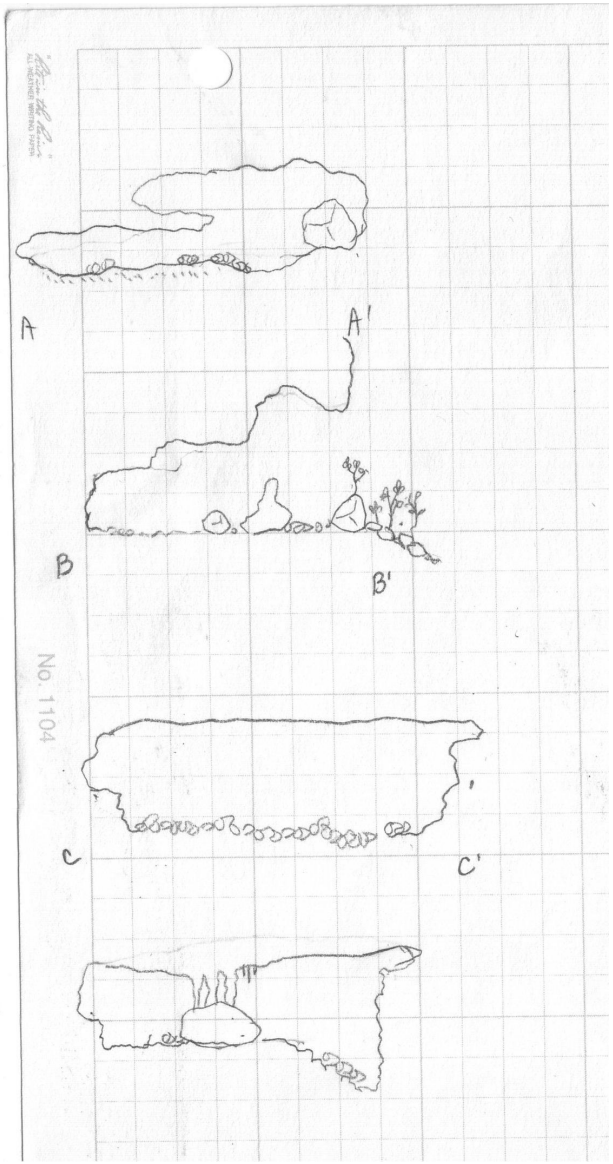
From-To	Dist	Az	Vert	L	R	U	D
7-420	30.7	223	+12				
		41	-11	20	7	9	8
20-421	42.8	225	-6	12	5	10	3
		39.5	+7				
21-422	34.6	204.5*	+19	30	4	5/15	5
		13.5	+15				
12-28	54.2	170	+5	7	18	6	4
		350.5	-3.5				
12-423	52.9	80	+1	8	15	6/	2
		260	-1				
13-424	24.3	75	-9	18	0	3	5
		253					
1-420	53.0	344	+2				
425	15.5	318	+6.5	8/Bdn	0	4	4
426	22.9	246	+9	7	4	3	3
427	15.8	281	-3	4	8	2.5	.75

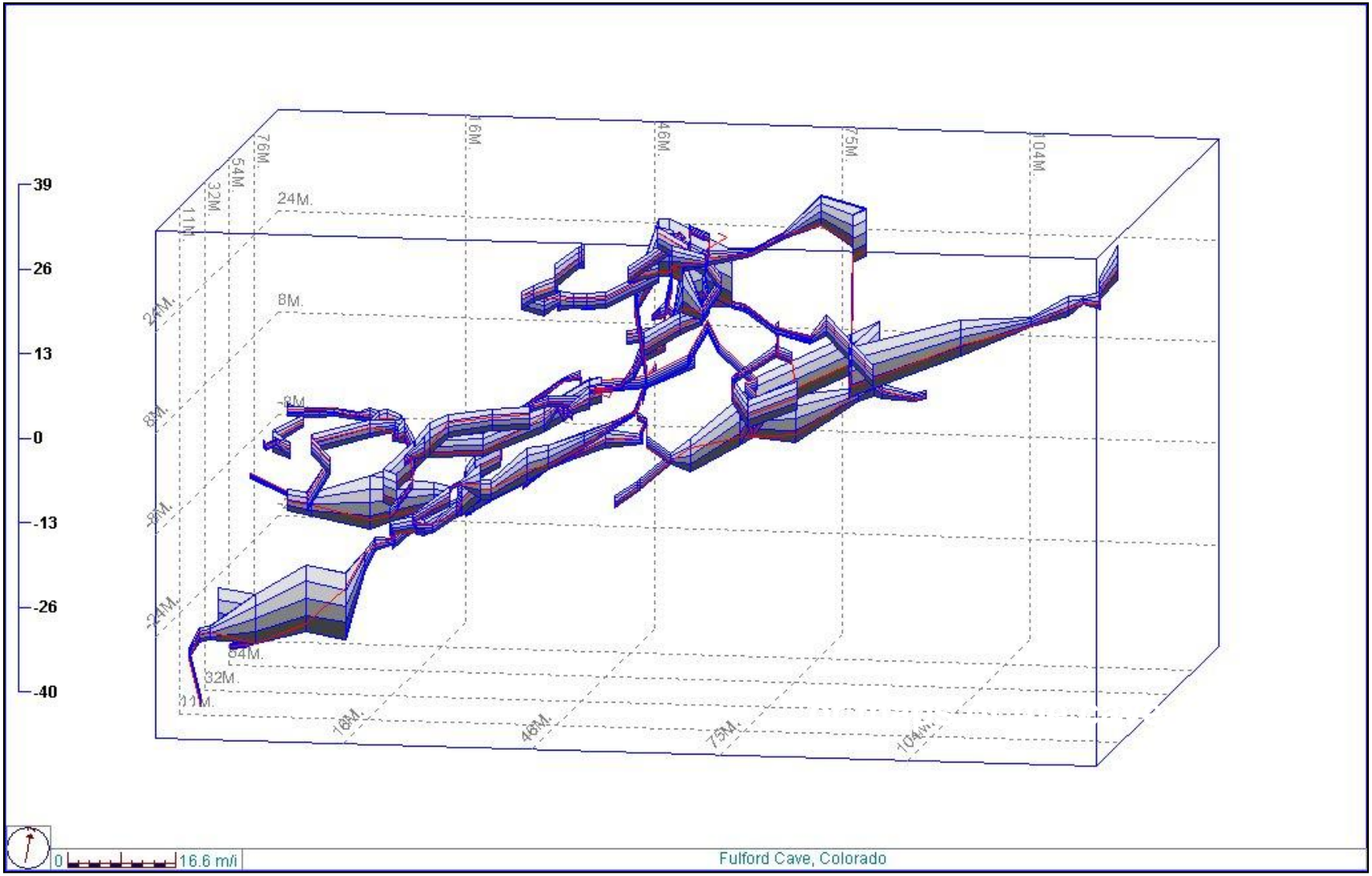
8/12

5. Passage dimensions

Station	Distance		Azimuth	Vertical Angle	left	right	up	down	Notes
B5	37.5	fs	317	+15	12	15	25	0/8	
		bs	135	−15					
B6	28.5	fs	349	−9	6	0/8	3	4.5	
		bs	167	+10					
B7	23.8	fs	268	−4	7	0	1	3	
		bs	86	+5					
B8	35.2	fs	164	+5	2	8	5	0	
		bs	346	−4					
B9	40.1	fs	89	−21	0	–	8	3	
		bs	—	—					
B10		fs			5	5	12	3/17	
		bs							

6. Cross Sections

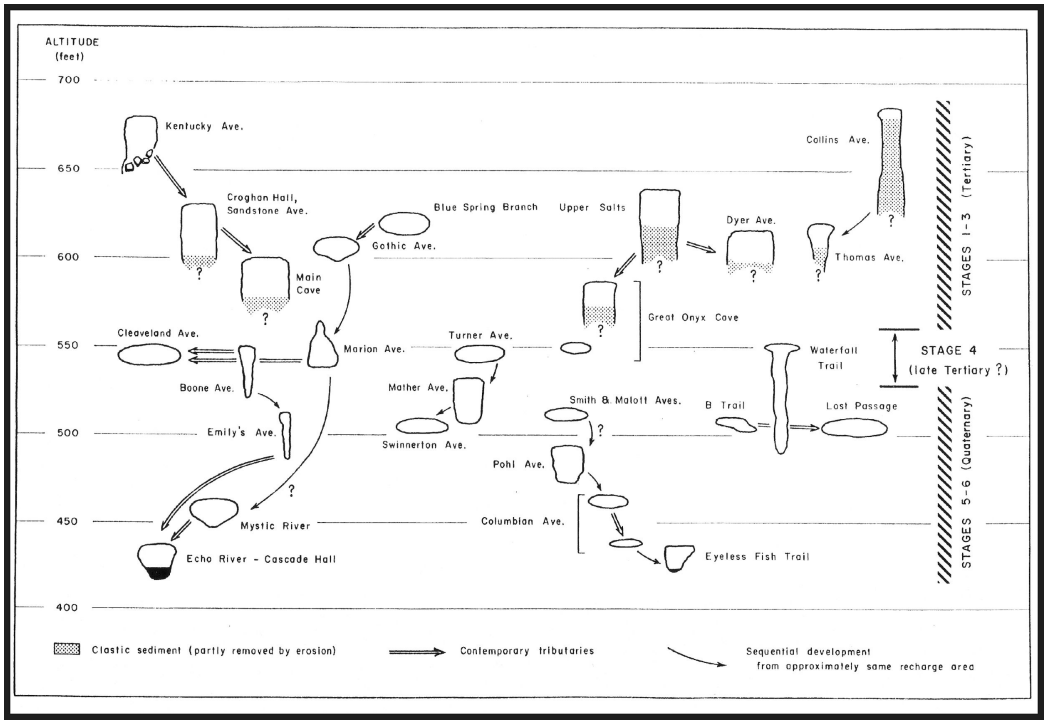




Passage dimensions are used in passage modeling Software, and for producing interim plots, or actual maps.

What can the passage dimension/cross section data tell us?

This data is used to show the morphology (shape) of cave passages which helps us understand how the cave is developed.



Passage morphology and levels in Mammoth Cave

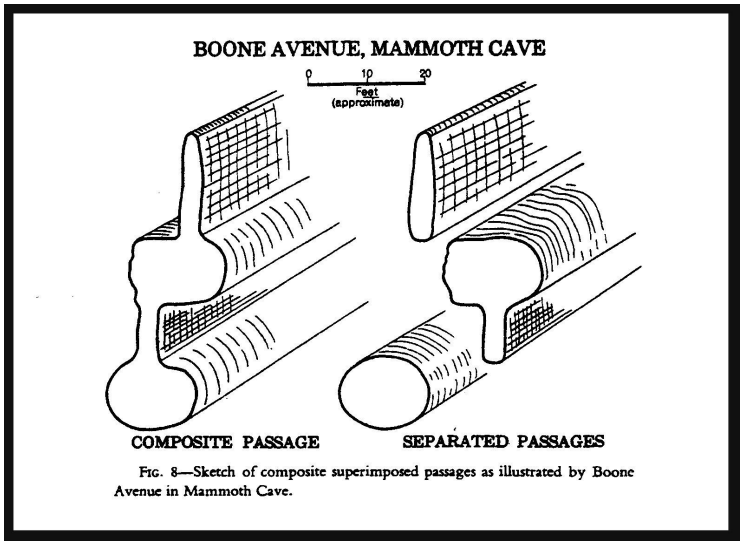
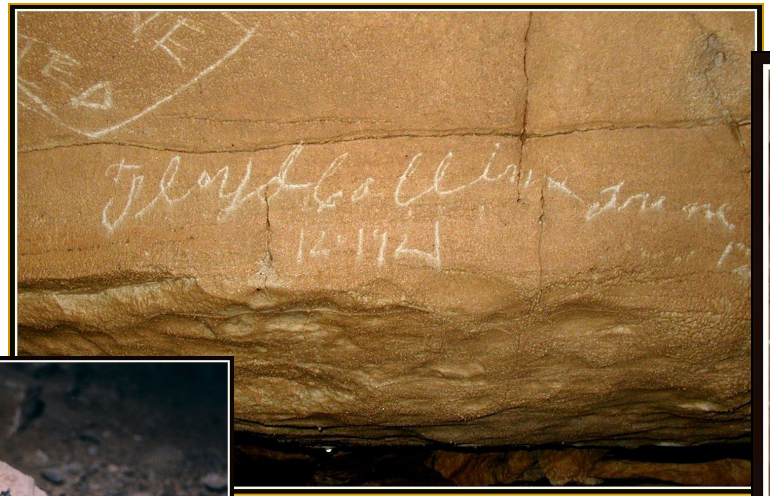


FIG. 8—Sketch of composite superimposed passages as illustrated by Boone Avenue in Mammoth Cave.

Passage shape and cave development

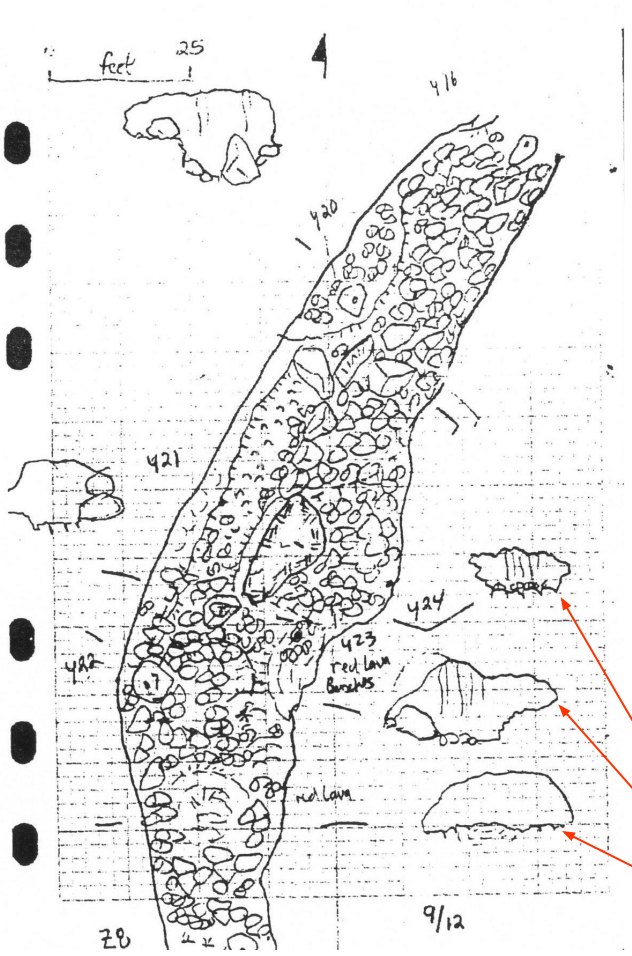
What is the nature of the cave passage?
What do the cave passages look like?

What are the resources contained within the cave passage?

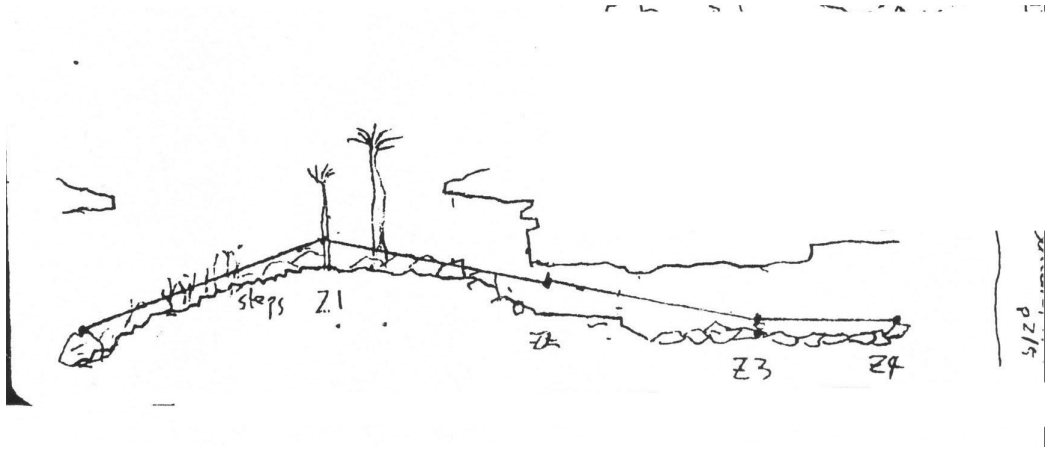


This information is revealed through detailed field sketches of the cave in all three dimensions (plan, profile, cross section)

Plan View



Profile View



Cross sections

Once the data is collected, what do we do with it?

Cave Editor - FARWEST.DAT

File Surveys Heading Shots Block Options Help

Select Survey | Edit Heading | Edit Survey

#	From	To	Tape	Comp	Inc	Left	Right	Up	Down
1	IBP23	IBP24	10.00ft	342.00	0.00	0.00ft	0.00ft	0.00ft	0.00ft
2	IBP24	IBP25	17.30ft	196.00	-7.00	15.00ft	15.00ft	9.00ft	5.00ft
3	IBP25	IBP26	8.20ft	155.00	-46.00	5.00ft	10.00ft	12.00ft	9.00ft
4	IBP26	IBP27	18.20ft	208.00	-3.00	2.00ft	12.00ft	6.00ft	3.00ft
5	IBP27	IBP28	6.90ft	0.00	-90.00	3.00ft	4.00ft	3.00ft	7.00ft
6	IBP28	IBP29	6.80ft	181.00	-44.00	3.00ft	2.00ft	7.00ft	0.00ft
7	IBP29	IBP30	11.70ft	239.00	-12.00	3.00ft	2.00ft	5.00ft	0.00ft
8	IBP30	IBP31	16.80ft	201.00	4.00	0.00ft	2.00ft	2.00ft	2.00ft
9	IBP31	IBP32	5.10ft	93.00	41.50	3.00ft	1.00ft	0.00ft	1.00ft
10	IBP32	IBP33	12.40ft	222.00	5.00	2.00ft	1.00ft	2.00ft	0.50ft

Cell: 3,1 | Shots: 21 | Modified: No | Errors: Invalid number!

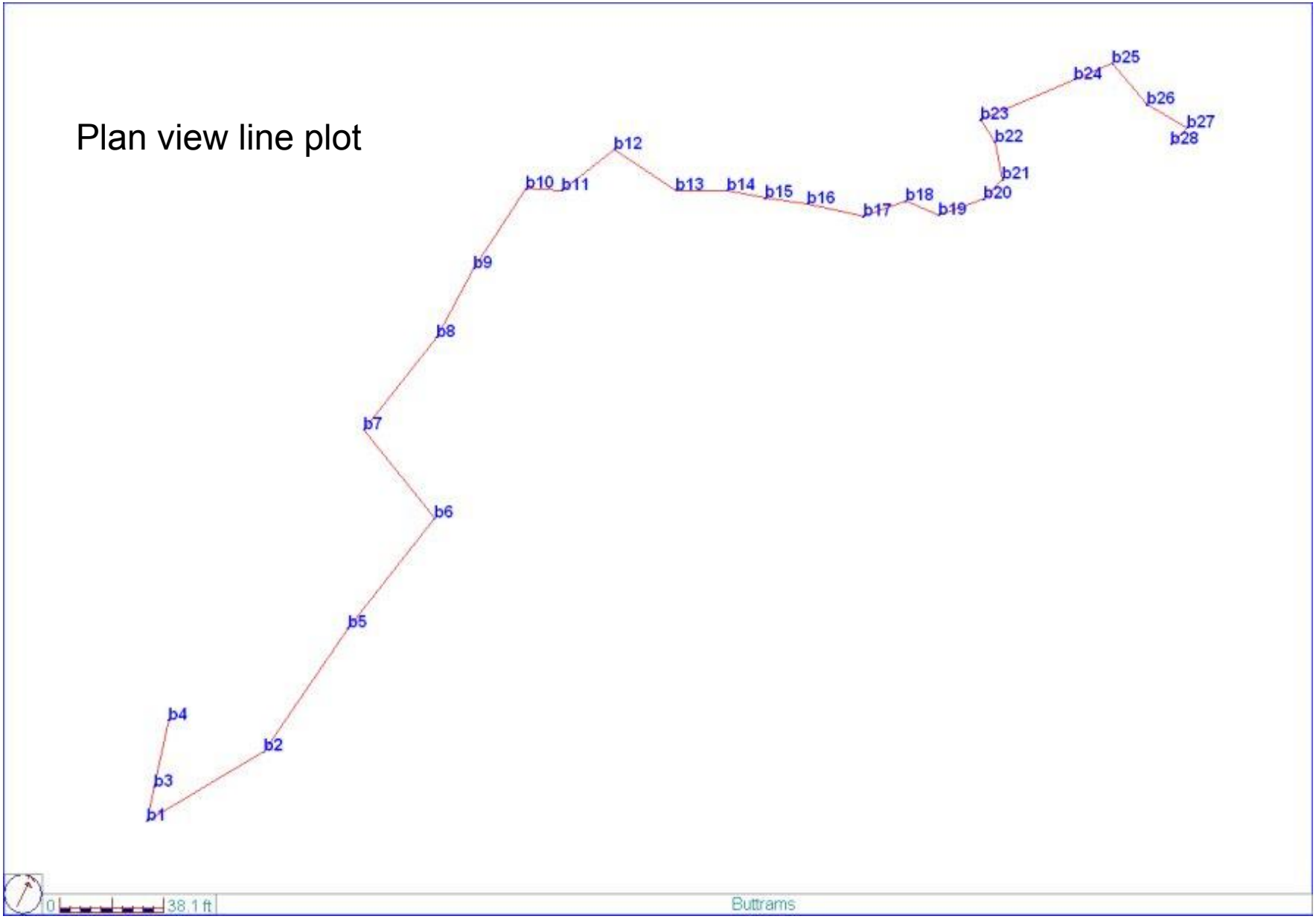
Enter: Decimal Feet

1. Review survey data and sketches for quality control

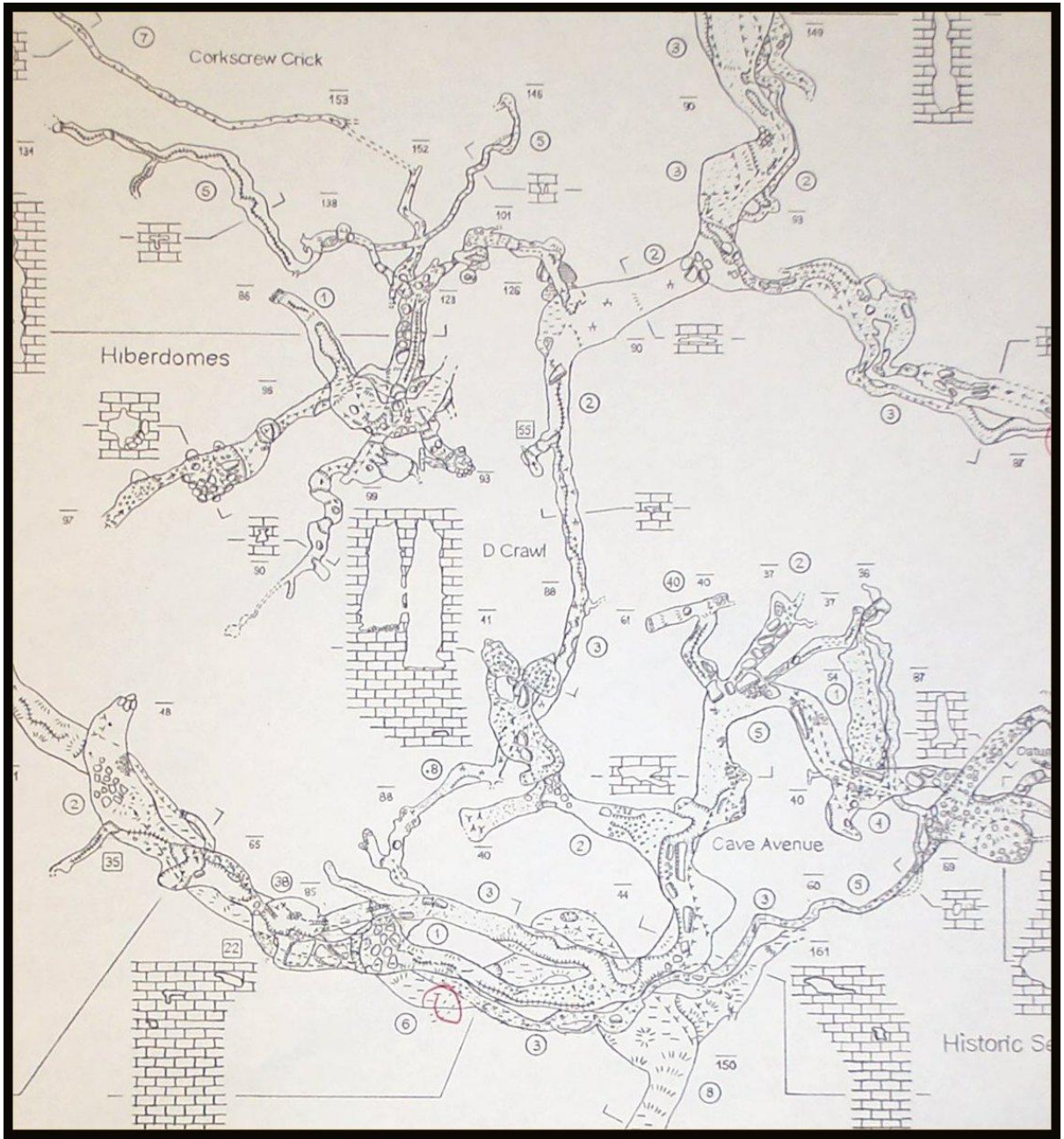
2. Enter survey data into data reduction/plotting software

The software will convert the data to rectangular coordinates, check on its accuracy, and produce digital and hard copy line plots, to be used for various map representations.

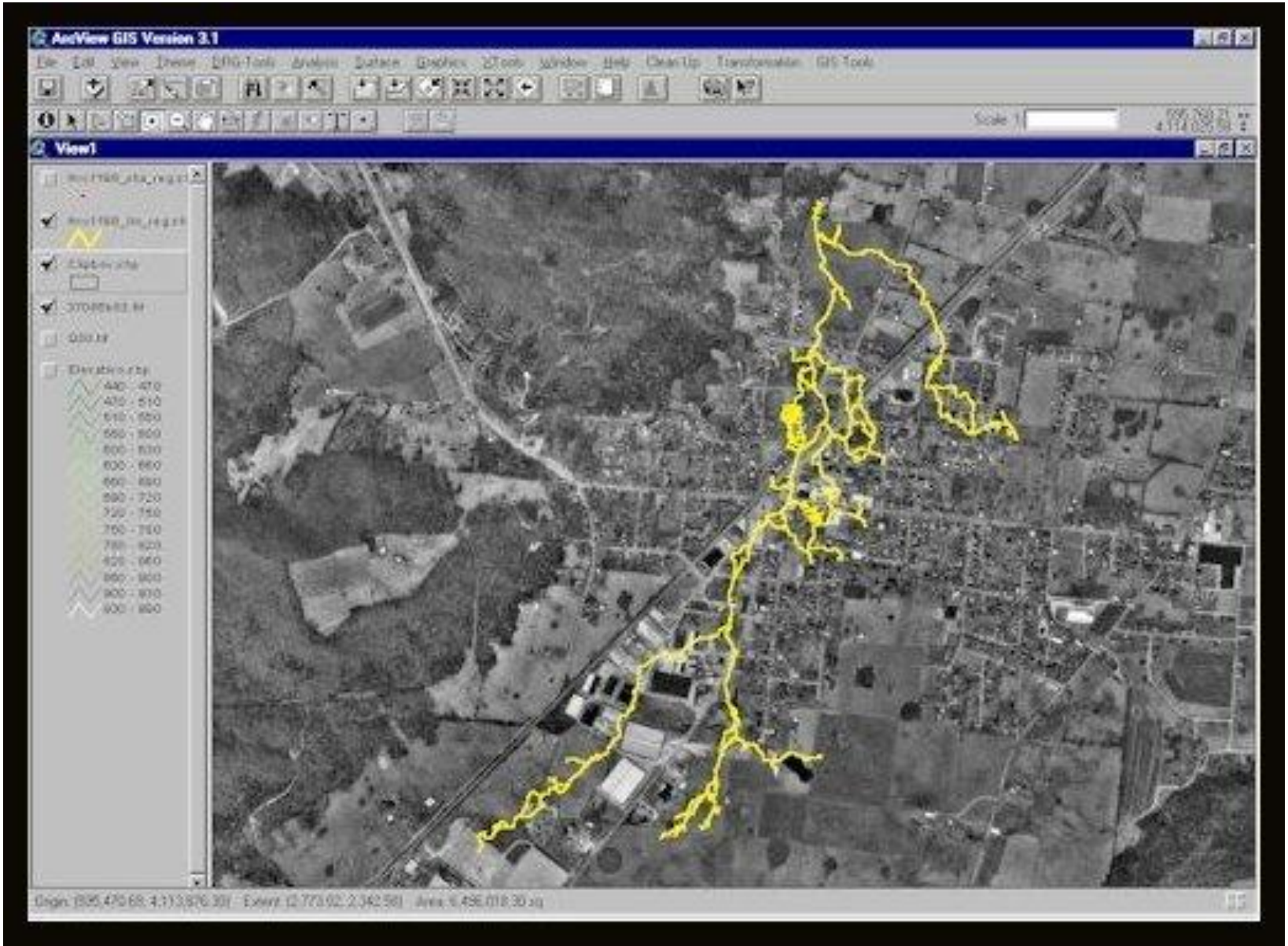
Plan view line plot



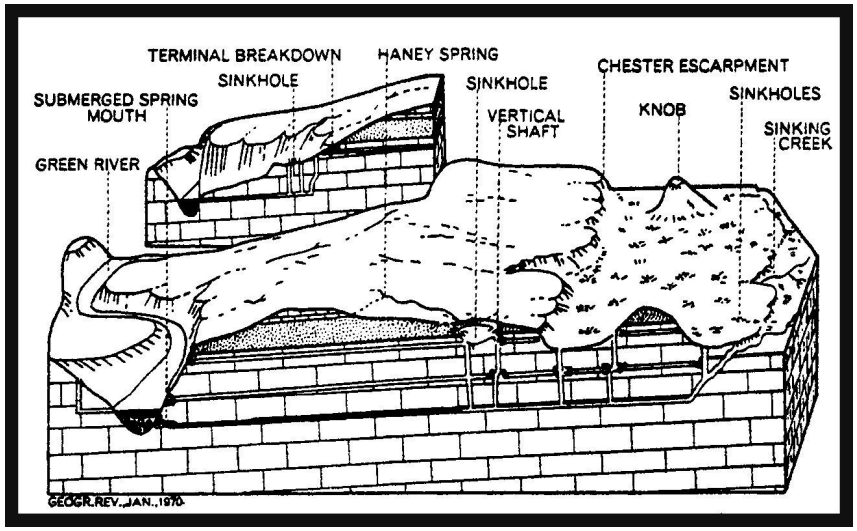
Line plots are used to make cave maps



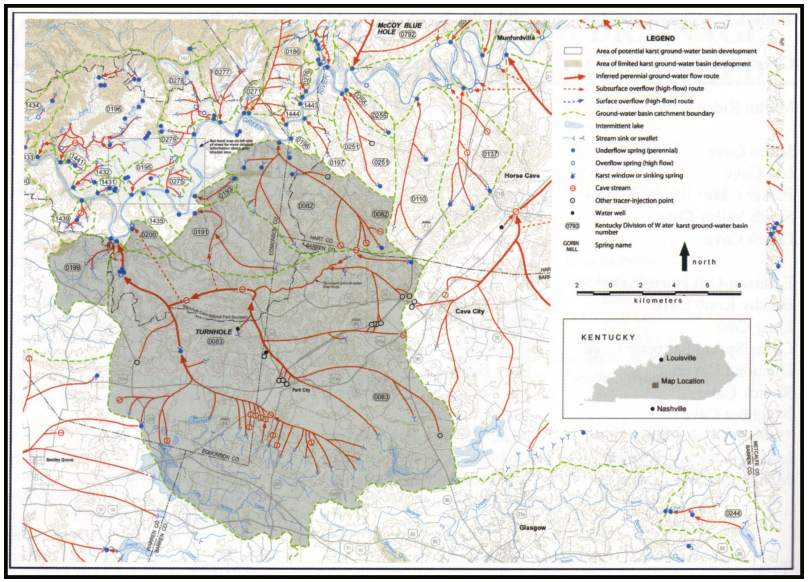
The cave data can also be used for GIS applications



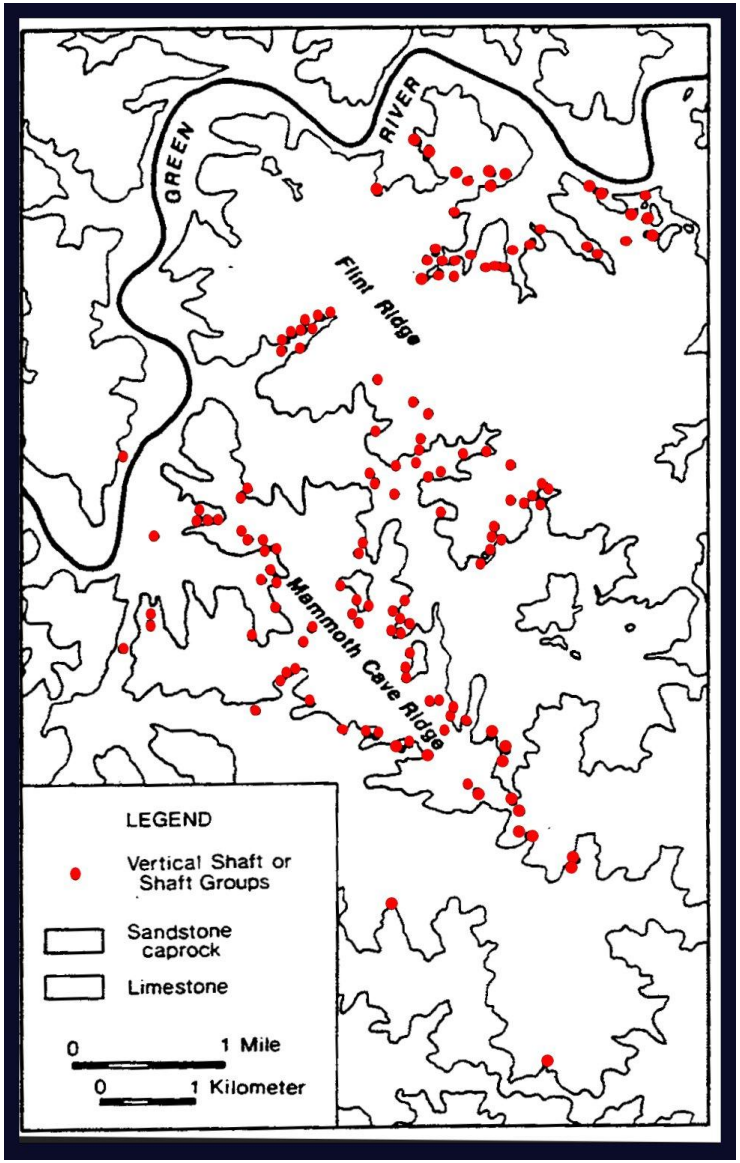
Cave data and maps are important for research, education and conservation



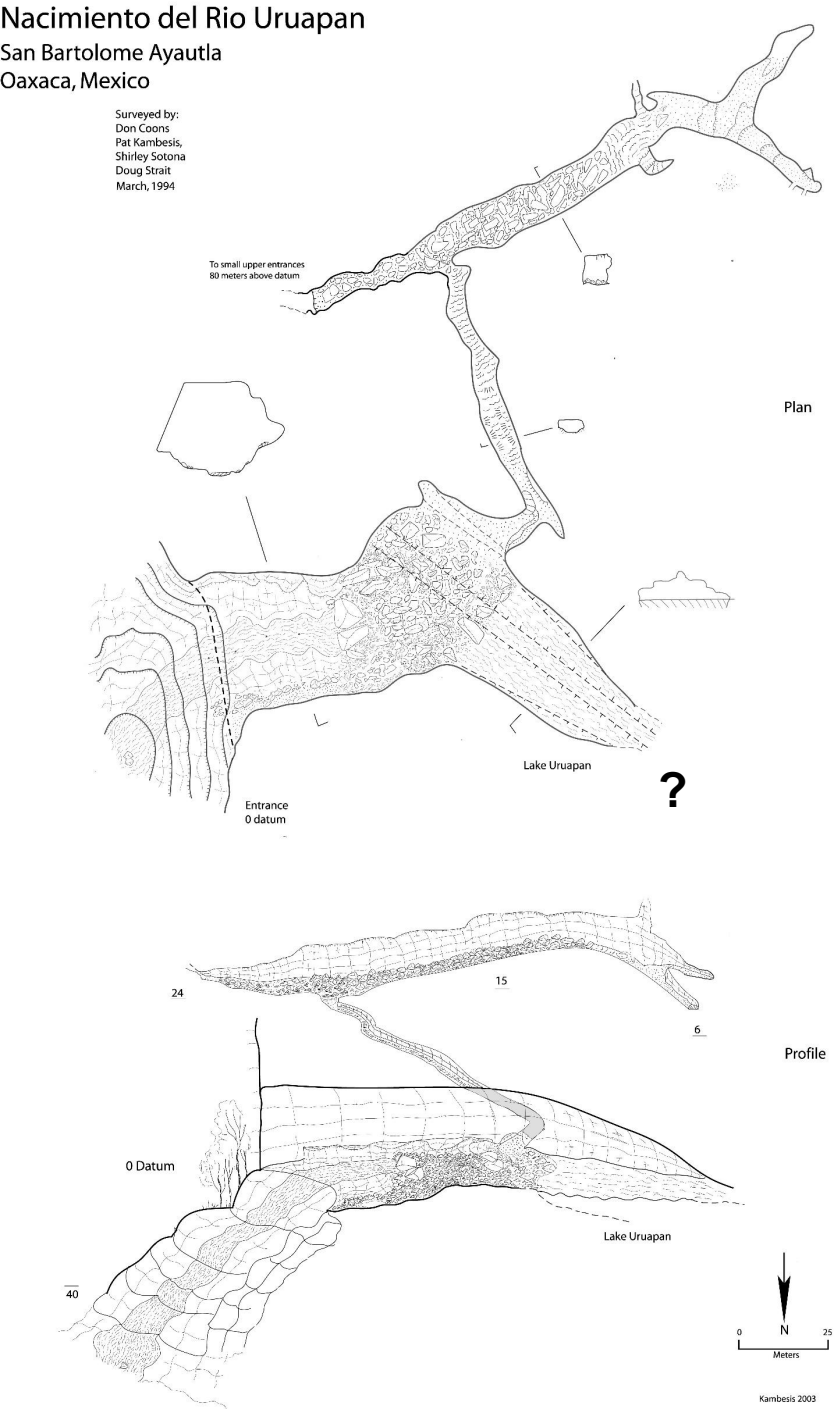
How cave passage relate to the land surface



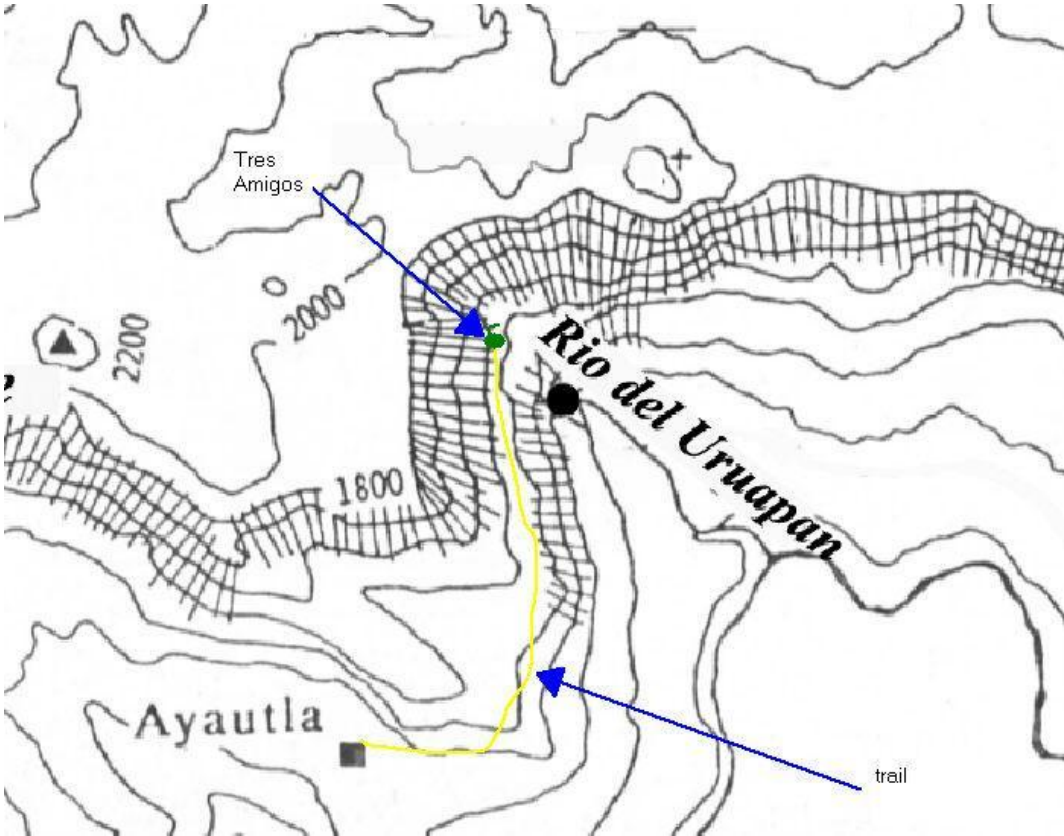
Dye trace results and relation to cave passages



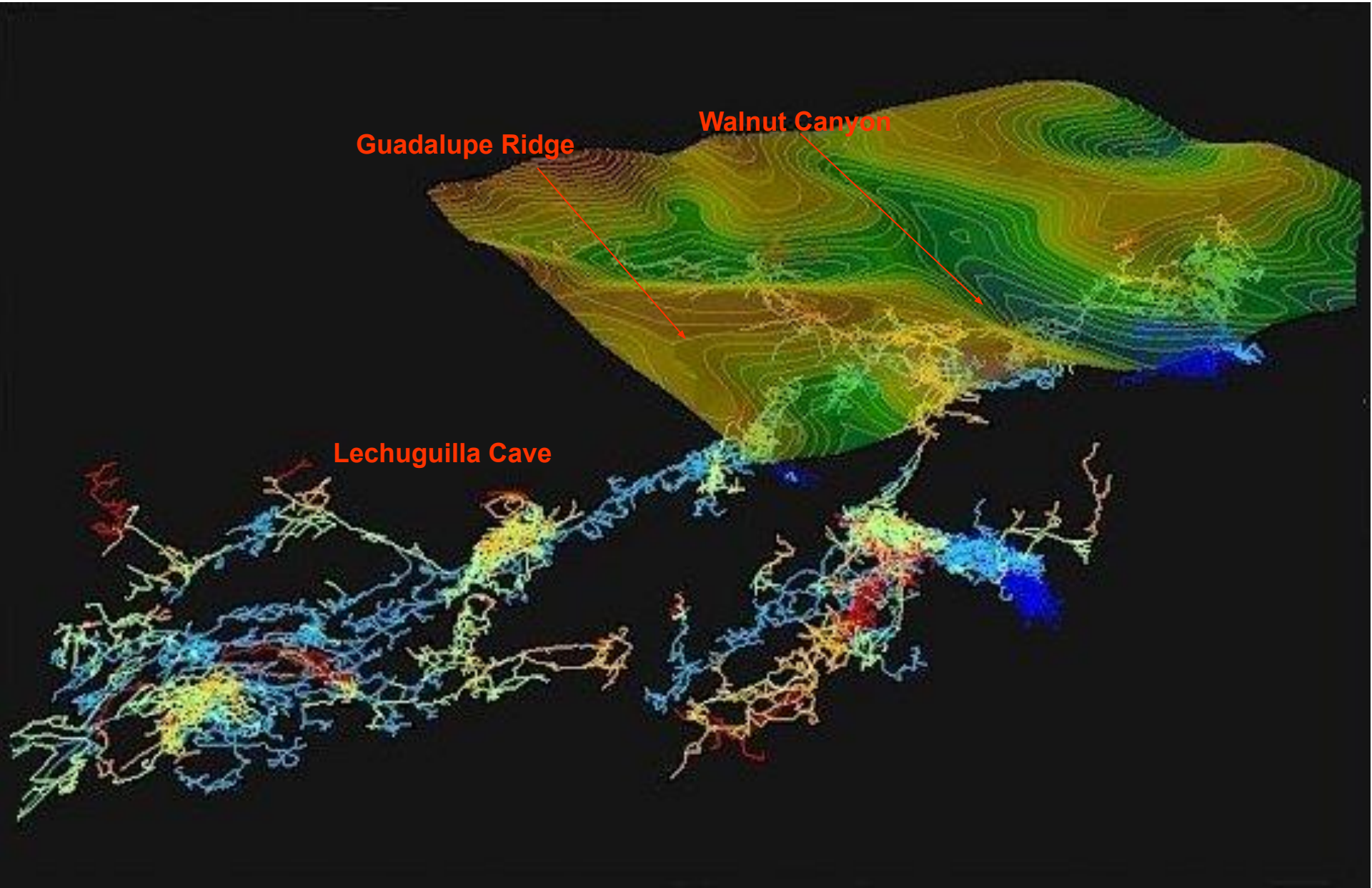
Location of shafts in Mammoth Cave and their relationship to the landscape



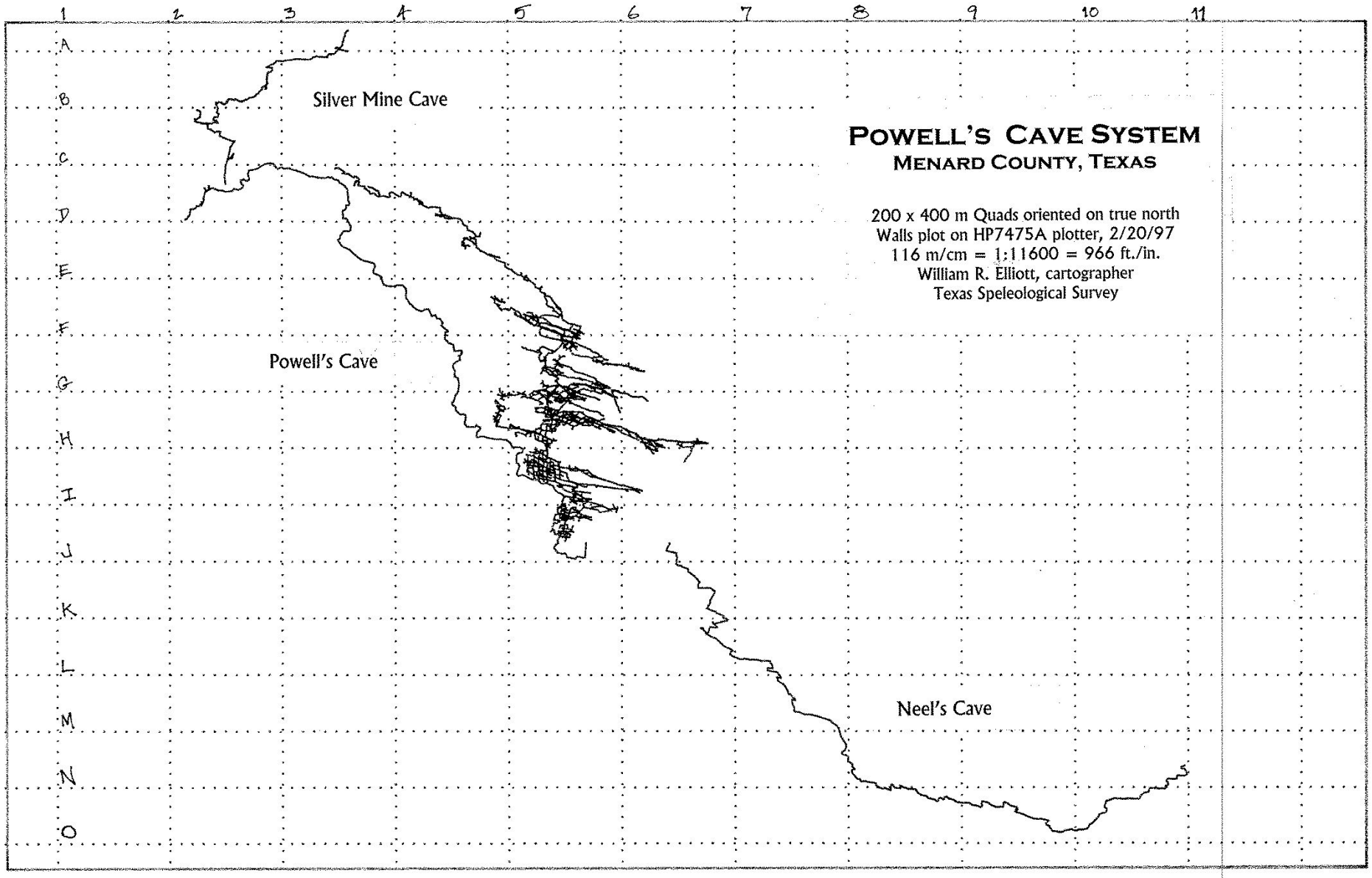
Cave data, plots, maps and land surface-cave relationships are extremely important for cave exploration (finding and documenting new caves).



Cave survey data is used to produce map representations that help us visualize and understand caves and karst areas.



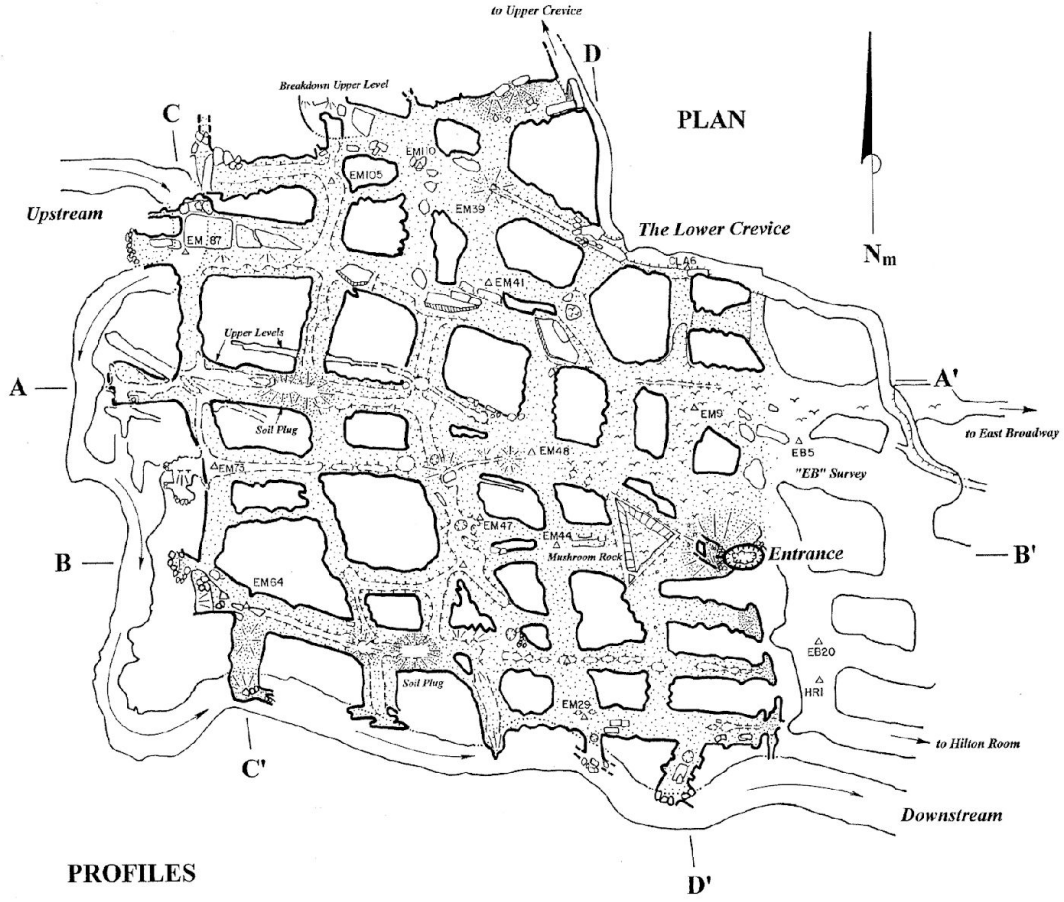
Who doesn't love a good CAVE MAP?



POWELLS CAVE

THE ENTRANCE MAZE

MENARD COUNTY, TEXAS



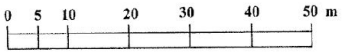
Suunto & tape surveys by the Texas Speleological Association:

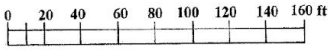
1989	1990	1991
January 28	February 24	February 23
October 28-29	June 23	June 22
	October 27-28	

Drafted by William R. Elliott, 1992.

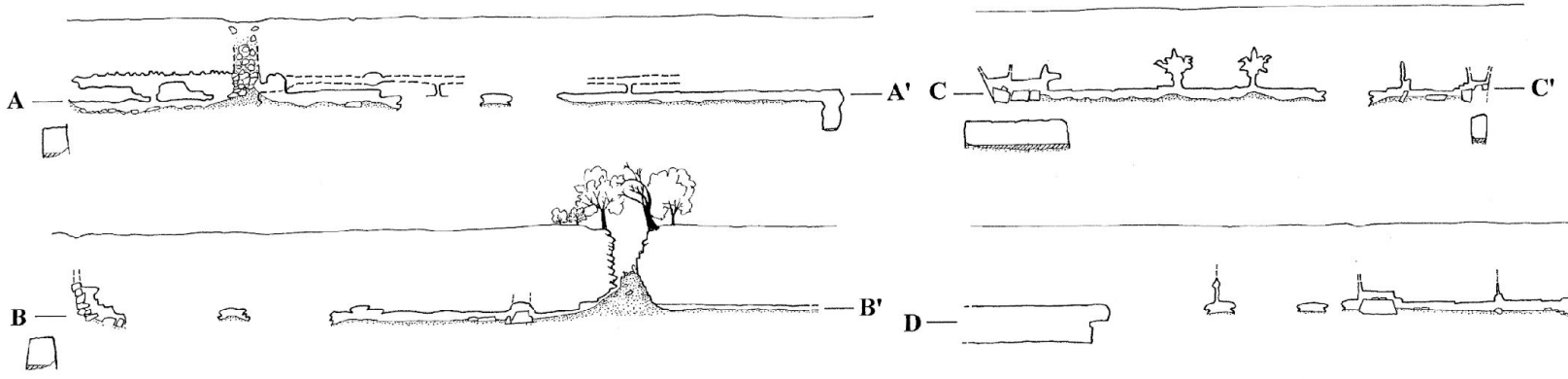
Personnel: William R. Elliott, Doug Allen, Linda Palit, Joann and David DeLuna, Juaquin Ketchbaw, Steve Barnes, Johanna Reece, Keith Heuss, Paul Reavely, Charles Withrow, Mike McCaskill, Claren Kotrla, Sean Trainor, Erik Quiroz, Beau Radloff, Jennifer Thomas, Christopher Lowe, and Carolyn Biegert.

Survey Statistics: Total traverse = 1,777 m (5,829 ft), 217 survey shots.
Depth below entrance: Upper levels = 11 m (36 ft); Main maze = 15 m (49 ft);
Junction with The Crevice at CLA6 = 19.5 m (64 ft).
Area of maze (west of entrance) = 1.25 hectares (3.1 acres).
Processed and plotted with SMAPS 4.3.





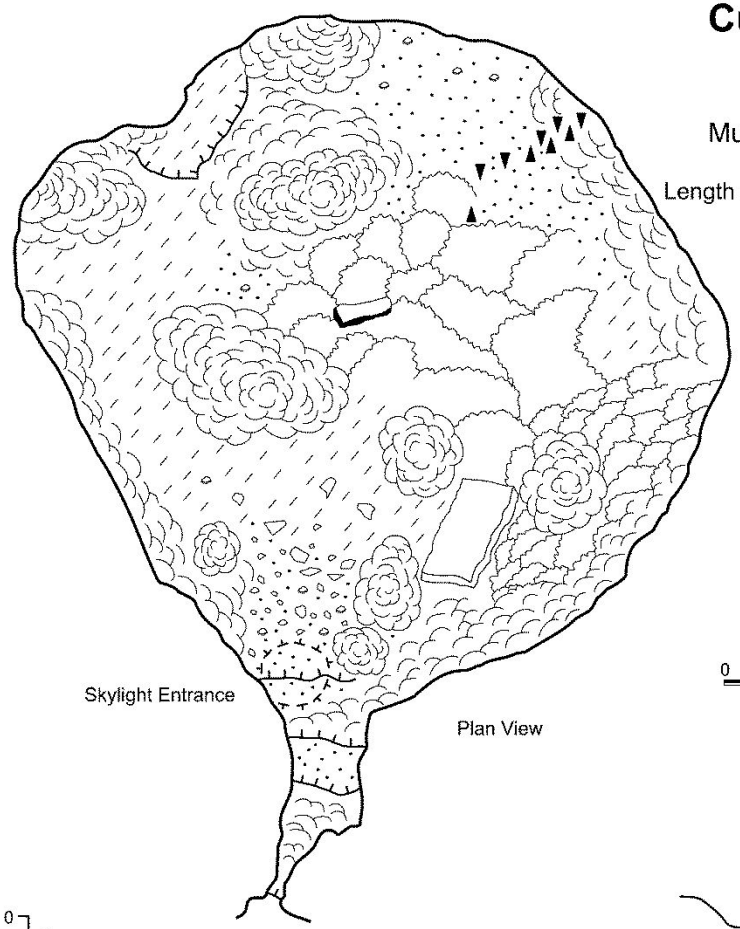
PROFILES



Cueva de Jovito

PESO 109
Rancho Nuevo,
Municipio de Valle Verde
Queretaro, Mexico
Length 40 meters Depth 18 meters

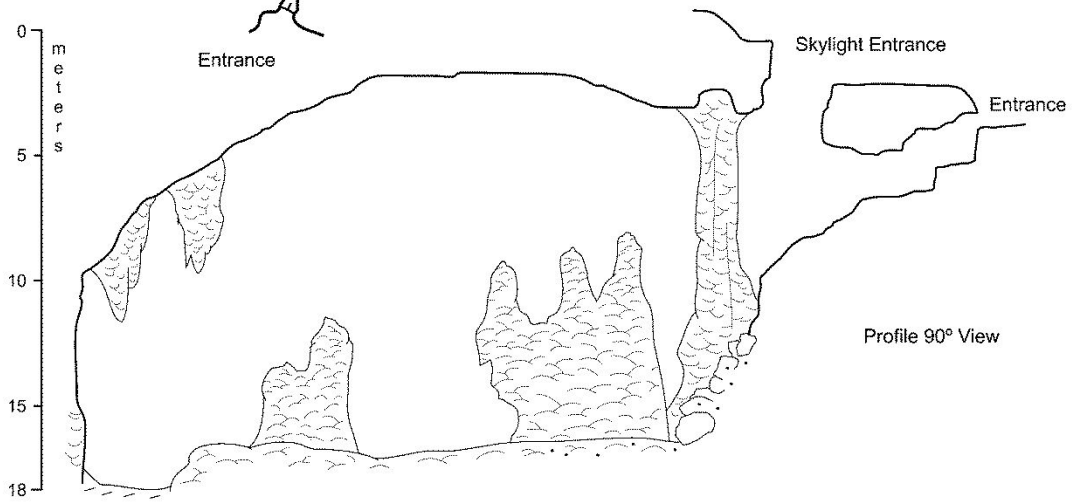
Controlled Sketch
March 13, 2007
By
Jim Kennedy
Draft by Jerry Fant



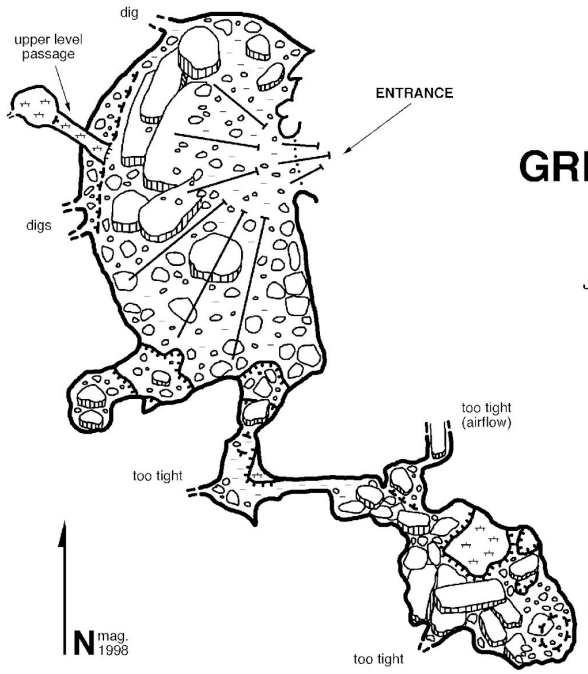
Plan View

N

0 4 Scale 10
2 6 meters



Profile 90° View



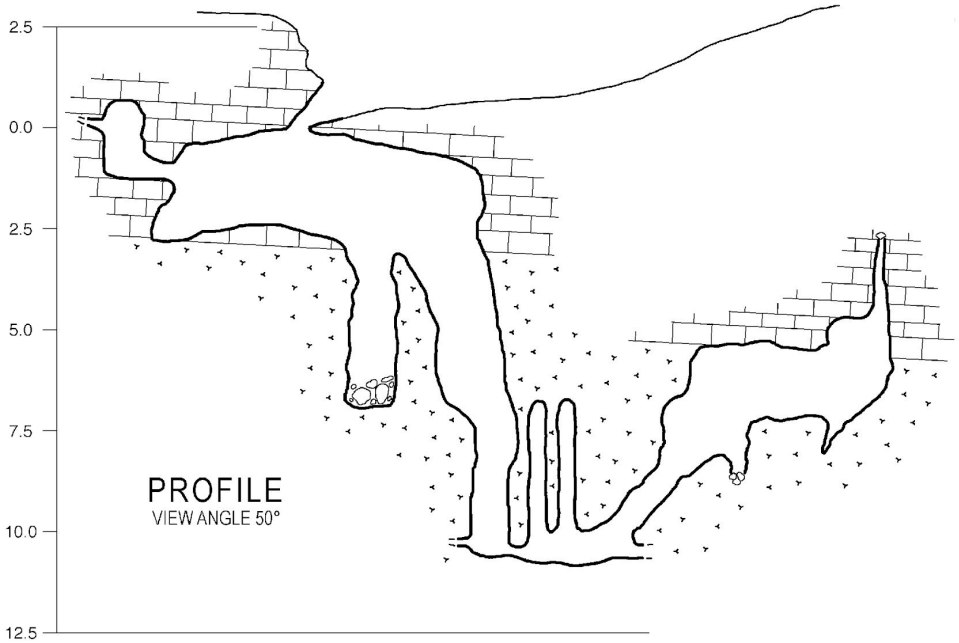
GREEN GYPSUM CAVE

KIMBLE COUNTY, TEXAS

Compass and Tape Survey
3 May 1997
Jim Kennedy, Patty Kennedy, Bill Stiver
23 May 1998
Jim Kennedy, Bill Stiver

Map 1 August 1999 by Jim Kennedy

0 5
meters



Naj Tunich

Municipio de Poptun
Peten, Guatemala

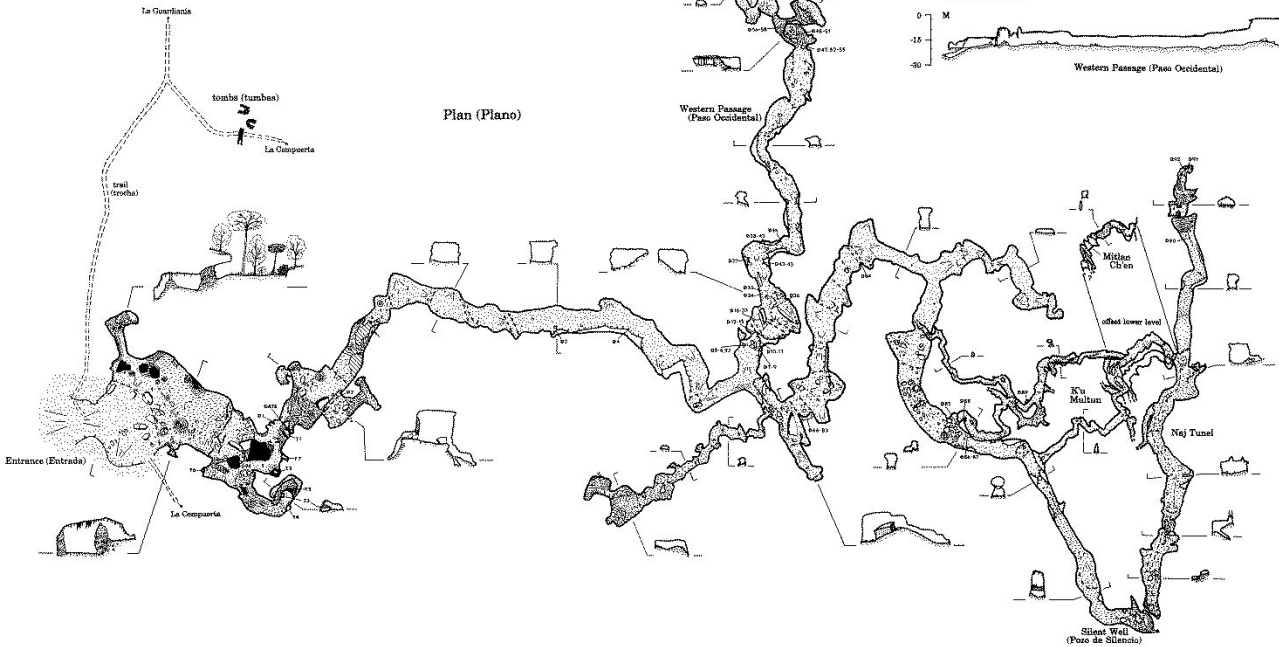
Suunto & Tape Survey, July 1988 & April 1989:
Allan Cobb, Andrea Stone and George Veni

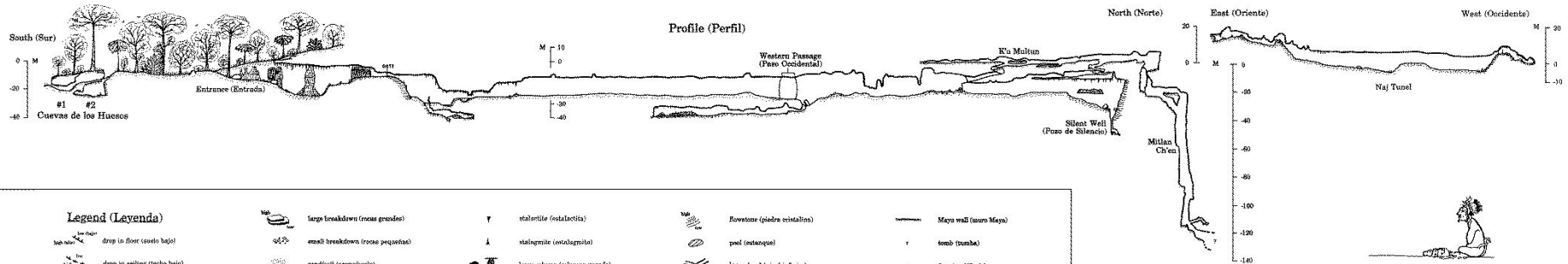
Plot by Ellipse and SMAPS
Draft: George Veni, June 1989

Length (Longitud): 3,054m
Depth (Profundidad): +145m

N

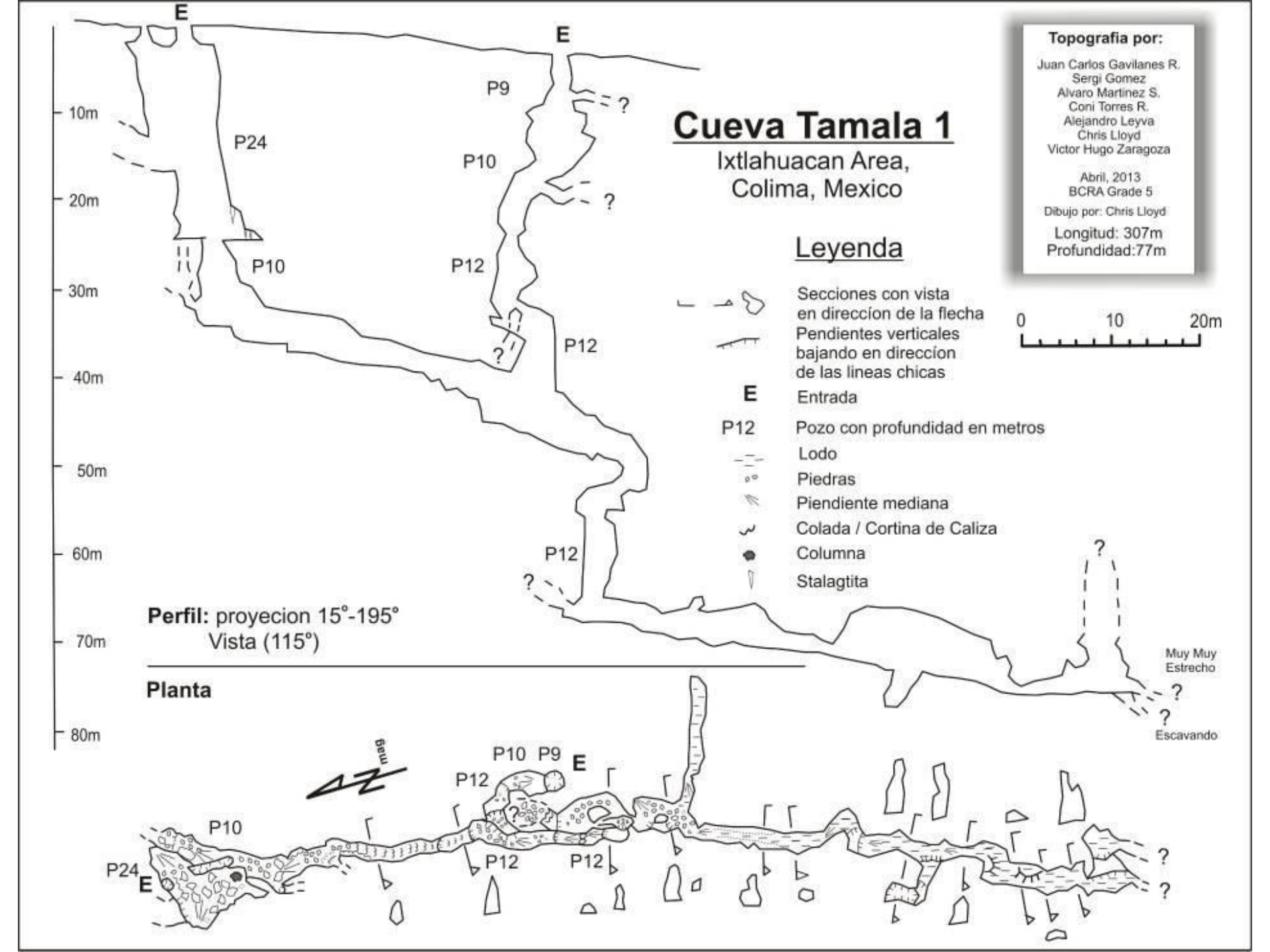
0 20 40 60 80 100
meters (metros)





Legend (Leyenda)

- drop in floor (suelo bajo)
- drop in ceiling (techo bajo)
- slope (pendiente)
- large breakdown (rocas grandes)
- small breakdown (rocas pequeñas)
- sand/soil (arena/suelo)
- silt/clay (cieno/arcilla)
- stalactite (estalactita)
- stalagmite (estalagmita)
- large column (columna grande)
- small column (columna pequeña)
- flowstone (piedra cristalina)
- pool (estanque)
- lower level (nivel inferior)
- cross section (sección transversal)
- Maya wall (muro Maya)
- t tomb (tumba)
- d drawing (dibujo)
- Maya footprints (pisadas Maya)


Cueva Tamala 1
Ixtlahuacan Area,
Colima, Mexico
Topografia por:
Juan Carlos Gavilanes R.
Sergi Gomez
Alvaro Martinez S.
Coni Torres R.
Alejandro Leyva
Chris Lloyd
Victor Hugo Zaragoza
Abril, 2013
BCRA Grade 5
Dibujo por: Chris Lloyd
Longitud: 307m
Profundidad:77m
Leyenda
Secciones con vista en direccion de la flecha
Pendientes verticales bajando en direccion de las lineas chicas
E Entrada
P12 Pozo con profundidad en metros
Lodo
Piedras
Piendiente mediana
Colada / Cortina de Caliza
Columna
Stalagtita
0 10 20m
10m
20m
30m
40m
50m
60m
70m
80m
P24
P10
P9
P12
Muy Muy Estrecho
Escavando
Perfil: proyecion 15°-195°
Vista (115°)
Planta
mag

SERENDIPITY PIT

A/K/A TRACY HOLLOW PIT

STONE COUNTY, ARKANSAS

A Suunto Tandem, laser rangefinder & fiberglass tape survey by Jeff Bartlett, Leah Bartlett & Michael Patton, August 28, 2010.
Surveyed extents: 256 ft horizontal, 81 ft vertical.

Association for Arkansas Cave Studies #ST5904
Cartography by Jeff Bartlett, NSS #59325, 2010

PROFILE VIEW

North-facing projection (0 degrees)

0.0 DATUM

10 ft

20 ft

30 ft

40 ft

50 ft

60 ft

p43

p27

Holes in ceiling connect to main chamber above

CROSS-SECTIONS

LEGEND

- Passage Walls
- Floor Ledges
- Ceiling Ledges
- Slopes
- Breakdown
- Large Dripstone
- Small Dripstone
- Flowstone
- Rimstone Dams
- Popcorn
- Soda Straws
- Cobble Floor
- Mud Floor
- p27 Pit Depths
- 10 Ceiling Heights
- 10' Depth Below datum
- Bedrock Wall

ENTRANCE

COMPOSITE PLAN VIEW

COMPONENT PLAN VIEWS

All azimuths corrected to true north.
All vertical data expressed in feet.

20 0 20 ft

5 0 5 m

p43
Entrance rappel pad
balcony & down to main chamber

ENTRANCE PIT & BALCONY

Pack rat nests

Additional (light) openings to lower level

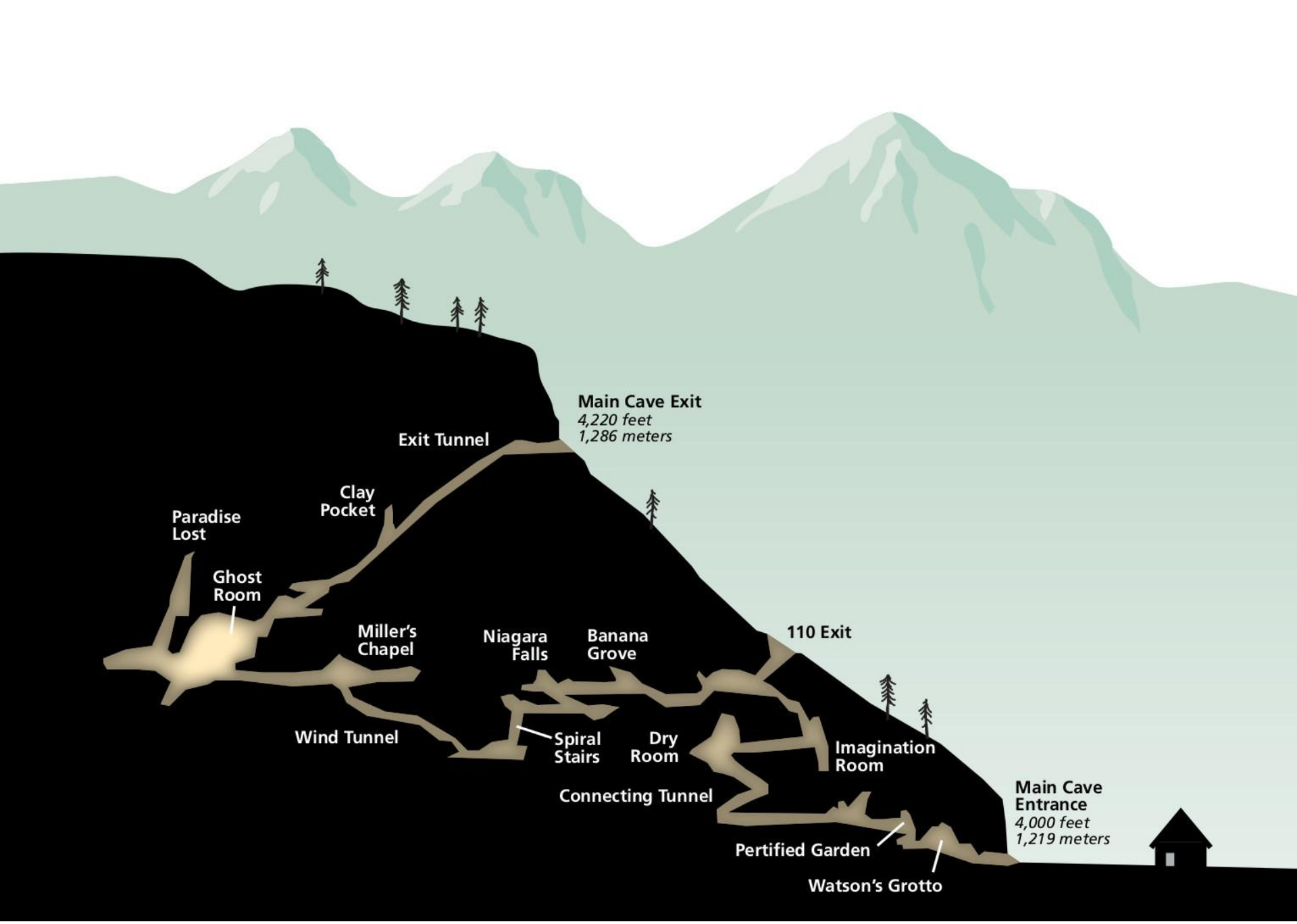
Delicate floor necessitates aqua socks for proceeding beyond column

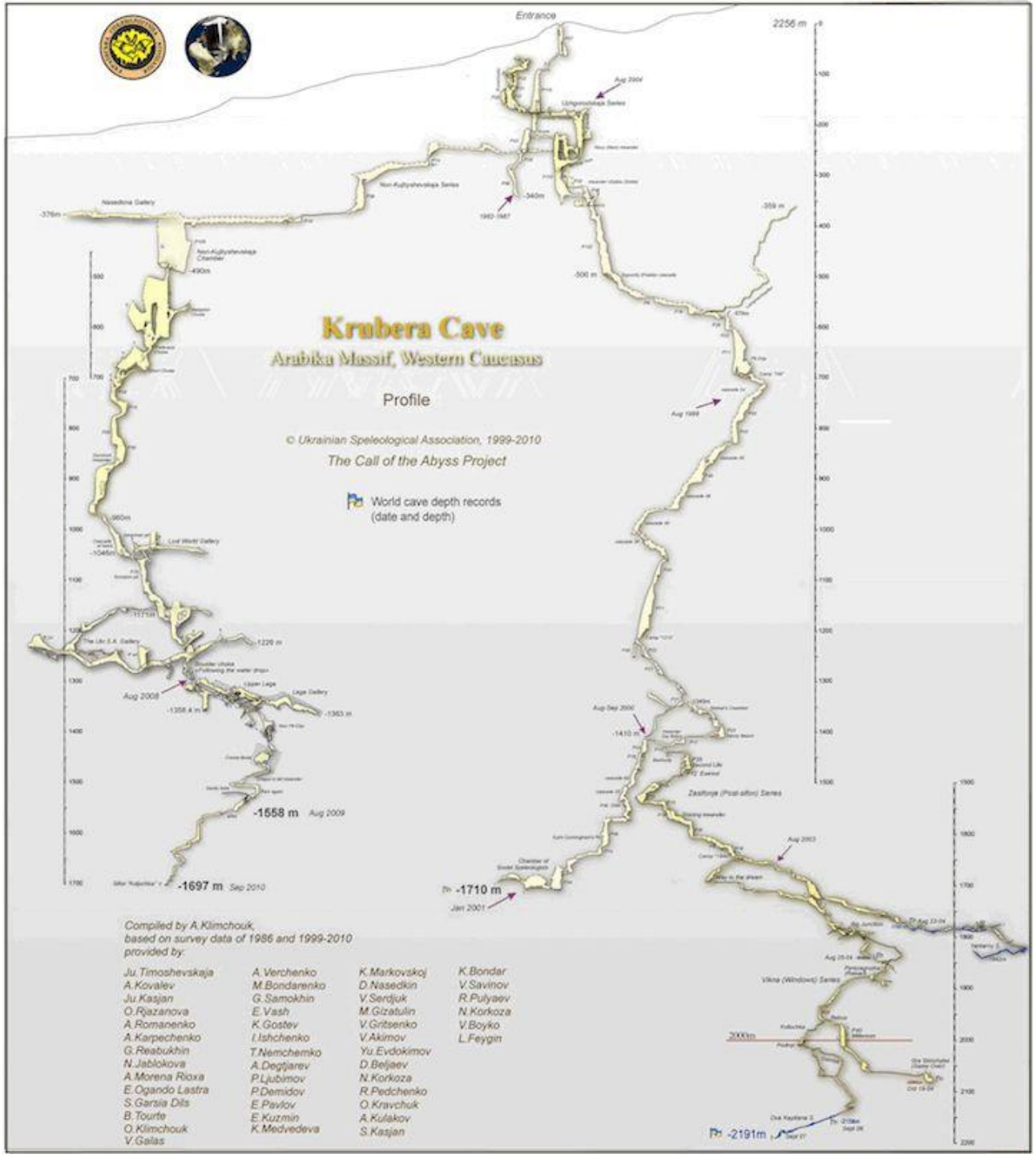
p27
Westernmost of 3 holes in floor provides best access to lower level

MAIN CHAMBER

LOWER LEVEL

Many turtle shells at bottom of this slope


Main Cave Exit
4,220 feet
1,286 meters
Exit Tunnel
Clay Pocket
Paradise Lost
Ghost Room
Miller's Chapel
Niagara Falls
Banana Grove
110 Exit
Wind Tunnel
Spiral Stairs
Dry Room
Imagination Room
Connecting Tunnel
Main Cave Entrance
4,000 feet
1,219 meters
Pertified Garden
Watson's Grotto


Entrance
2256 m
Aug 2004
Ungrondskaja Series
Non-Kuybyshevskaja Series
-345m
1982-1987
-359 m
-500 m
Nasedkina Gallery
-376m
Non-Kuybyshevskaja Chamber
-490m
Krubera Cave
Arabika Massif, Western Caucasus
Profile
© Ukrainian Speleological Association, 1999-2010
The Call of the Abyss Project
World cave depth records
(date and depth)
Aug 1999
-980m
Lost World Gallery
-1045m
-1171m
The Ukr S.A. Gallery
1226 m
Aug 2008
-1358 A m
Upper Lago
Lago Gallery
-1363 m
-1558 m Aug 2009
-1697 m Sep 2010
Aug Sep 2000
-1410 m
Zasifonja (Post-sifon) Series
Aug 2003
-1710 m
Jan 2001
Aug 23-24
Aug 25-24
Vikna (Windows) Series
2000m
Oct 19-24
-2191m
Compiled by A.Klimchouk,
based on survey data of 1986 and 1999-2010
provided by:
Ju.Timoshevskaja
A.Kovalev
Ju.Kasjan
O.Rjazanova
A.Romanenko
A.Karpechenko
G.Reabukhin
N.Jablokova
A.Morena Rioxa
E.Ogando Lastra
S.Garsia Dits
B.Tourte
O.Klimchouk
V.Galas
A.Verchenko
M.Bondarenko
G.Samokhin
E.Vash
K.Gostev
I.Ishchenko
T.Nemchemko
A.Degtjarev
P.Ljubimov
P.Demidov
E.Pavlov
E.Kuzmin
K.Medvedeva
K.Markovskoj
D.Nasedkin
V.Serdjuk
M.Gizatulin
V.Gritsenko
V.Akimov
Yu.Evdokimov
D.Beljaev
N.Korkoza
R.Pedchenko
O.Kravchuk
A.Kulakov
S.Kasjan
K.Bondar
V.Savinov
R.Pulyaev
N.Korkoza
V.Boyko
L.Feygin

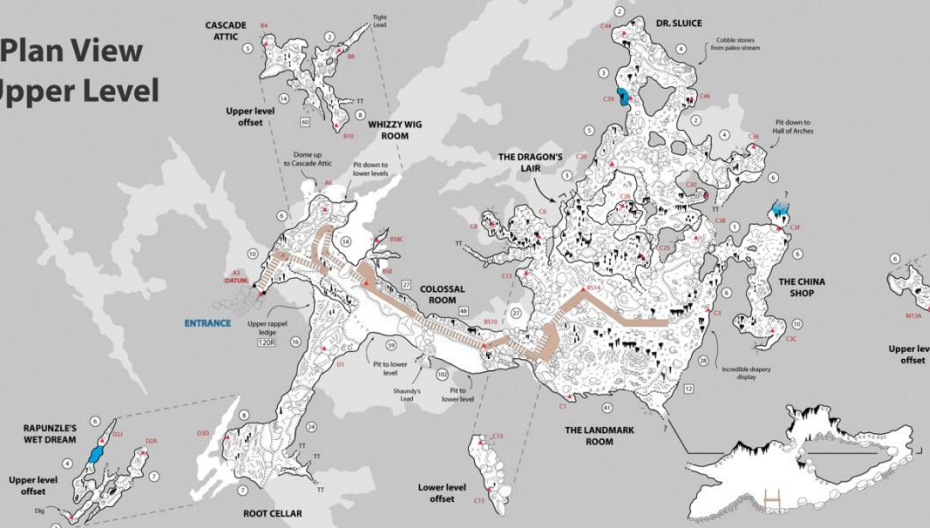
BLACK CHASM CAVERN

SIERRA NEVADA RECREATION CORPORATION
AMADOR COUNTY, CALIFORNIA

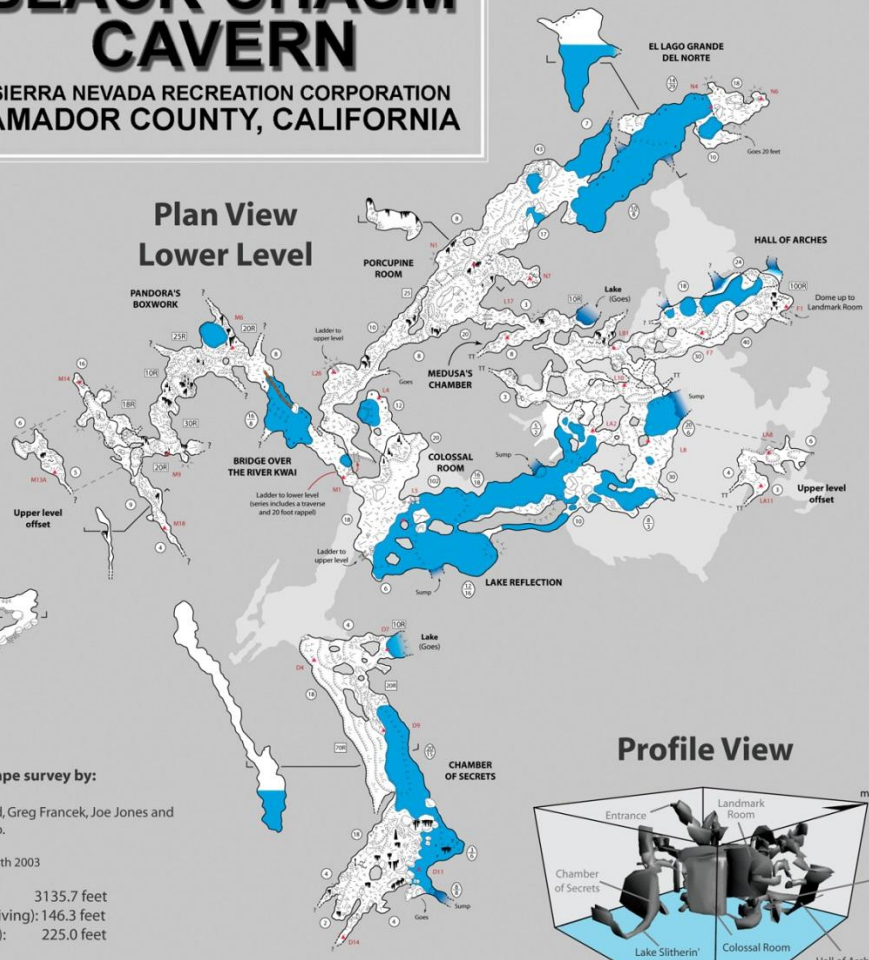
LEGEND

- Passage
- Lower Passage
- Lead
- Lake
- Sump
- Pit
- Ledge/Drop
- Ceiling Change
- Slope
- Mud
- Bedrock
- Ladder
- Ceiling Height
- Pit depth/Rope
- Too Tight
- Boardwalk
- Survey Station
- Helictite
- Flowstone
- Stalactites
- Rimstone Dams
- Draperies
- Boxwork

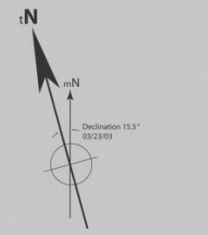
Plan View Upper Level



Plan View Lower Level



Profile View



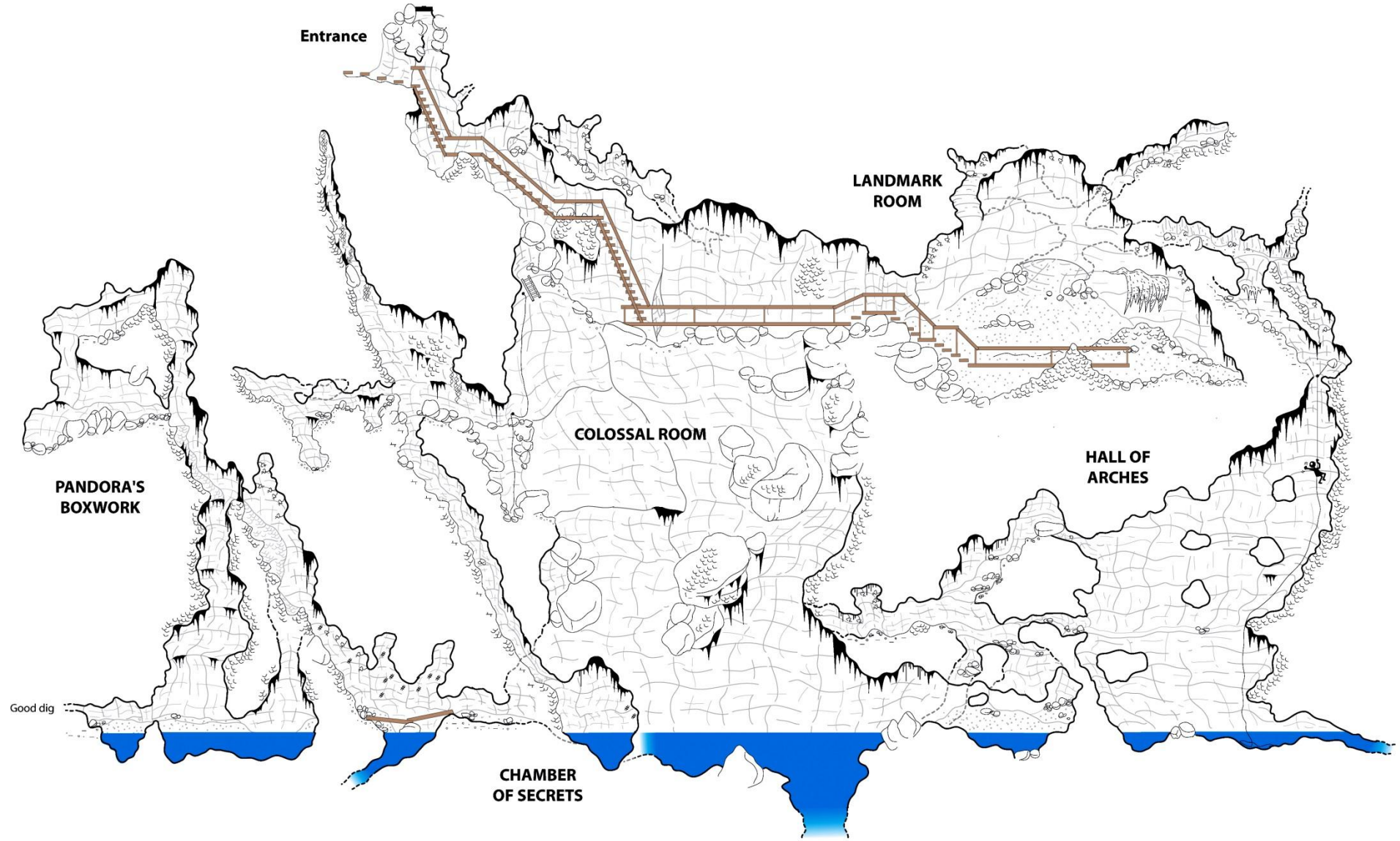
A Suunto and fiberglass tape survey by:

Hazel A. Barton, Dave Bunnell, Steve Fairchild, Greg Francek, Joe Jones and Marianne Russo.

March 3rd 2003 - July 12th 2003

Total Surveyed Length:	3135.7 feet
Total Surveyed Depth (non-diving):	146.3 feet
Total Surveyed Depth (diving):	225.0 feet

Cartography by Hazel A. Barton
Data reduction - Compass for Windows (www.fountainware.com/compass)
Illustration software: Adobe Illustrator CS

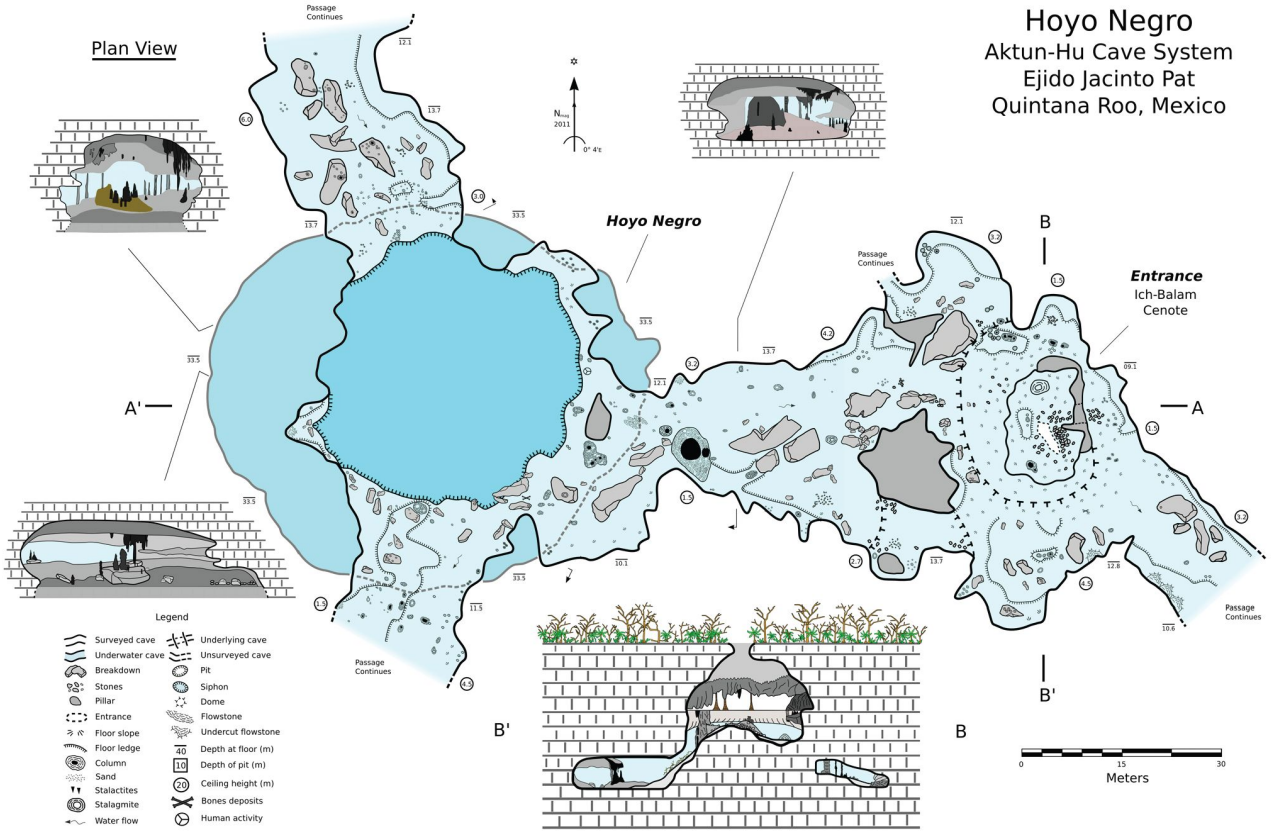

Entrance
LANDMARK ROOM
COLOSSAL ROOM
PANDORA'S BOXWORK
HALL OF ARCHES
Good dig
CHAMBER OF SECRETS


Cancun
Playa del Carmen
Cozumel Island
Sistema Sac Actun
Quintana Roo, México
Chemuyil
Xcacelito
Dos Ojos
Dos Ojos
Bat Cave
Dos Palmas
El Pit
Jaguar
Nicte Ha
Pet Cemetery
Blue Abyss
Ich Balam
Tak Be Ha
Actun Hu
Hidden Worlds
Dream Gate
Nohoch Nah Chich
Mol Balam
Yax Muul
Labna Ha
Nohoch Nah Chich
Mar Caribe
Carwash
Manati
Sac Actun
Gran Cenote
Longitud: 353.012 km (219.351 mi)
Calavera
Tulum
Ruins
0
2.5 km
N
Compilation: EMR
Data: INEGI/QRSS/Kambesis&Coke

Hoyo Negro

Aktun-Hu Cave System
Ejido Jacinto Pat
Quintana Roo, Mexico

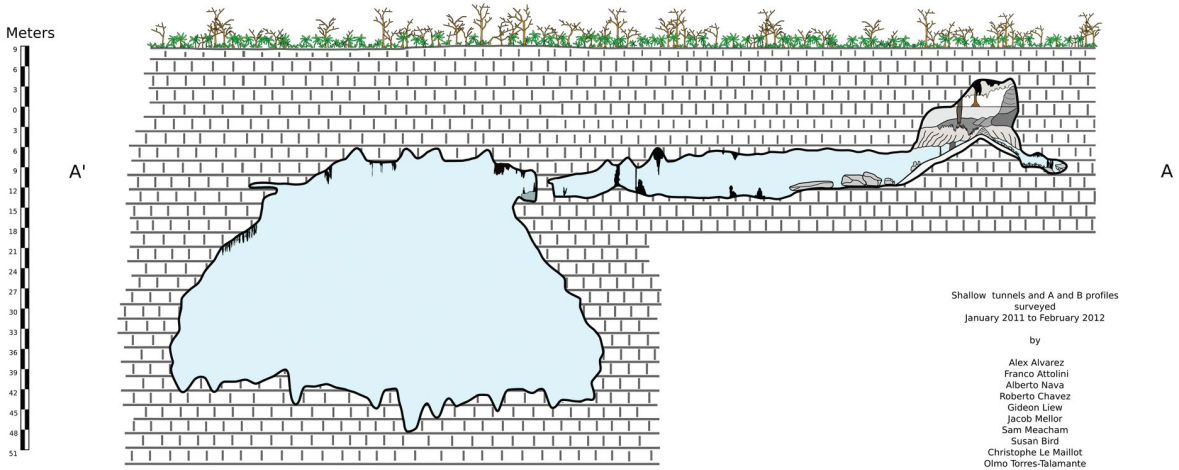
Plan View



Legend

Surveyed cave	Underlying cave
Underwater cave	Unsurveyed cave
Breakdown	Pit
Stones	Siphon
Pillar	Dome
Entrance	Flowstone
Floor slope	Undercut flowstone
Floor ledge	Depth at floor (m)
Column	Depth of pit (m)
Sand	Ceiling height (m)
Stalactites	Bones deposits
Stalagmite	Human activity
Water flow	

Profile View

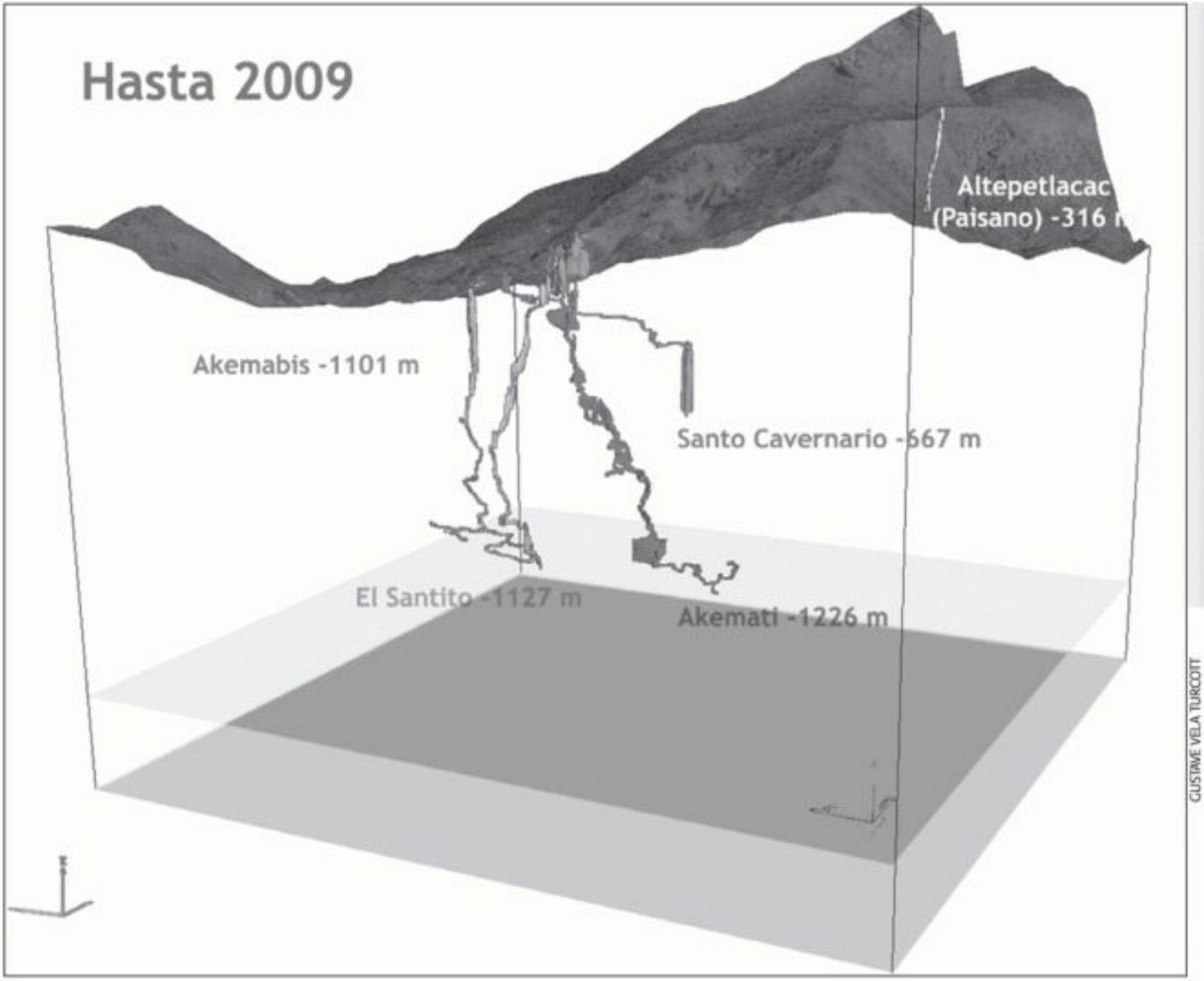


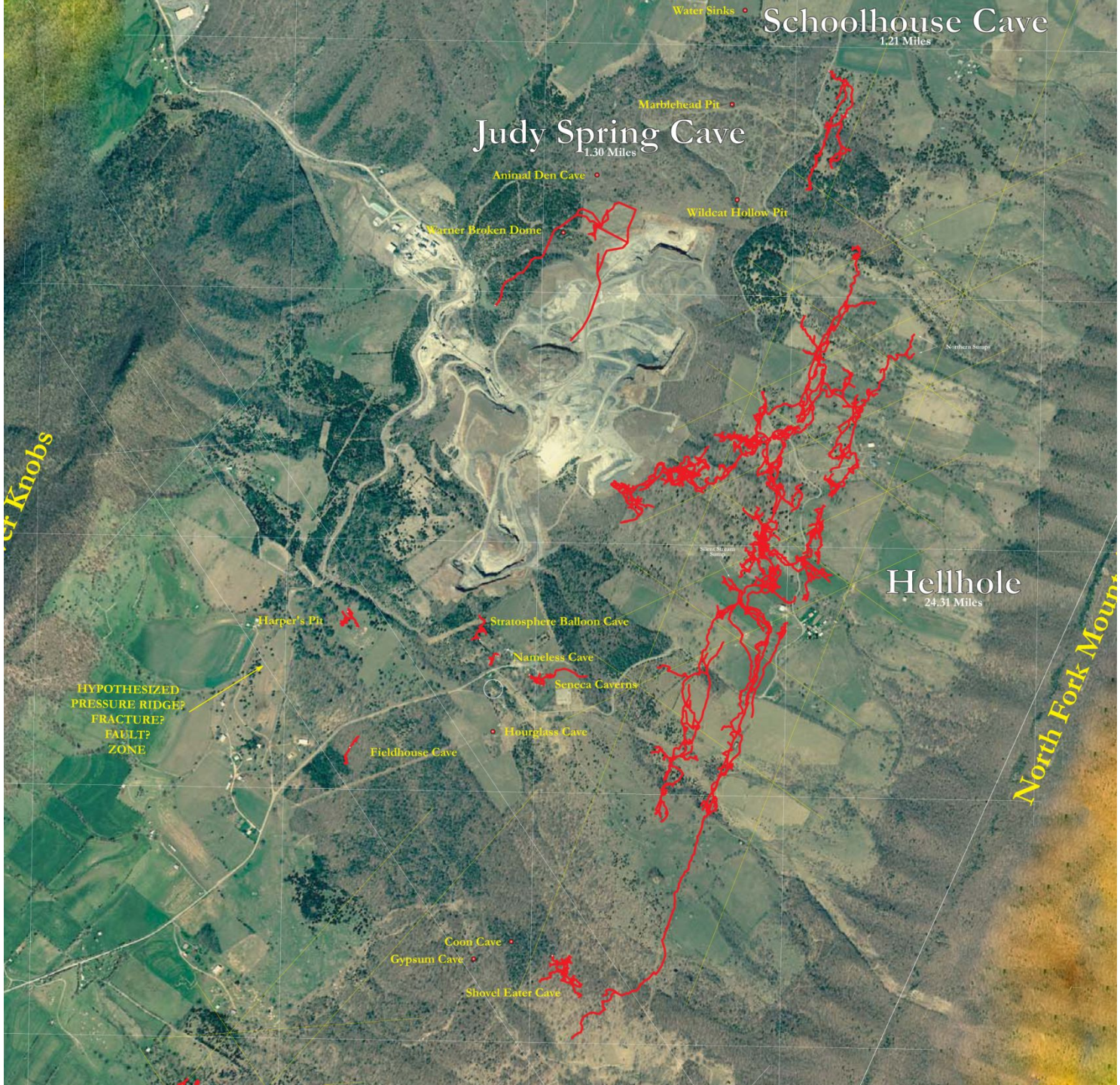
Shallow tunnels and A and B profiles surveyed
January 2011 to February 2012

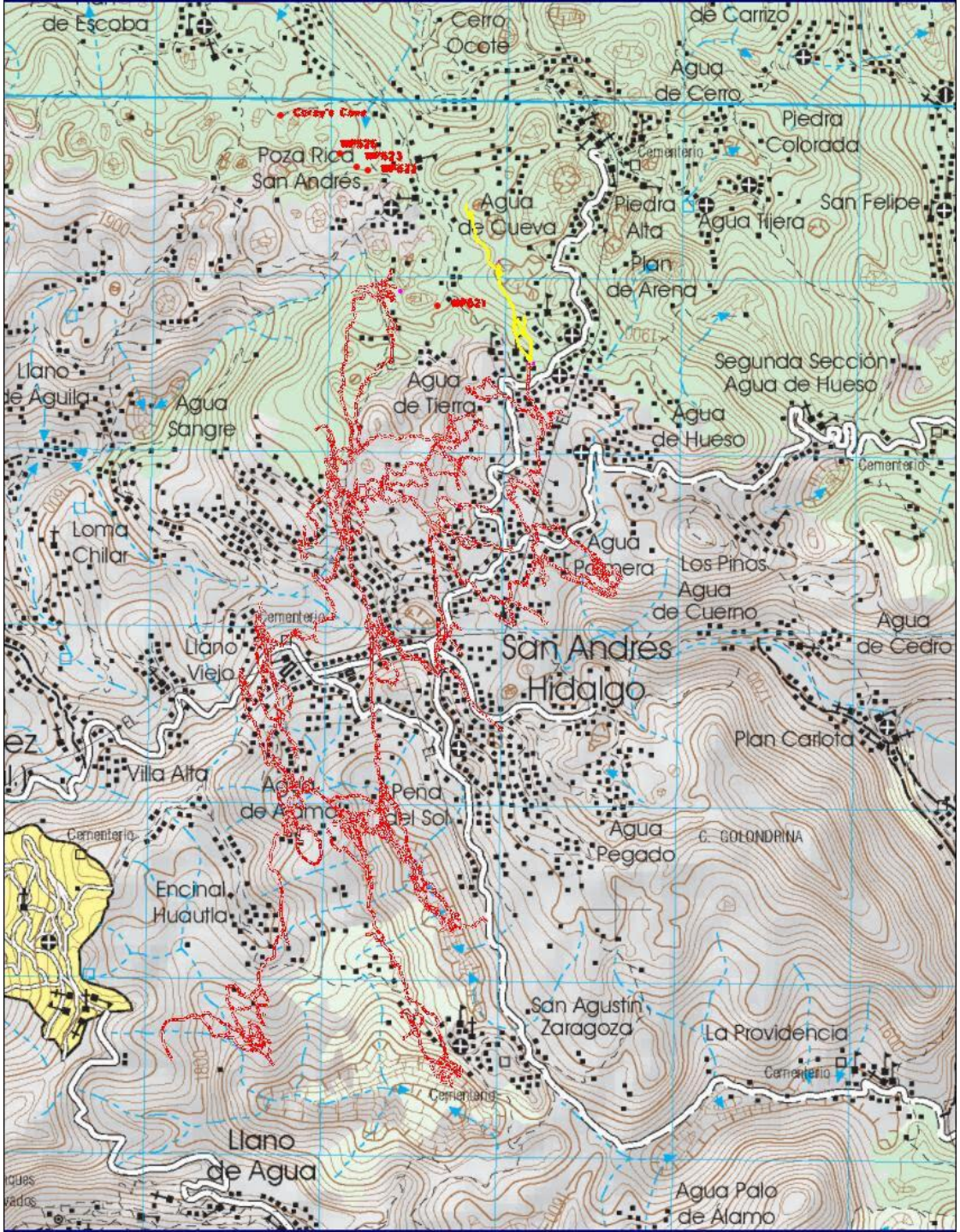
by

Alex Alvarez
Franco Attolini
Alberto Nava
Roberto Chavez
Gideon Liew
Jacob Mellor
Sam Meacham
Susan Bird
Christophe Le Maillot
Olmo Torres-Talamante

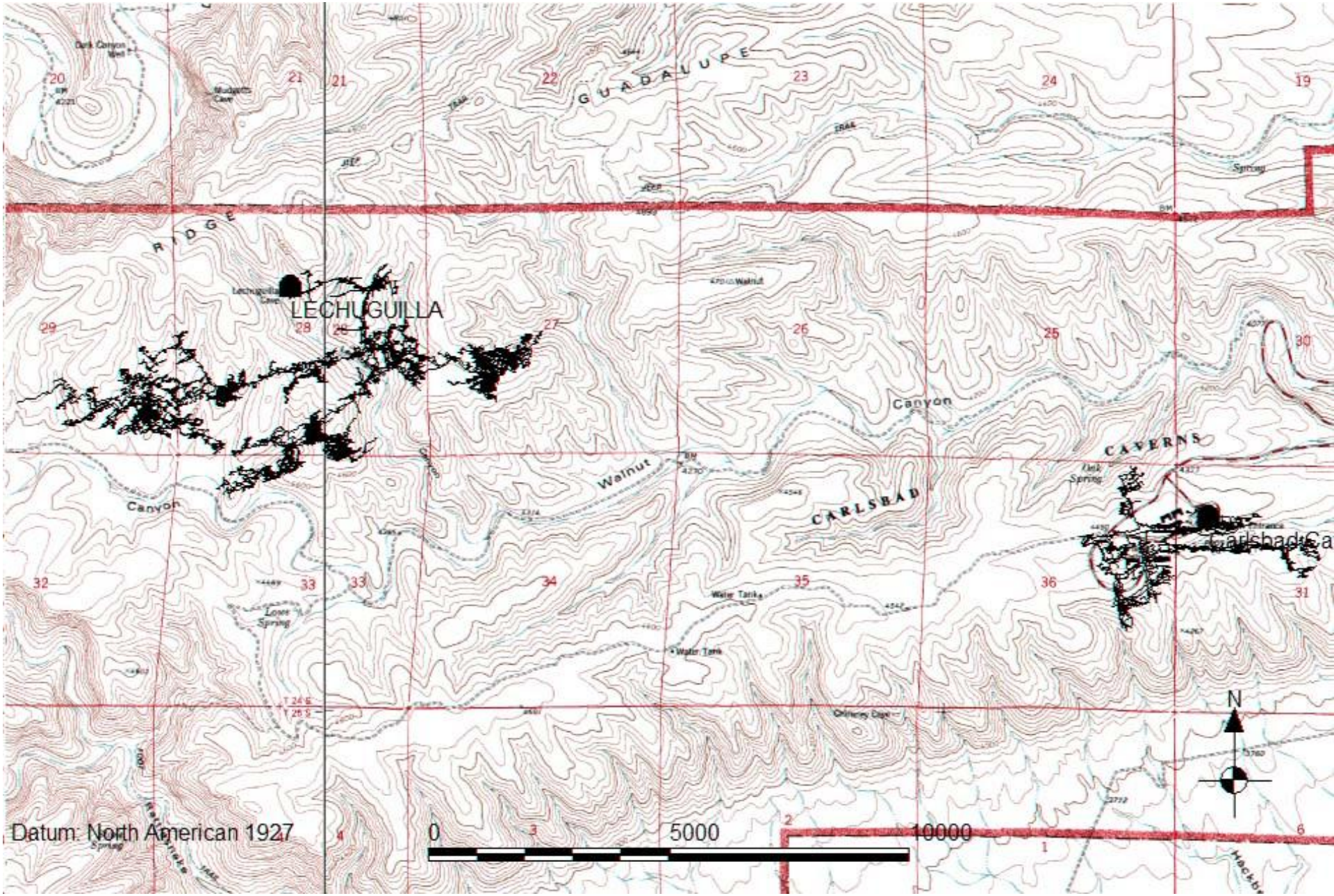
Cartography by Alberto Nava Blank

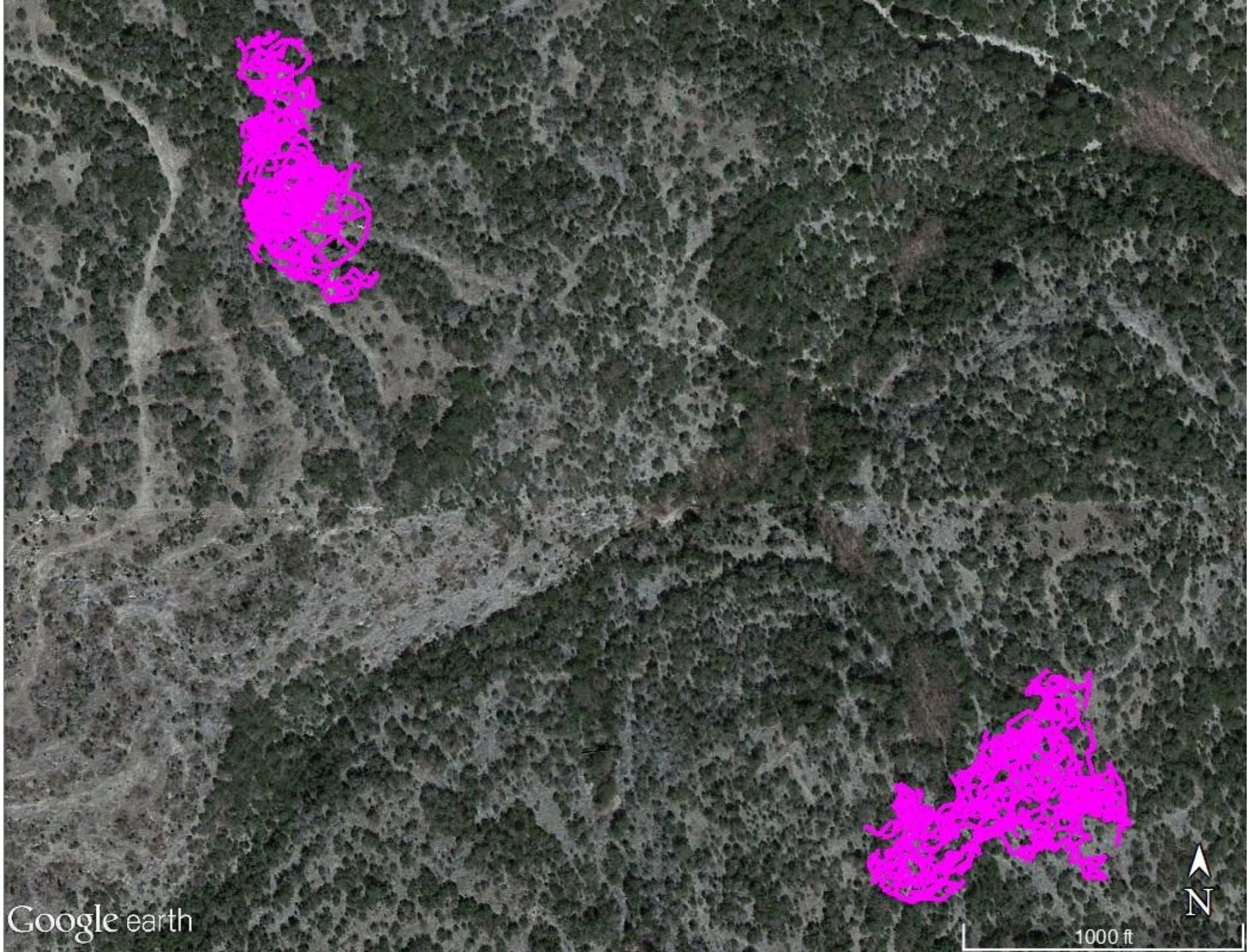

Hasta 2009
Altepetlacac
(Paisano) -316 m
Akemabis -1101 m
Santo Cavernario -667 m
El Santito -1127 m
Akemati -1226 m
GUSTAVE VELA TURCOIT

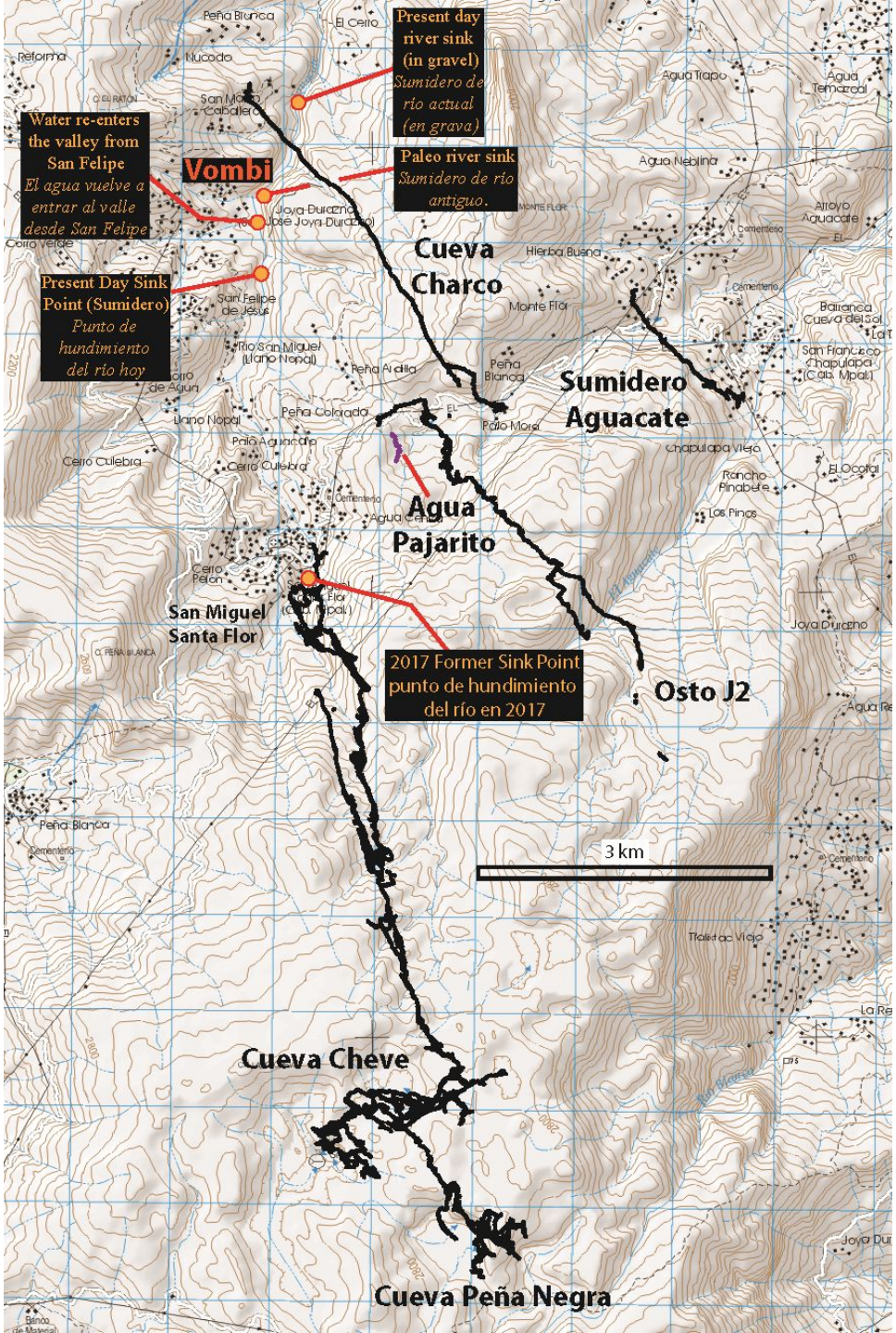

Water Sinks
Schoolhouse Cave
1.21 Miles
Marblehead Pit
Judy Spring Cave
1.30 Miles
Animal Den Cave
Wildcat Hollow Pit
Warner Broken Dome
Northern Passage
Silent Stream Passage
Hellhole
24.31 Miles
Harper's Pit
Stratosphere Balloon Cave
Nameless Cave
Seneca Caverns
HYPOTHESIZED
PRESSURE RIDGE?
FRACTURE?
FAULT?
ZONE
Hourglass Cave
Fieldhouse Cave
Coon Cave
Gypsum Cave
Shovel Eater Cave
North Fork Mount

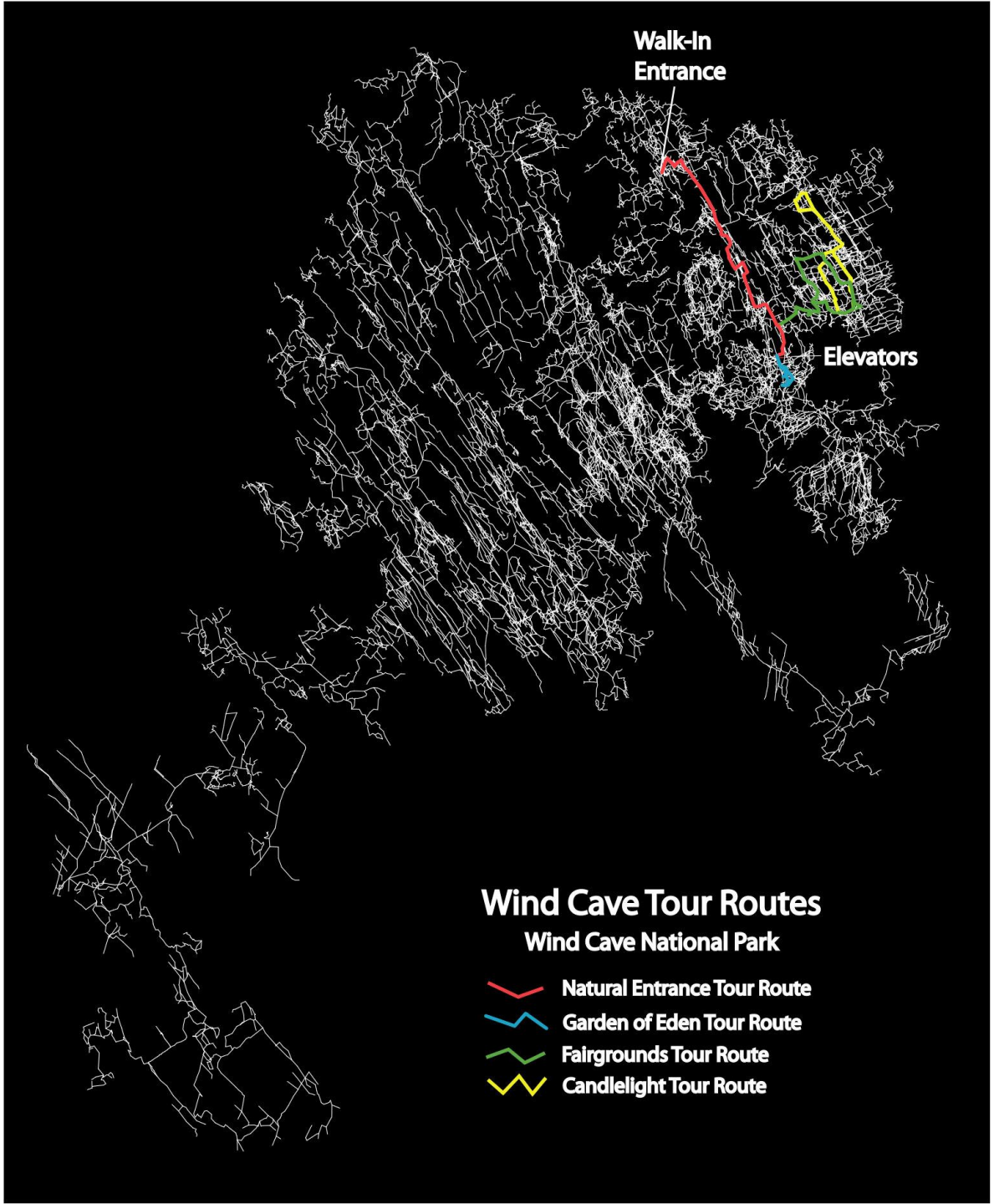

de Escoba
Cerro Ocote
de Carrizo
Agua de Cerro
Piedra Colorada
Cementerio
Poza Rica
San Andrés
Agua de Cueva
Piedra Alta
Agua Tijera
San Felipe
Plan de Arena
Llano de Águila
Agua Sangre
Agua de Tierra
Segunda Sección Agua de Hueso
Agua de Hueso
Cementerio
Loma Chilar
Agua Palmera
Los Pinos
Agua de Cuerno
Agua de Cedro
Cementerio
Llano Viejo
San Andrés Hidalgo
Plan Carlota
Villa Alta
Peña del Sol
Agua Pegado
C. GOLONDRINA
Cementerio
Encinal Huautla
San Agustín Zaragoza
La Providencia
Cementerio
Llano de Agua
Agua Palo de Álamo

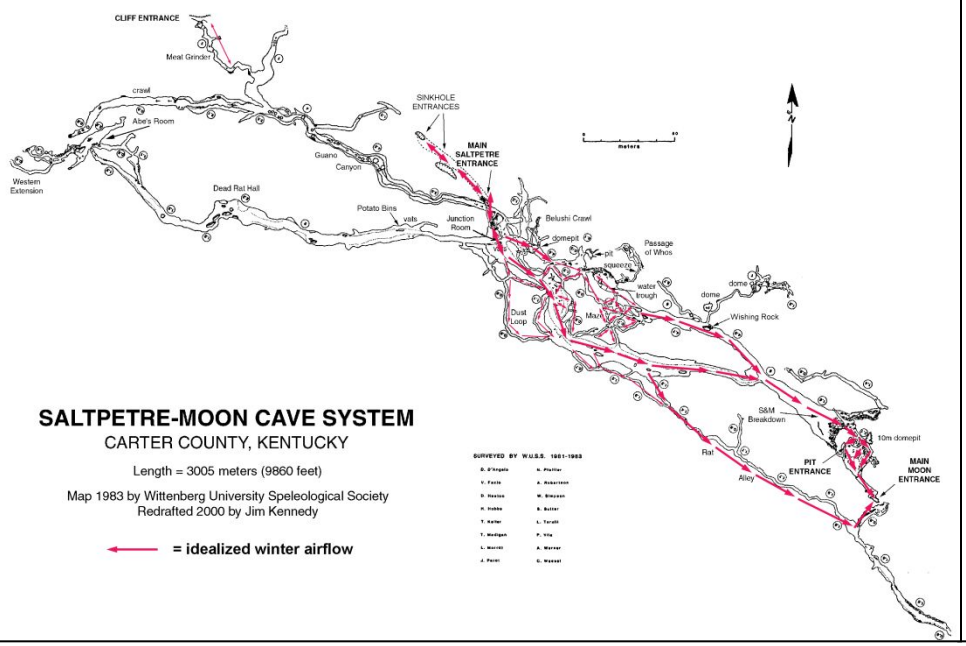
Adwell Spring
Picnic Area
Mammoth Cave
N A T I O N A L P A R K
New Discovery Entrance
Jim Lee Ridge
Hunts Sink
Ridge
Sloans Crossing
Lookout Tower
Frozen Niagara Entrance
Sand Cave
HART CO
BARREN CO
Owens Valley
1 1/2 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0.5 0 1 KILOMETER

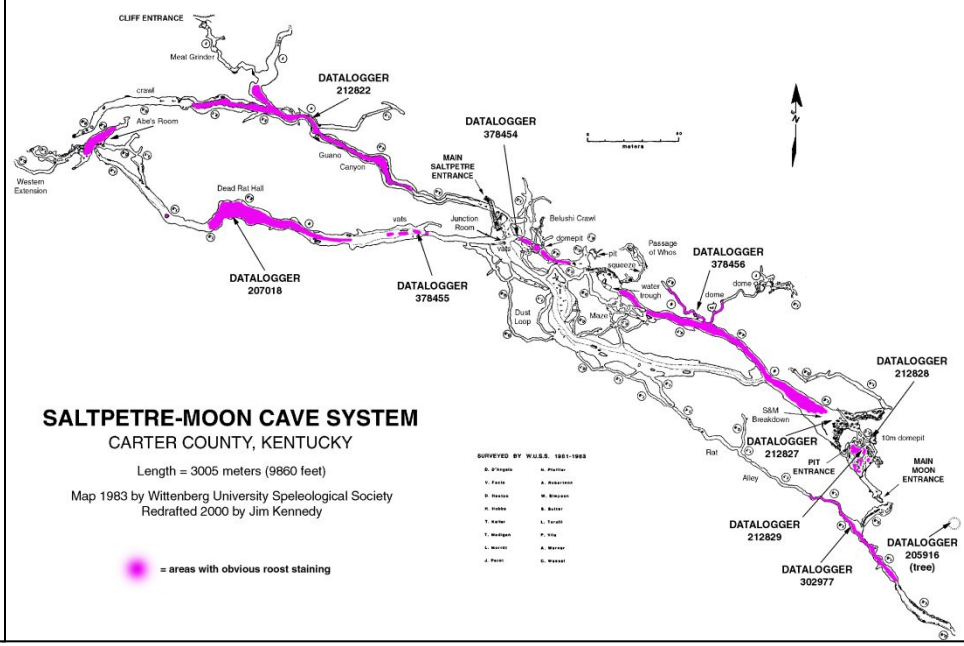

LECHUGUILLA
GUADALUPE
RIDGE
Canyon
Walnut
CARLSBAD
CAVERNS
Carlsbad Ca
Lone Spring
Water Tank
Datum: North American 1927
0
5000
10000
N


Google earth
N
1000 ft

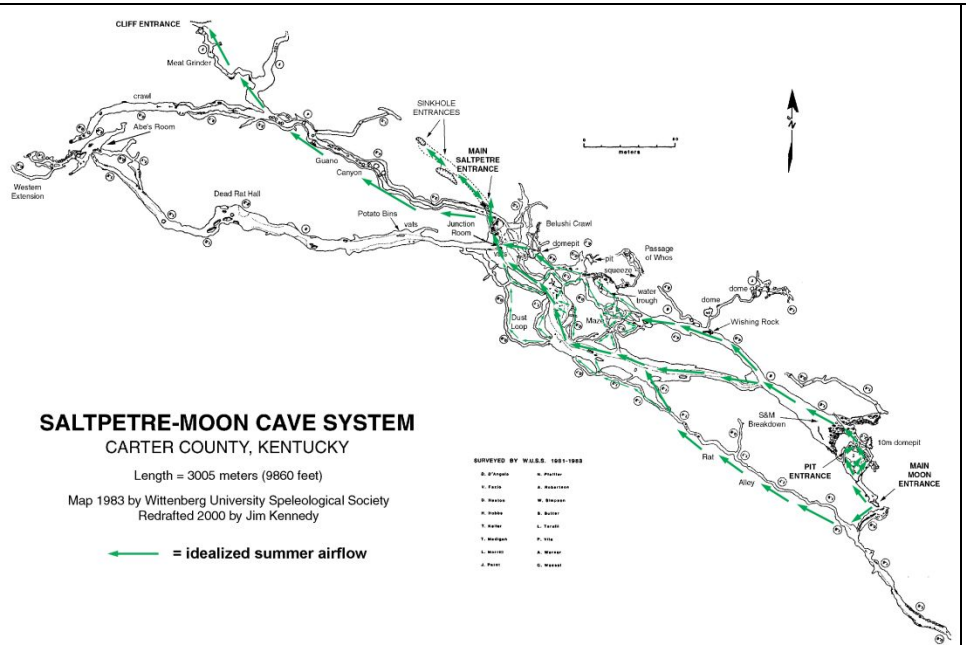

Present day river sink (in gravel)
Sumidero de río actual (en grava)
Paleo river sink
Sumidero de río antiguo.
Water re-enters the valley from San Felipe
El agua vuelve a entrar al valle desde San Felipe
Vombi
Present Day Sink Point (Sumidero)
Punto de hundimiento del río hoy
Cueva Charco
Sumidero Aguacate
Agua Pajarito
San Miguel Santa Flor
2017 Former Sink Point
punto de hundimiento del río en 2017
Osto J2
Cueva Cheve
Cueva Peña Negra
3 km

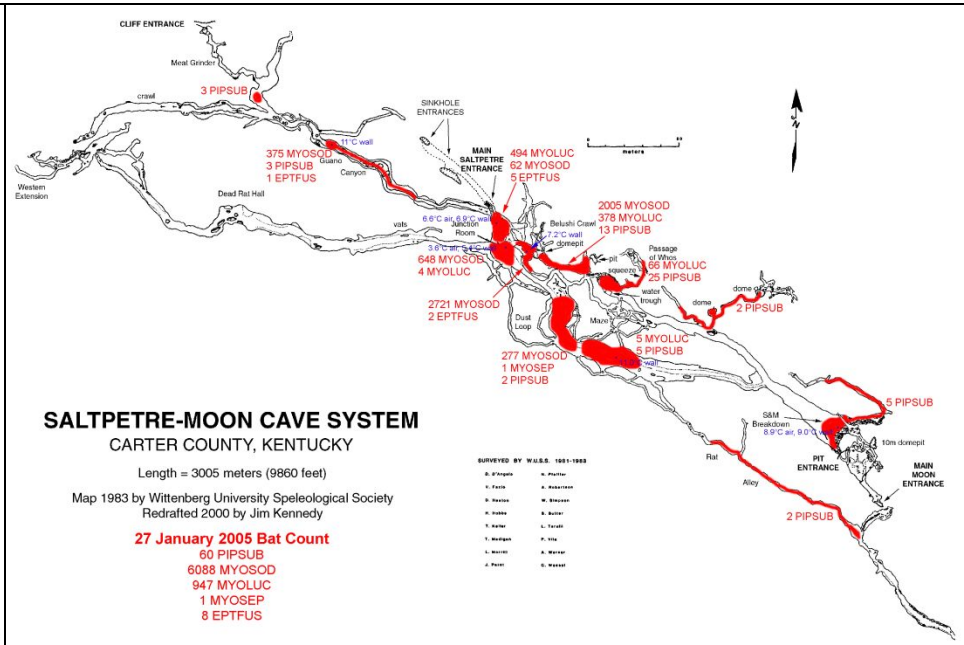

Walk-In
Entrance
Elevators
Wind Cave Tour Routes
Wind Cave National Park
Natural Entrance Tour Route
Garden of Eden Tour Route
Fairgrounds Tour Route
Candlelight Tour Route

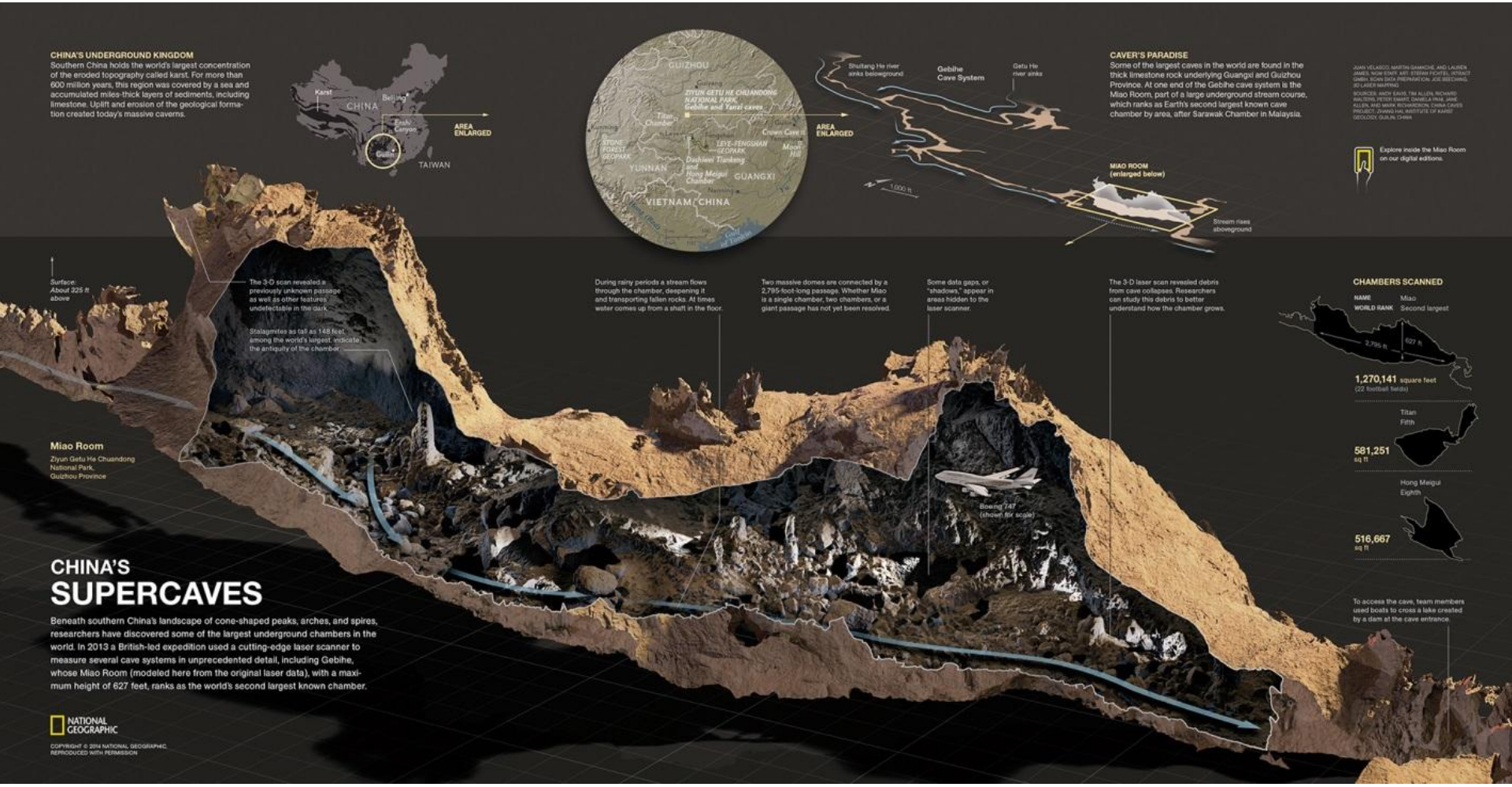

CLIFF ENTRANCE
Meat Grinder
crawl
Abe's Room
SINKHOLE ENTRANCES
MAIN SALTPETRE ENTRANCE
Guano Canyon
Western Extension
Dead Rat Hall
Potato Bins
vats
Junction Room
Belushi Crawl
domepit
pit
squeeze
Passage of Whos
water trough
dome
Wishing Rock
Dust Loop
Maze
S&M Breakdown
10m domepit
Rat
Alley
PIT ENTRANCE
MAIN MOON ENTRANCE
meters
SURVEYED BY W.U.S.S. 1981-1983
SALTPETRE-MOON CAVE SYSTEM
CARTER COUNTY, KENTUCKY
Length = 3005 meters (9860 feet)
Map 1983 by Wittenberg University Speleological Society
Redrafted 2000 by Jim Kennedy
= idealized winter airflow


CLIFF ENTRANCE
Meat Grinder
crawl
Abe's Room
DATALOGGER 212822
DATALOGGER 378454
MAIN SALTPETRE ENTRANCE
Guano Canyon
Western Extension
Dead Rat Hall
DATALOGGER 207018
DATALOGGER 378455
vats
Junction Room
Belushi Crawl
domepit
pit
squeeze
Passage of Whos
DATALOGGER 378456
water trough
dome
Dust Loop
Maze
DATALOGGER 212828
S&M Breakdown
10m domepit
DATALOGGER 212827
Rat
Alley
PIT ENTRANCE
MAIN MOON ENTRANCE
DATALOGGER 212829
DATALOGGER 205916 (tree)
DATALOGGER 302977
meters
SURVEYED BY W.U.S.S. 1981-1983
SALTPETRE-MOON CAVE SYSTEM
CARTER COUNTY, KENTUCKY
Length = 3005 meters (9860 feet)
Map 1983 by Wittenberg University Speleological Society
Redrafted 2000 by Jim Kennedy
= areas with obvious roost staining

Science!


CLIFF ENTRANCE
Meat Grinder
crawl
Abe's Room
SINKHOLE ENTRANCES
MAIN SALTPETRE ENTRANCE
Guano Canyon
Western Extension
Dead Rat Hall
Potato Bins
vats
Junction Room
Belushi Crawl
domepit
pit
squeeze
Passage of Whos
water trough
dome
Wishing Rock
Dust Loop
Maze
S&M Breakdown
10m domepit
Rat
Alley
PIT ENTRANCE
MAIN MOON ENTRANCE
meters
SURVEYED BY W.U.S.S. 1981-1983
SALTPETRE-MOON CAVE SYSTEM
CARTER COUNTY, KENTUCKY
Length = 3005 meters (9860 feet)
Map 1983 by Wittenberg University Speleological Society
Redrafted 2000 by Jim Kennedy
= idealized summer airflow


CLIFF ENTRANCE
Meat Grinder
crawl
3 PIPSUB
SINKHOLE ENTRANCES
11°C wall
375 MYOSOD
3 PIPSUB
1 EPTFUS
MAIN SALTPETRE ENTRANCE
494 MYOLUC
62 MYOSOD
5 EPTFUS
Guano Canyon
Western Extension
Dead Rat Hall
6.6°C air, 6.0°C wall
2005 MYOSOD
378 MYOLUC
13 PIPSUB
vats
Junction Room
Belushi Crawl
7.2°C wall
3.6°C air, 6.4°C wall
domepit
pit
squeeze
Passage of Whos
648 MYOSOD
4 MYOLUC
66 MYOLUC
25 PIPSUB
water trough
dome
2 PIPSUB
2721 MYOSOD
2 EPTFUS
Dust Loop
Maze
5 MYOLUC
6 PIPSUB
277 MYOSOD
1 MYOSEP
2 PIPSUB
S&M Breakdown
8.9°C air, 9.0°C wall
5 PIPSUB
10m domepit
Rat
Alley
PIT ENTRANCE
MAIN MOON ENTRANCE
2 PIPSUB
meters
SURVEYED BY W.U.S.S. 1981-1983
SALTPETRE-MOON CAVE SYSTEM
CARTER COUNTY, KENTUCKY
Length = 3005 meters (9860 feet)
Map 1983 by Wittenberg University Speleological Society
Redrafted 2000 by Jim Kennedy
27 January 2005 Bat Count
60 PIPSUB
6088 MYOSOD
947 MYOLUC
1 MYOSEP
8 EPTFUS



Cave Survey Basics

Cave survey data is collected by a team of two or four members, which sets a series of stations within the cave passage that defines the survey line.

For gathering the data:

For underground surveying, *Suunto compasses and clinometers* (for measuring azimuth and inclination) have been the preferred instruments. They are compact, relatively easy to read and can be waterproofed. *DistoX*'s and similar instruments are now replacing them.

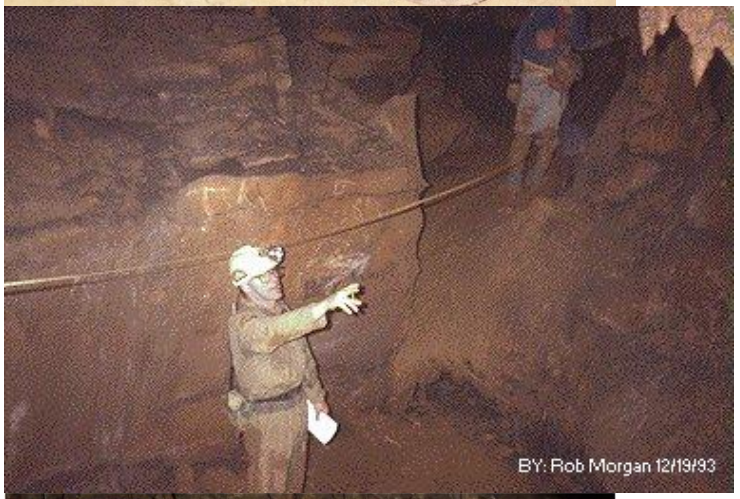
Survey tapes (for measuring distance) used are either 50 or 100-foot lengths (or 15- or30-meter lengths), graduated in tenths. In most cases survey tapes are on a reel. In situations where the passage is extremely muddy, loose tapes are easier to handle. These are being replaced by laser distance meters, like *Distos*.

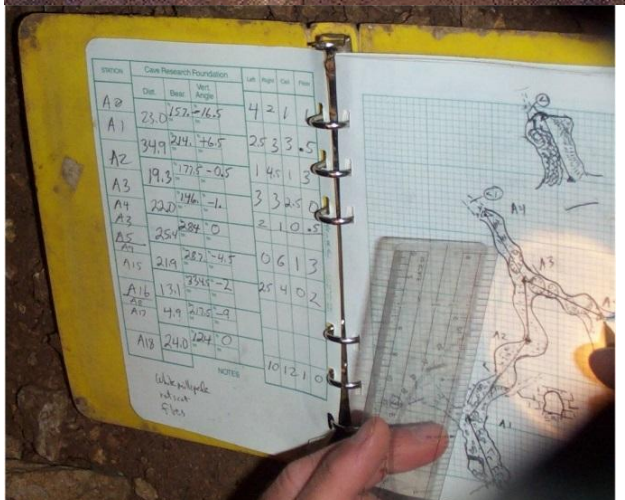
For recording the data:

Loose leaf *waterproof paper* (Rite-in-the-Rain brand) of standard surveyors size which are kept in a *surveyors binder*.

A *protractor and scale* are important for drawing the sketches to scale. *Mechanical pencils* work best for recording data and sketching.

In some situations (very large passages), cave sketches can be done on 8-1/2x11 sheets (also Rite-in-the-Rain) on a clipboard.

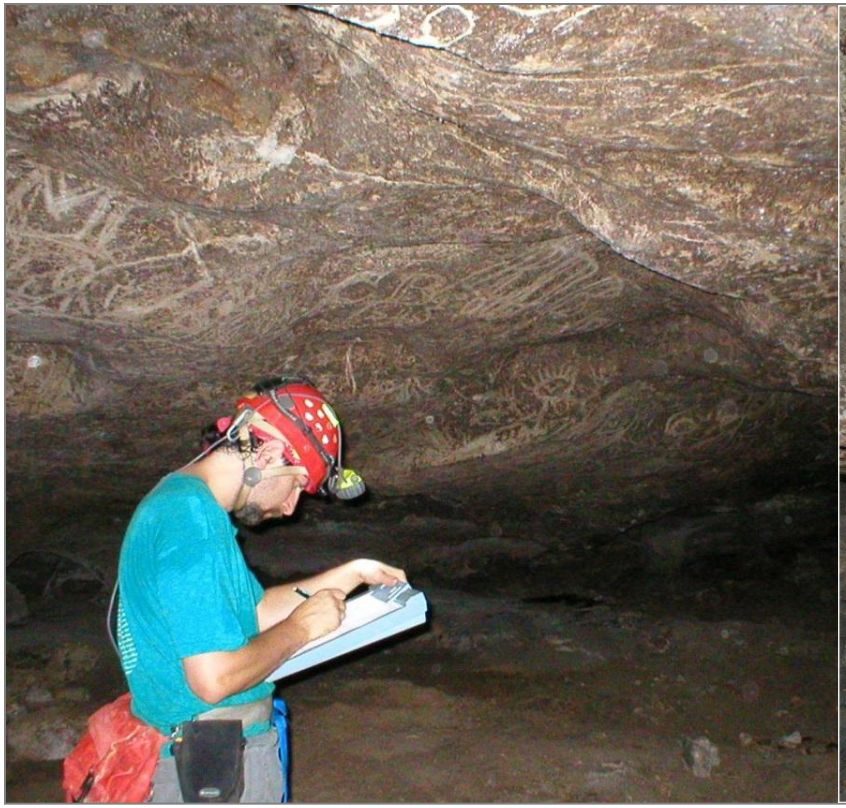




Each team consists of a lead point person whose job it is to set and label survey stations, measure the distance between stations, and determine passage dimensions.

The instrument reader measures the horizontal and vertical angles between each survey station.

The sketcher records the numeric data and draws diagrammatic sketches of the cave passage, consisting of a plan view, profile view, and cross sections.



The survey is conducted by establishing a series of stations which can be located on the walls, ceiling, or floor of the passage.

The front point person selects the location of the first station (FROM station). The instrument reader remains at the station while the front point person proceeds ahead in search of the next station (TO station). When that station is selected, the front point person marks the station as necessary and then holds the end of the tape on the station. The instrument reader (or rear point person) pulls the tape taut and reads the distance between the two stations. The distance is reported to the sketcher who records it.

Next, the point person either estimates or measures the passage dimensions with respect to the station, and reports them to the sketcher.

The frontsite compass and inclinometer readings are taken next. The front point person puts a target light on the TO station and points it back at the FROM station. The instrument reader (who is at the FROM station) sights on the target light in order to read the azimuth and inclination between the FROM station and the TO station. To check the accuracy of the readings, the instrument person moves to the TO station to take backsite compass and inclinometer readings to the FROM station. Depending on the survey party and the passage, the point person, rear point person, or the sketcher will put the target light on station for backsite.

While all measurements are being taken, the sketcher plots the stations in the survey book and makes an interpretive drawing of the cave passage between the two stations. When the station readings are complete, the front point person moves ahead to locate and set the next TO station.

How do you get ceiling measurements?

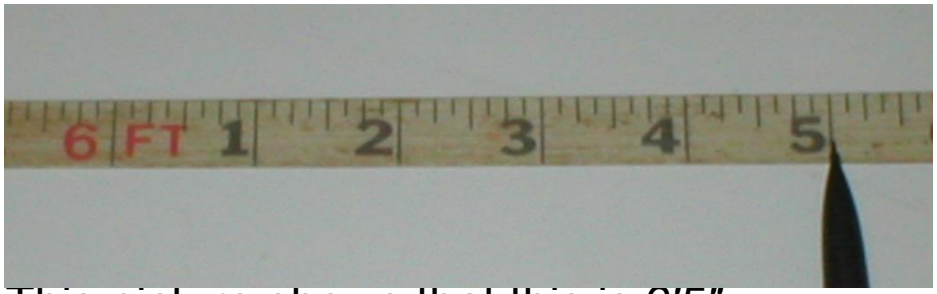
- Estimates are acceptable if ceiling is not higher than ~6m (20 feet).
- You can triangulate if you know how.
- Use the Percent Grade measure on the inclinometer
- Use a laser range finder, if available.

Common Blunders during the survey trip

- *Reading the wrong side on the tape* between markings (results in errors of up to 1 foot or meter.
- *Not holding compass level* (random errors)
- *Reading wrong scale on the compass* (180 degree error)
- *Decade inversion* – reading the wrong direction between major increments (up to 10 degree error)
- *Dyslexia in writing* the numbers in book (random, potentially nasty error)
- *Failure to record inclination sign* (plus or minus) in the book (random, really nasty error)
- *Magnetic effects on compass* caused by batteries, glasses, helmet etc (5-10 degree error – usually caught on backsite)
- *Sketcher records fore- and back-site reversed* (this will be apparent in the sketch)
- *Illegible book* - mud, erasures, lousy handwriting (random errors)

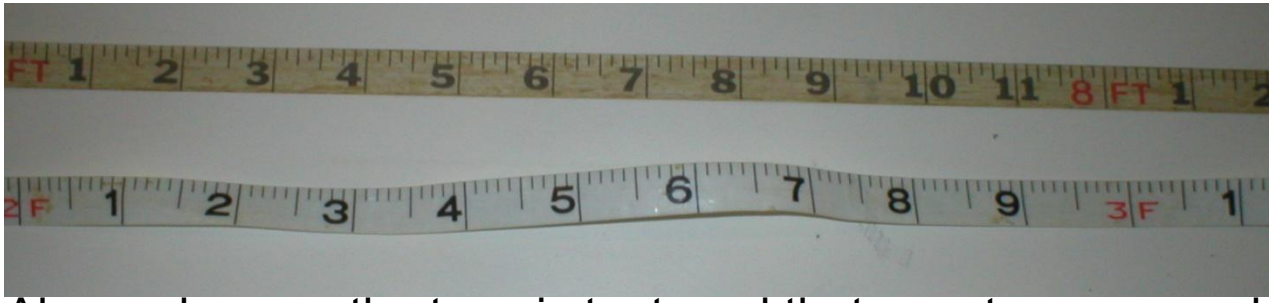
One very common error is reading the tape incorrectly.

Is this 6 feet 5 inches? Or 6.5 feet?

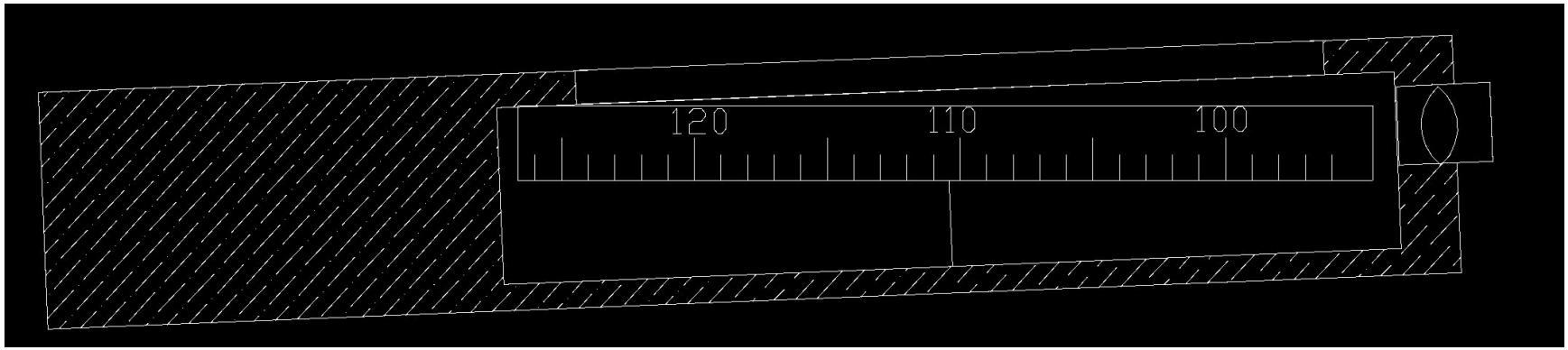


This picture shows that this is 6′5″.

As a sketcher it is important to know what tape you are using and make sure this is recorded in the book.



Also make sure the tape is taut, and that your tape person knows how to read and call out the distance.

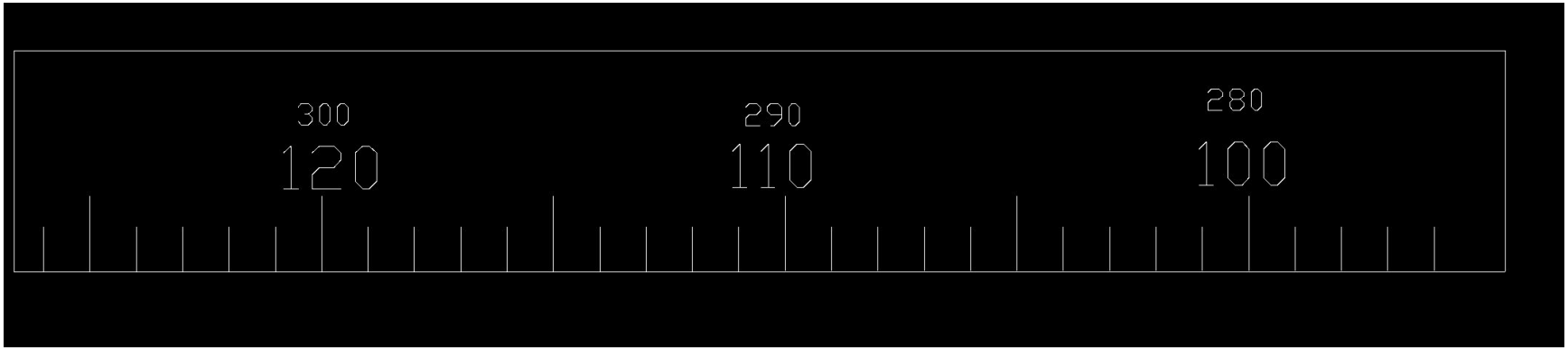


A major source of compass error can be a result of not holding the instrument level.

The compass card (dial) will rub inside the capsule and not give a good reading.

Solution: During the reading, hold the instrument level, and rotate it back and forth, checking that the card swings free.

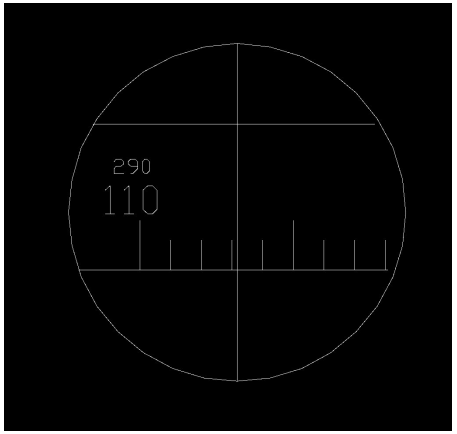
Many compasses have two scales.



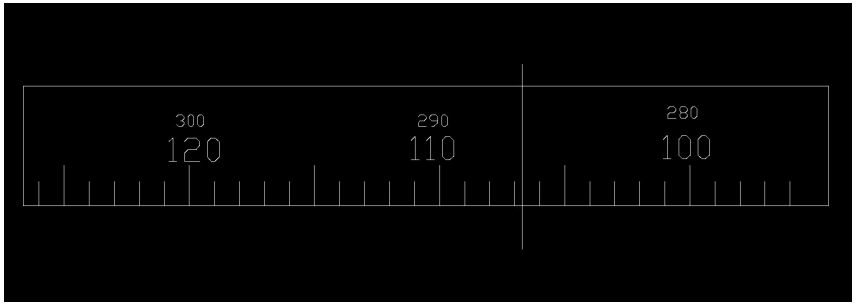
So… is this 290 or 110?

Solution: Use the big-sized numbers! Fortunately, this mistake can usually be caught in sketch (remember to sketch to scale!!)

Decade Inversion — reading on the wrong side of the numbers.



Is this 113, or 107?



Looking at the whole card makes it plain that it is 107, but we cannot see the whole card.

Solution: Again, rock the compass back and forth a little to see both sets of numbers. This can also be caught on the backsite.

Book-Keepers Errors

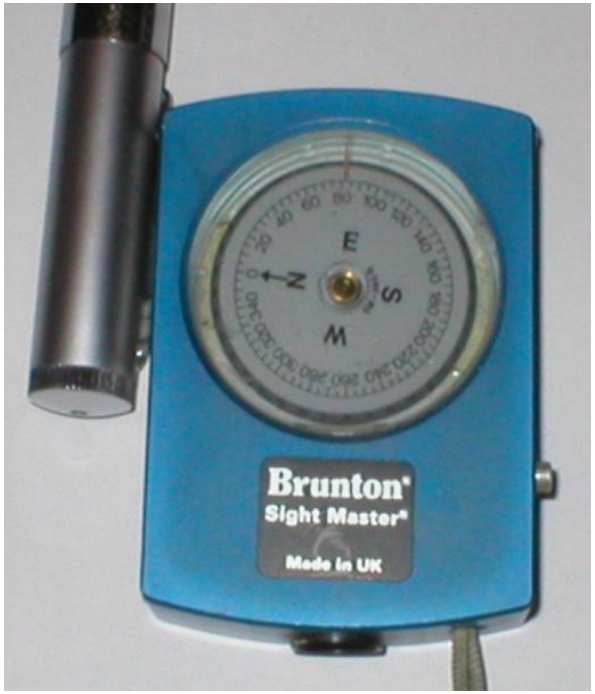
Lesdixsia uhh…uhh.. Dyslexia – random and insidious swaps of numbers – some people are prone to it. Make sure you repeat numbers back AS you write them down, and in a different format.

Inclination Signs Missing – Another one that can be hard to catch. Again, repeat readings as back as called to you.

Reversing back and front sights This can happen if you get behind. This can usually be caught during the sketch.

Magnetic Interference

Don't forget that metal can pull readings off. Even minor amounts can change a reading by a lot.



Solution: Make sure that the compass reader is free of metal in and around helmets and lights. Do compass checks in full gear! Even headlamp batteries can affect readings from a foot away

This mistake can usually be caught on backsite.

Survey team dynamics and communication

•***Communication*** is one of the most important aspects of team dynamics.

- It is important that all team members ***communicate the data to the sketcher*** clearly. The sketcher should acknowledge that she/he received the data by repeating the numbers, preferably in a different format. If the sketcher doesn't repeat, then they did NOT hear the data.

- When the point person is ready to take measured distance, he/she should say "Tape On" or "On point". This **alerts the other team members** to hold their end of the tape on station.

- When the light is **on the station ready for the instrument person** to sight, the lead person should call "On Station". Same for clinometer reading.

- Always ***give the data in the same order*** for each station. For example: distance, azimuth, inclination, passage dimensions. It's the sketchers call on the order of the data.

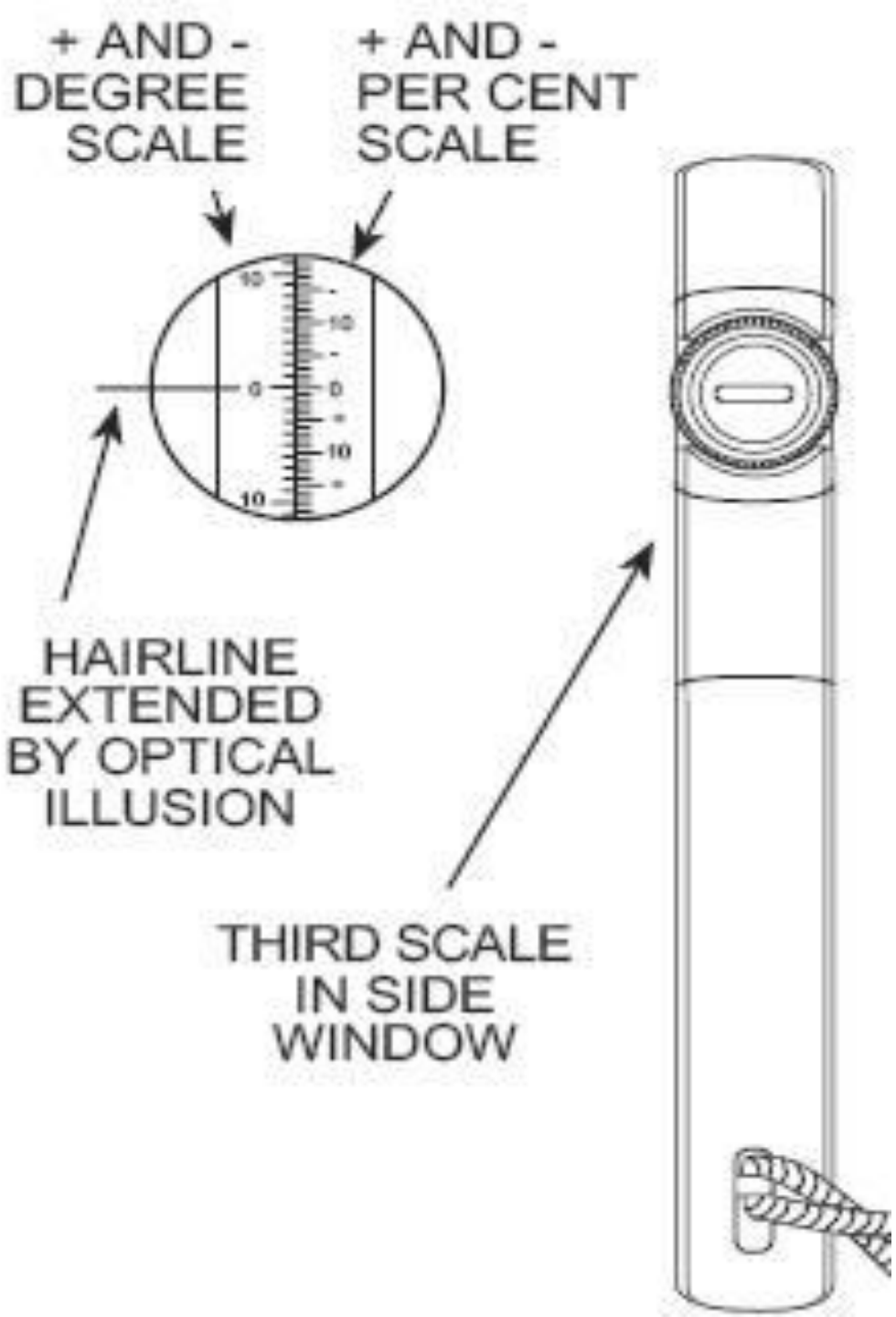
- Always **indicate to the sketcher which data you are giving** them. For example, when reading the distance, call out "Distance XX.X meters" or "Azimuth XX.X degrees".

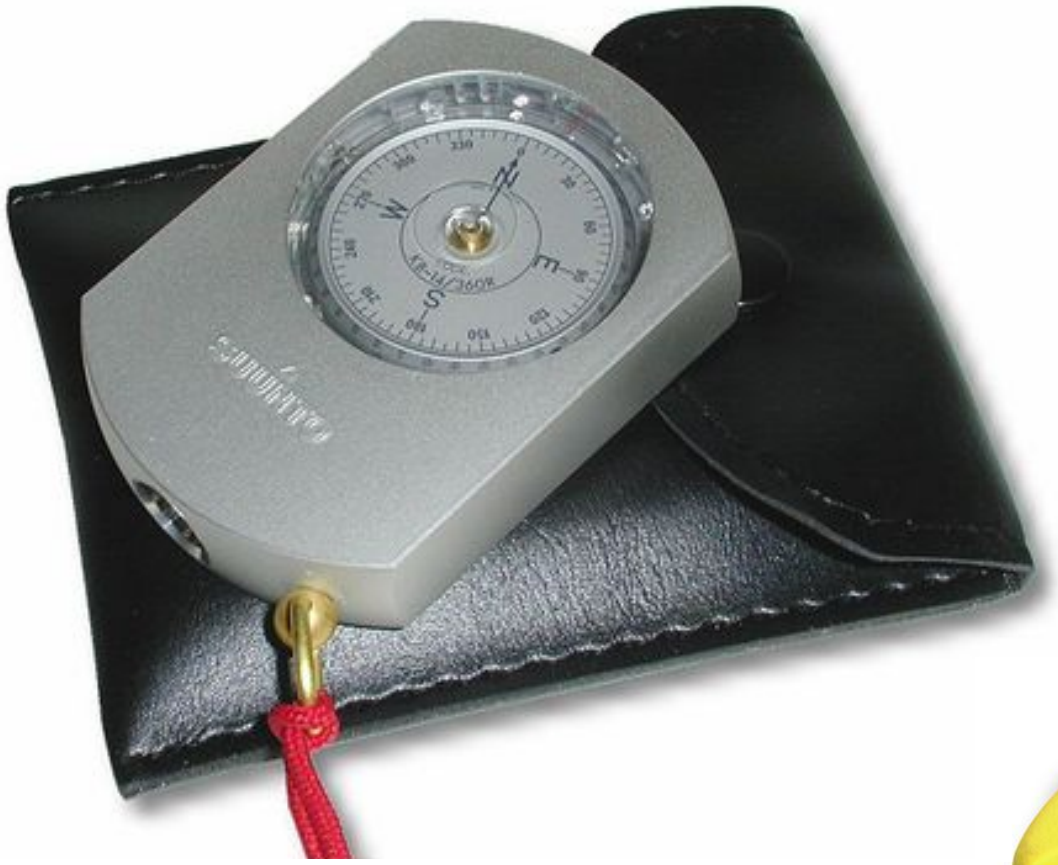
- Always **present the passage dimensions as a "package"** of information rather than making the sketcher wait for each and every number separately. Ordering and packaging the data makes it easier for the sketcher to stay focused on the sketch and to keep the survey moving.

SURVEY INSTRUMENTS


330
0
30
300
60
270
W
N
E
240
90
210
S
120
180
150
KB-14/360R G
Global
SUUNTO
MADE IN FINLAND
SUUNTO


SUUNTO
MADE IN FINLAND
PM-5/360PC
80 70 60 50 40 30 20 10 0 10 20 30 40 50
SUUNTO


+ AND -
DEGREE
SCALE
+ AND -
PER CENT
SCALE
10
0
10
HAIRLINE
EXTENDED
BY OPTICAL
ILLUSION
THIRD SCALE
IN SIDE
WINDOW



Use a case, protect your investment!

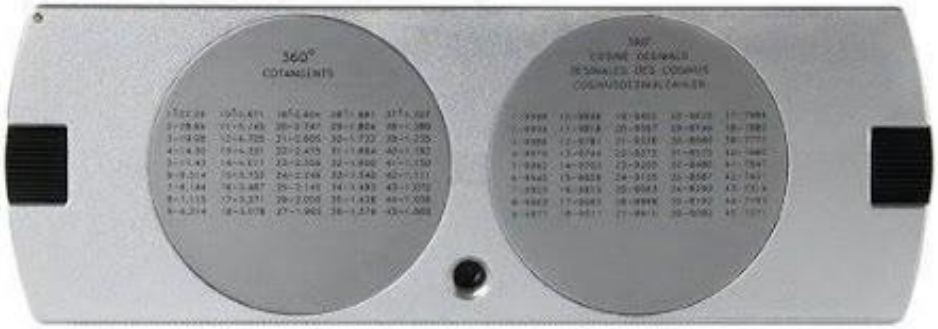
Other acceptable instruments


SUUNTO
SUUNTO


SUUNTO
TANDEM
SUUNTO


SUUNTO


W
S
CM-360-%-A


360°
COTANGENTS


W
S
Rexford
TOOLS

Avoid the dreaded Brunton!

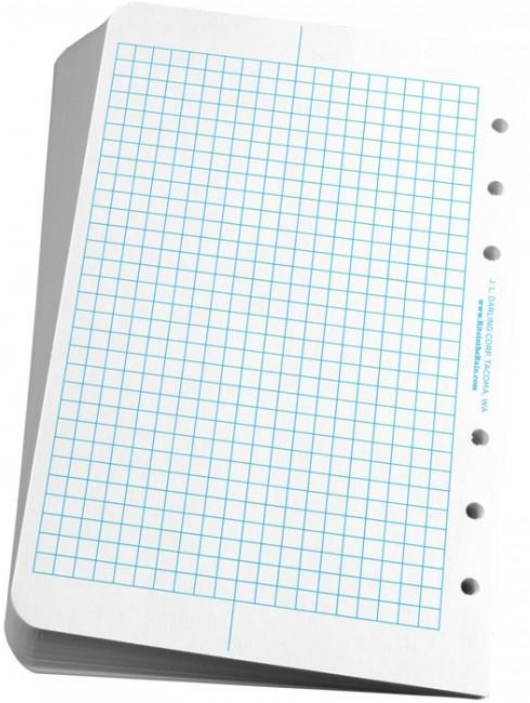
TAPES

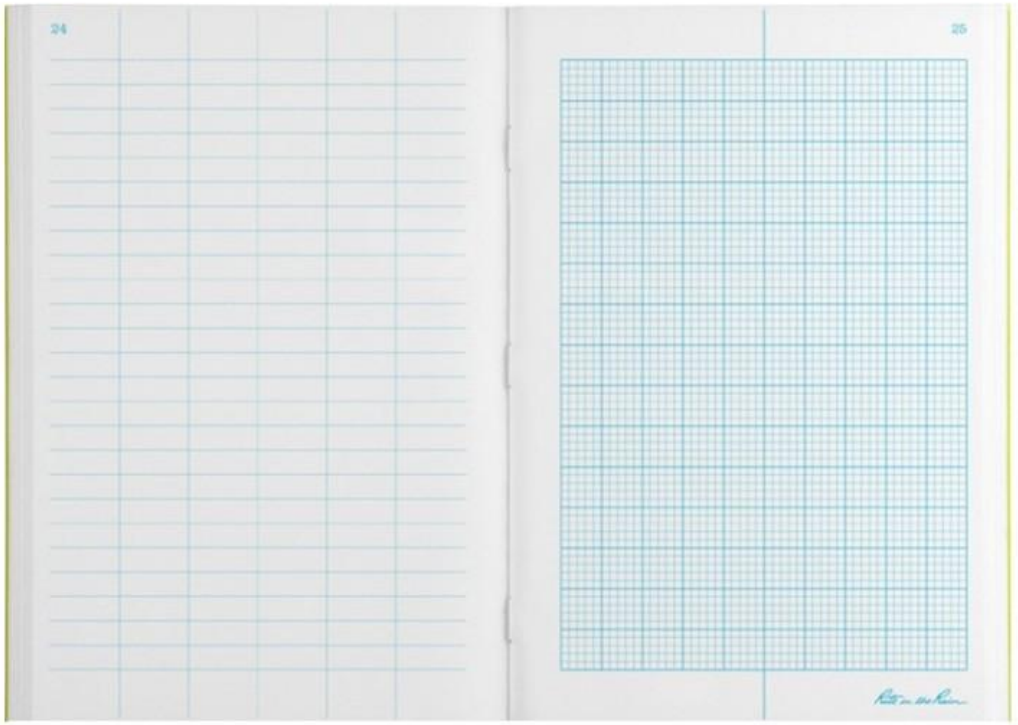
Laser distance meters, aka “Distos”

See, they are not ALL made by Leica!

Survey Books

Survey Paper



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Rite in the Rain
DEFYING MOTHER NATURE
ALL-WEATHER
COPIER PAPER
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20# Rite in the Rain Paper (75 g/m²)
50 Sheets, 8½" x 11" (letter size)
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WOOD-BASED & RECYCLABLE
DOCUMENTS
USE A LASER PRINTER OR PHOTOCOPIER
not for ink-jet
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available colors
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WHITE
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FOR 100 YEARS
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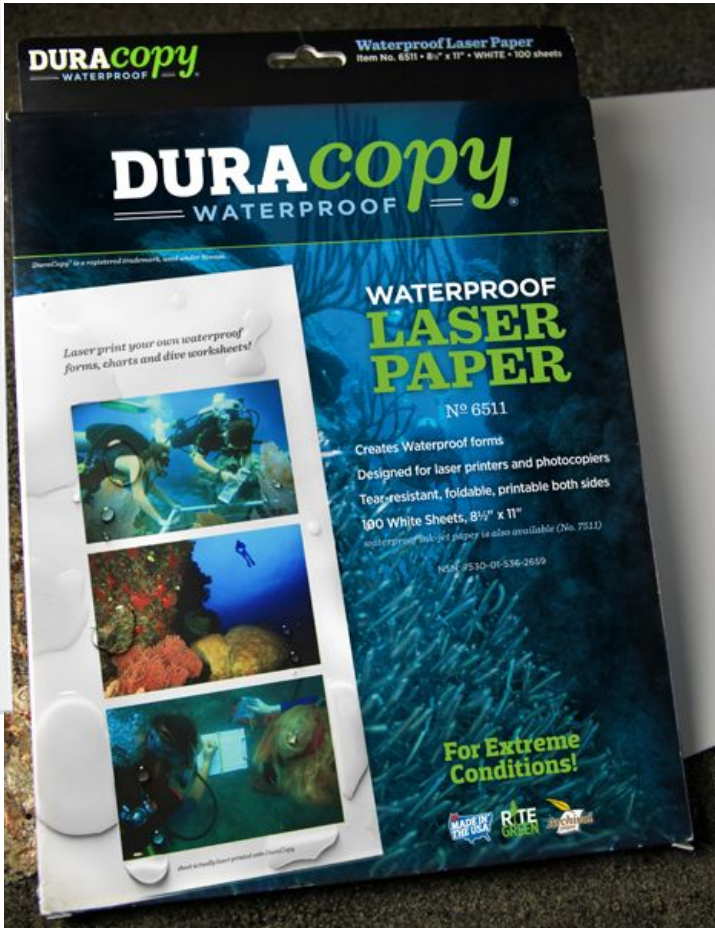
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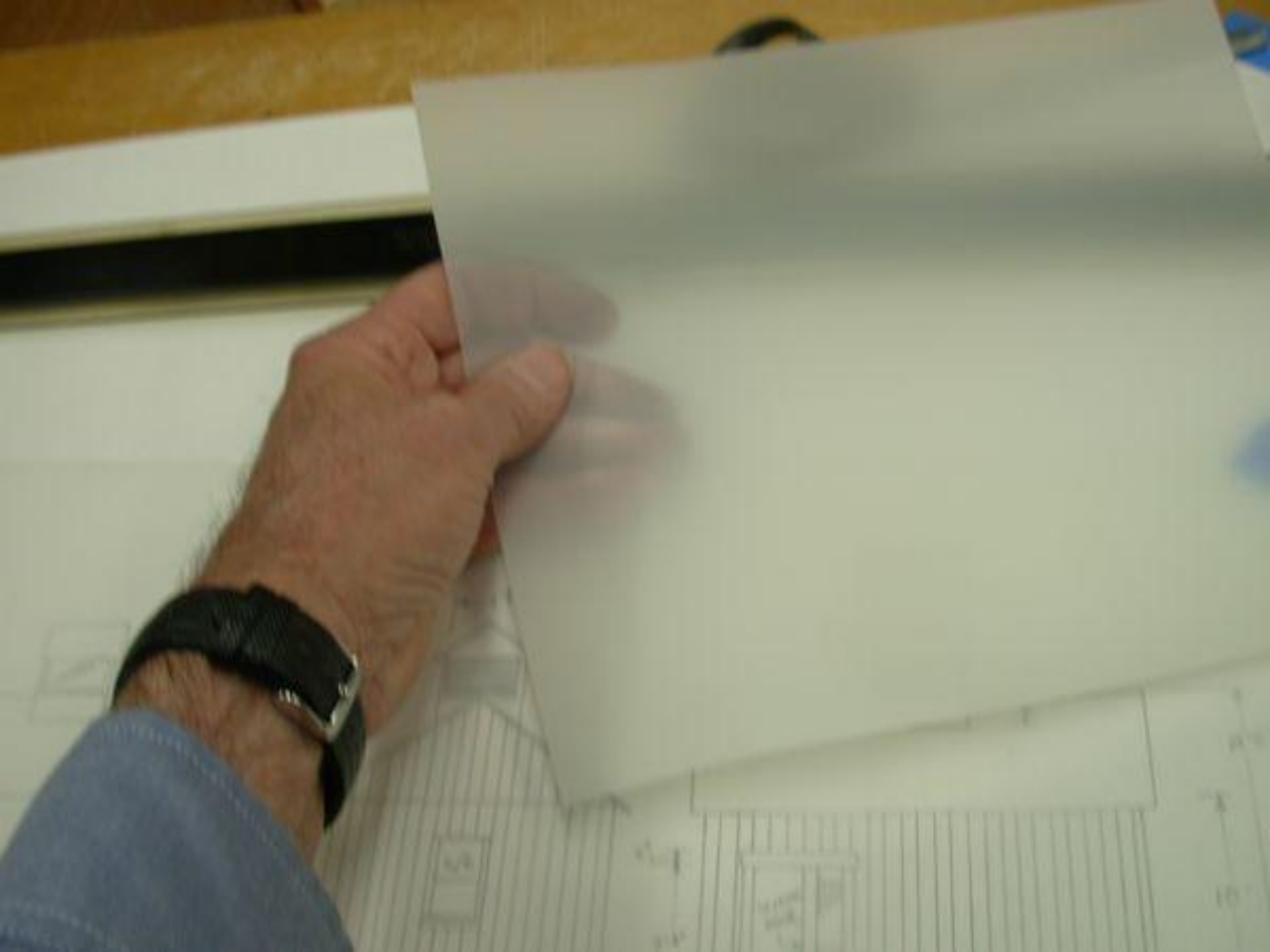
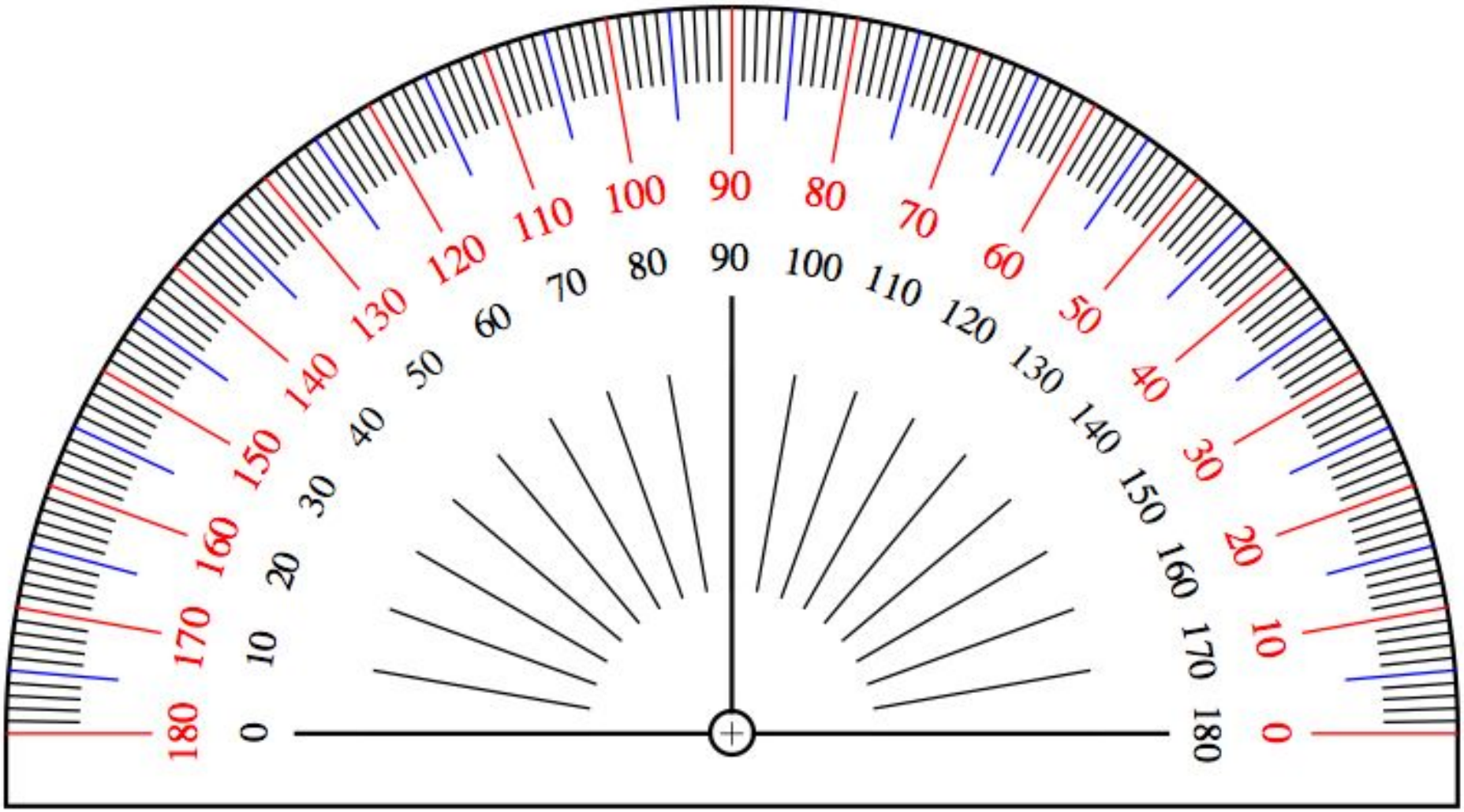
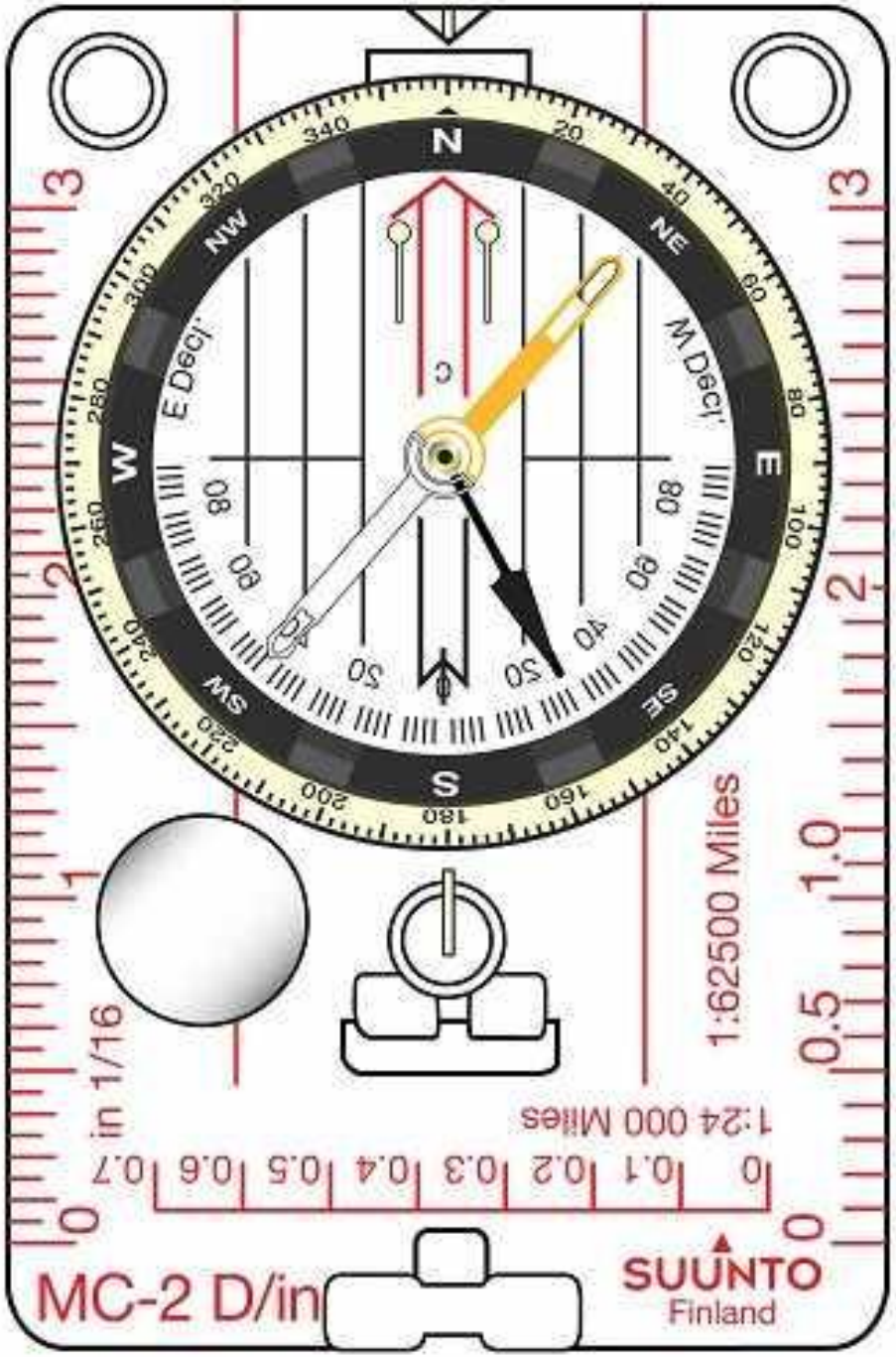
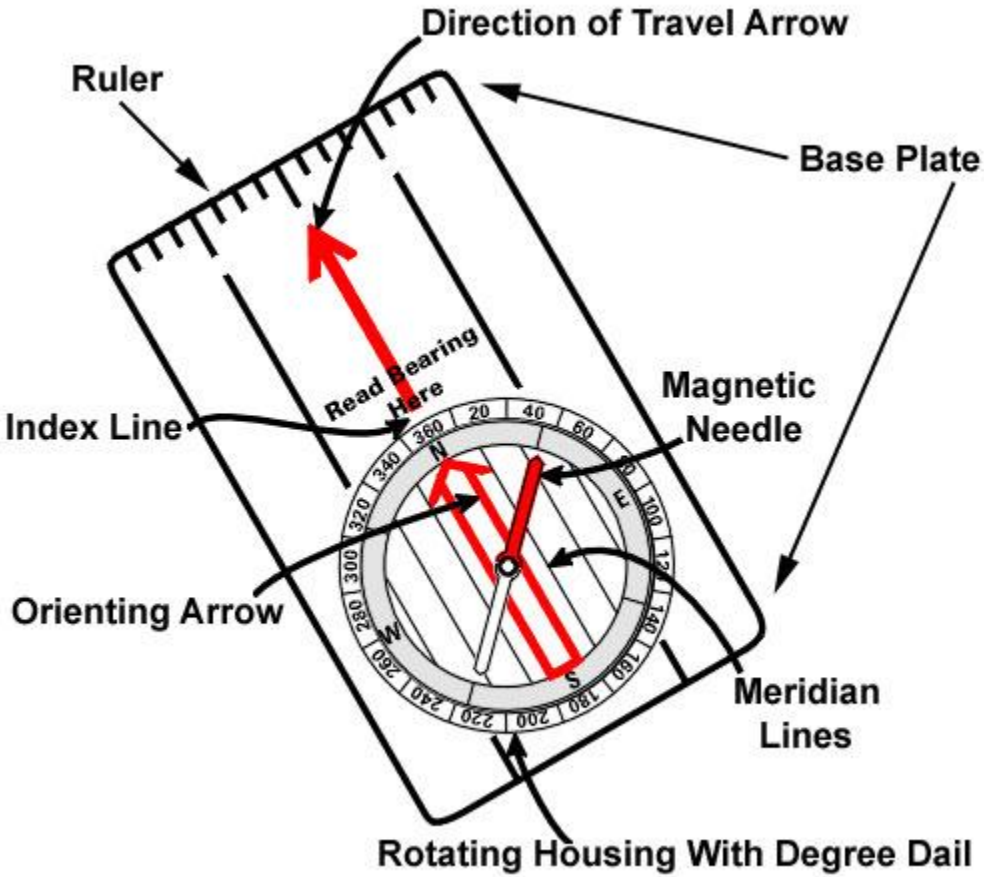
WATERPROOF
Waterproof Laser Paper
Item No. 6511 • 8½" x 11" • WHITE • 100 sheets
DURAcopy
WATERPROOF
Laser print your own waterproof forms, charts and dive worksheets!
WATERPROOF
LASER
PAPER
№ 6511
Creates Waterproof forms
Designed for laser printers and photocopiers
Tear-resistant, foldable, printable both sides
100 White Sheets, 8½" x 11"
waterproof ink-jet paper is also available (No. 7511)
NSN 7530-01-536-2659
For Extreme Conditions!
MADE IN THE USA
RITE IN THE RAIN



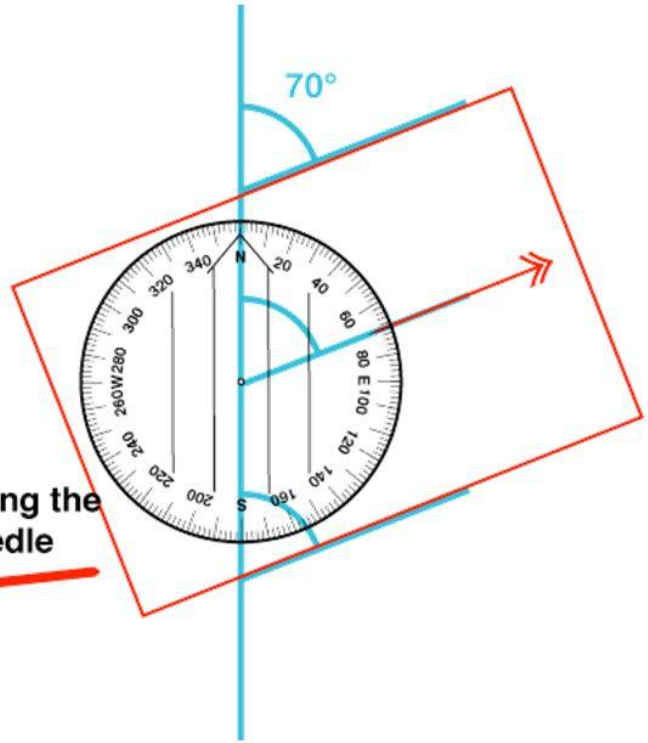

40696
#1 Selling Mechanical Pencil
BIC
Pencil
Xtra Sparkle
Sparkly, fun designs
1 BIC® Pencil = 2½ wood case pencils
Medium Mediana
0.7 mm
#2
24
Mechanical Pencils
Lápices mecánicos
Sharpie
FINE POINT
Permanent Marker


0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0

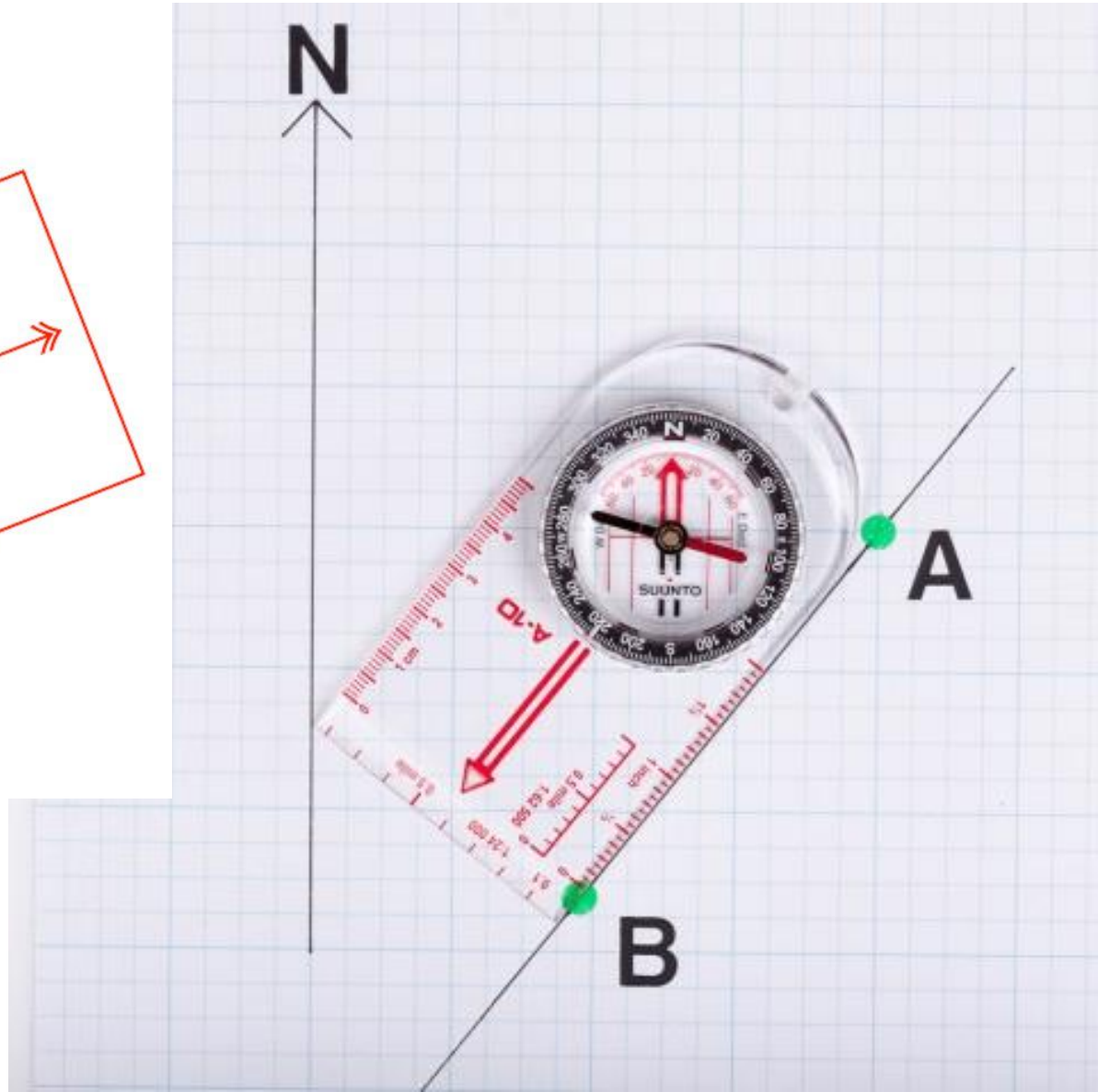

N
NE
E
SE
S
SW
W
NW
E Decl.
M Decl.
1:62500 Miles
1:24 000 Miles
in 1/16
MC-2 D/in
SUUNTO
Finland


Direction of Travel Arrow
Ruler
Base Plate
Read Bearing Here
Index Line
Magnetic Needle
Orienting Arrow
Meridian Lines
Rotating Housing With Degree Dail

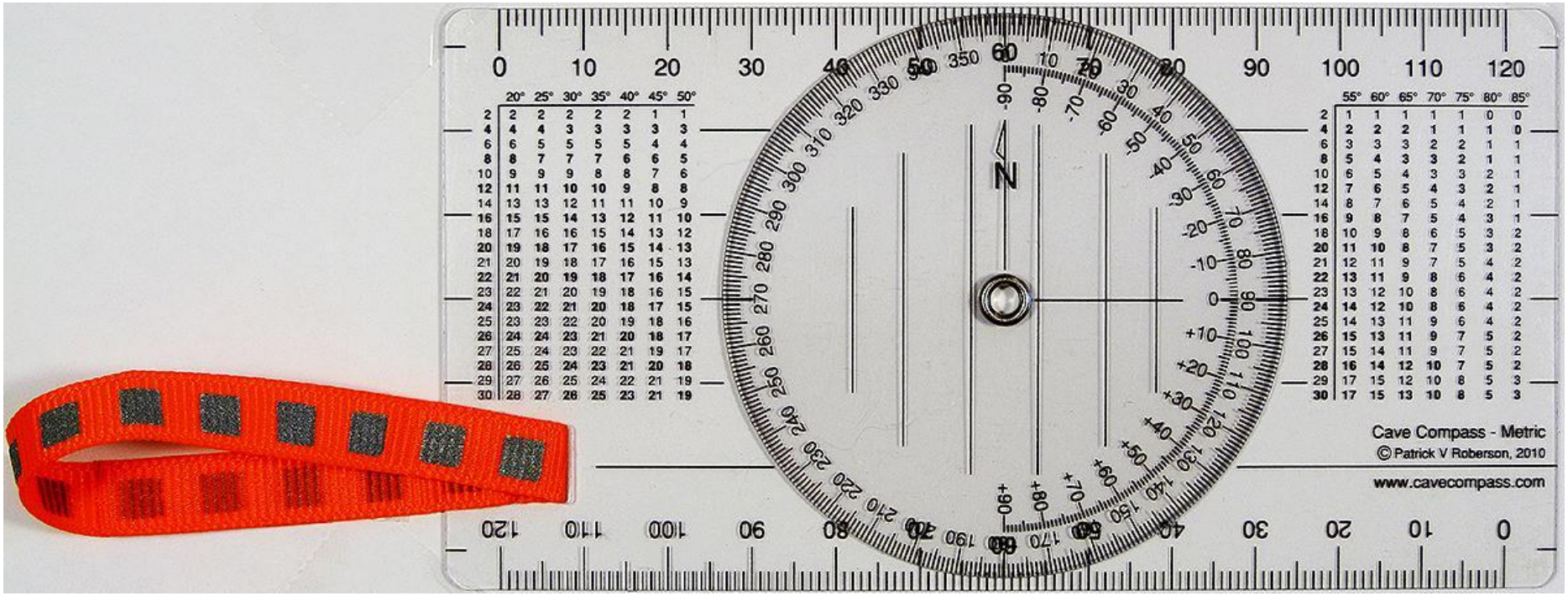
You can use your compass as a protractor



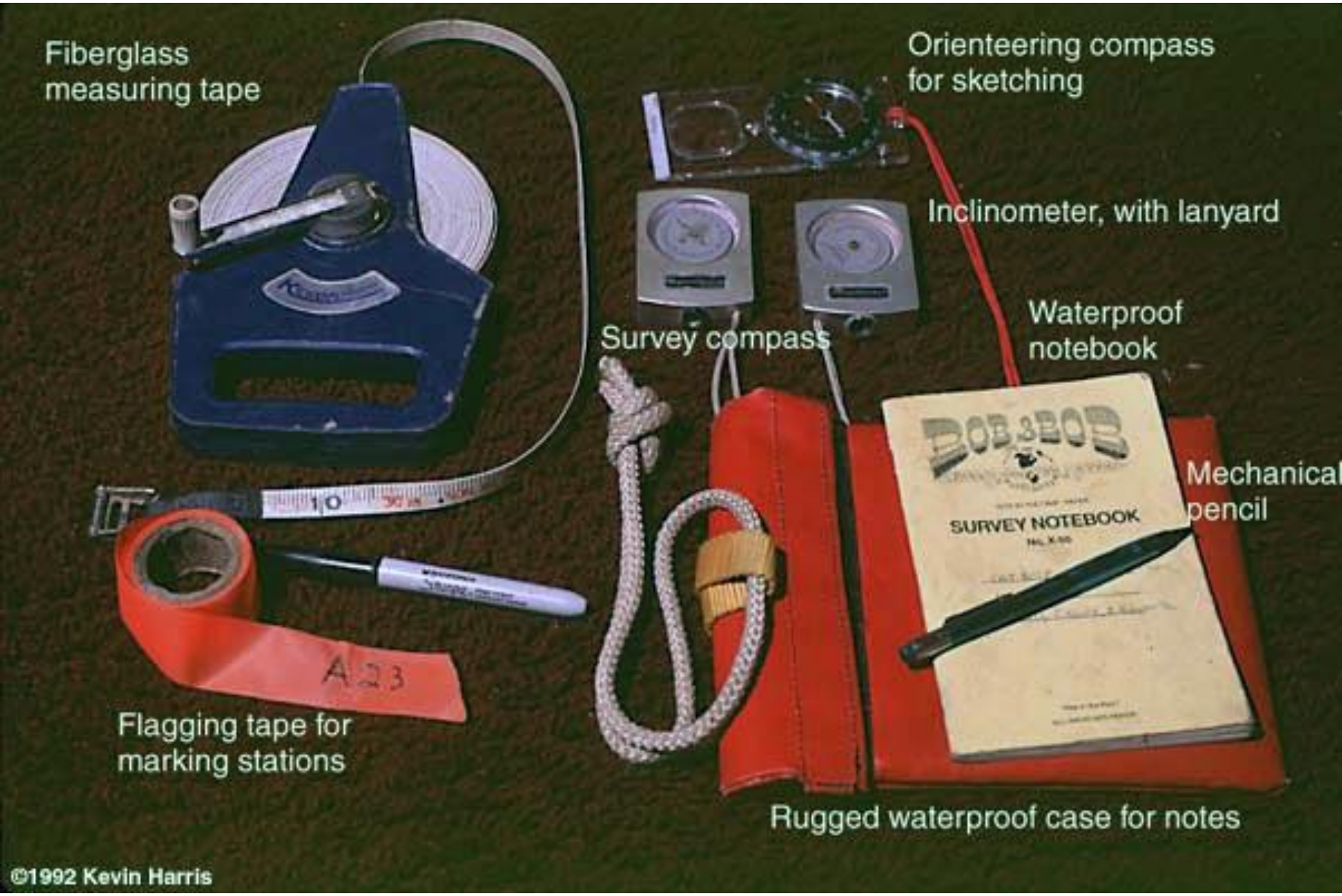
We're not using the magnetic needle



The Cave Compass



Survey Pouch


Fiberglass measuring tape
Orienteering compass for sketching
Inclinometer, with lanyard
Survey compass
Waterproof notebook
SURVEY NOTEBOOK
Mechanical pencil
A23
Flagging tape for marking stations
Rugged waterproof case for notes
©1992 Kevin Harris

Setting up your Survey Book

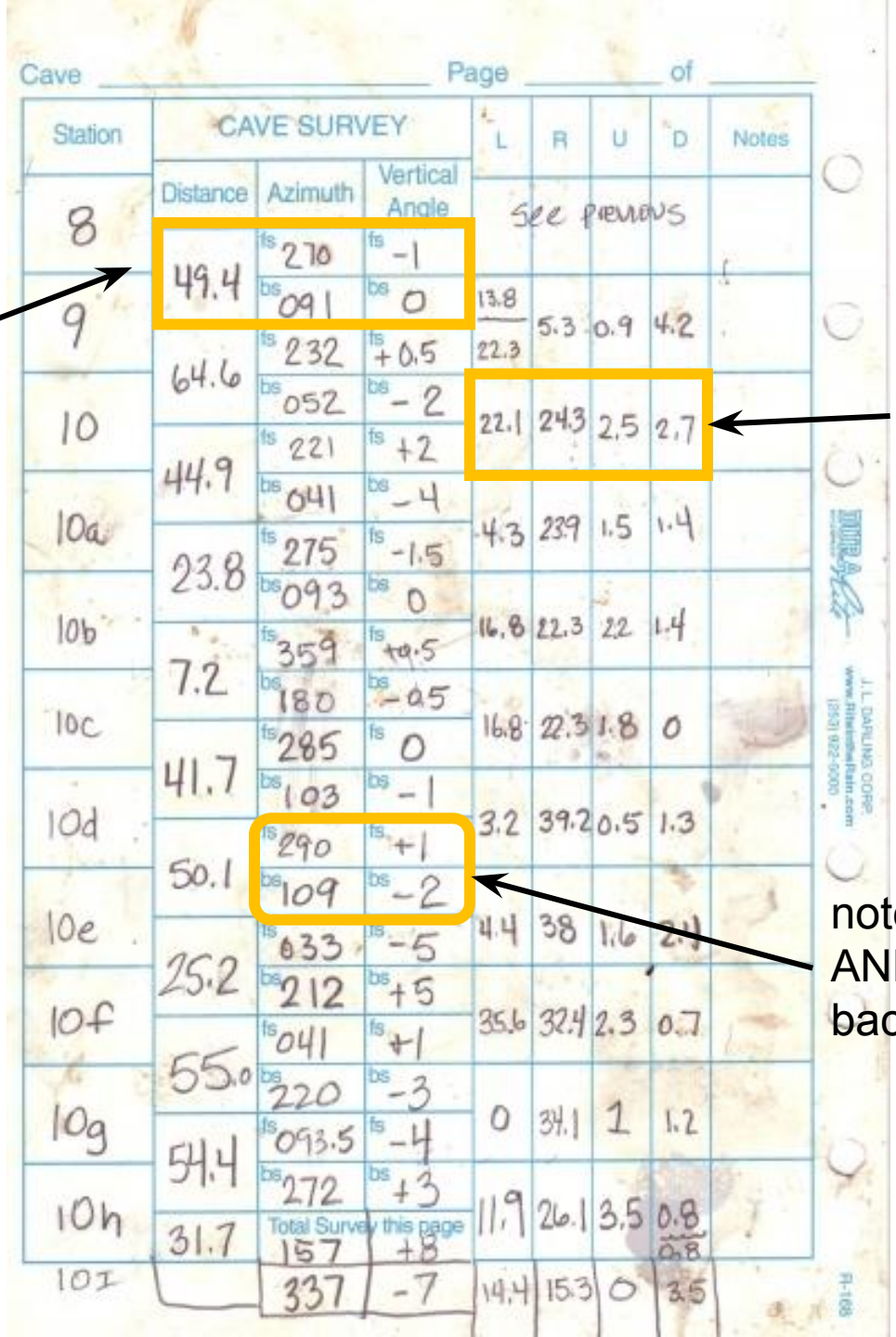
SURVEY DATA:
Station names
Distances between stations
Azimiths between stations
Inclinations between stations
LRUDs (passage dimensions Left, Right, Up, and Down from station)

METADATA:
Cave name
Cave location
Survey date
Survey party (and tasks)
Type of survey
Page numbers (out of how many pages)

SKETCH:
Plan
Profile
Cross-sections
Labels
North arrow
Scale

MARGINAL NOTES
Leads
Fauna
Geology
Comic quotes
Etc.

Essential data to bring back



Cave _____ Page _____ of _____

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance	Azimuth	Vertical Angle					
8				See previous				
	49.4	fs 270	fs -1					
9		bs 091	bs 0	13.8 / 22.3	5.3	0.9	4.2	
	64.6	fs 232	fs +0.5					
		bs 052	bs -2					
10				22.1	24.3	2.5	2.7	
	44.9	fs 221	fs +2					
		bs 041	bs -4					
10a				4.3	23.9	1.5	1.4	
	23.8	fs 275	fs -1.5					
		bs 093	bs 0					
10b				16.8	22.3	22	1.4	
	7.2	fs 359	fs +0.5					
		bs 180	bs -0.5					
10c				16.8	22.3	1.8	0	
	41.7	fs 285	fs 0					
		bs 103	bs -1					
10d				3.2	39.2	0.5	1.3	
	50.1	fs 290	fs +1					
		bs 109	bs -2					
10e				4.4	38	1.6	2.1	
	25.2	fs 033	fs -5					
		bs 212	bs +5					
10f				35.6	32.4	2.3	0.7	
	55.0	fs 041	fs +1					
		bs 220	bs -3					
10g				0	34.1	1	1.2	
	54.4	fs 093.5	fs -4					
		bs 272	bs +3					
10h				11.9	26.1	3.5	0.8 / 0.8	
	31.7	Total Survey this page 157	+8					
10I		337	-7	14.4	15.3	0	3.5	

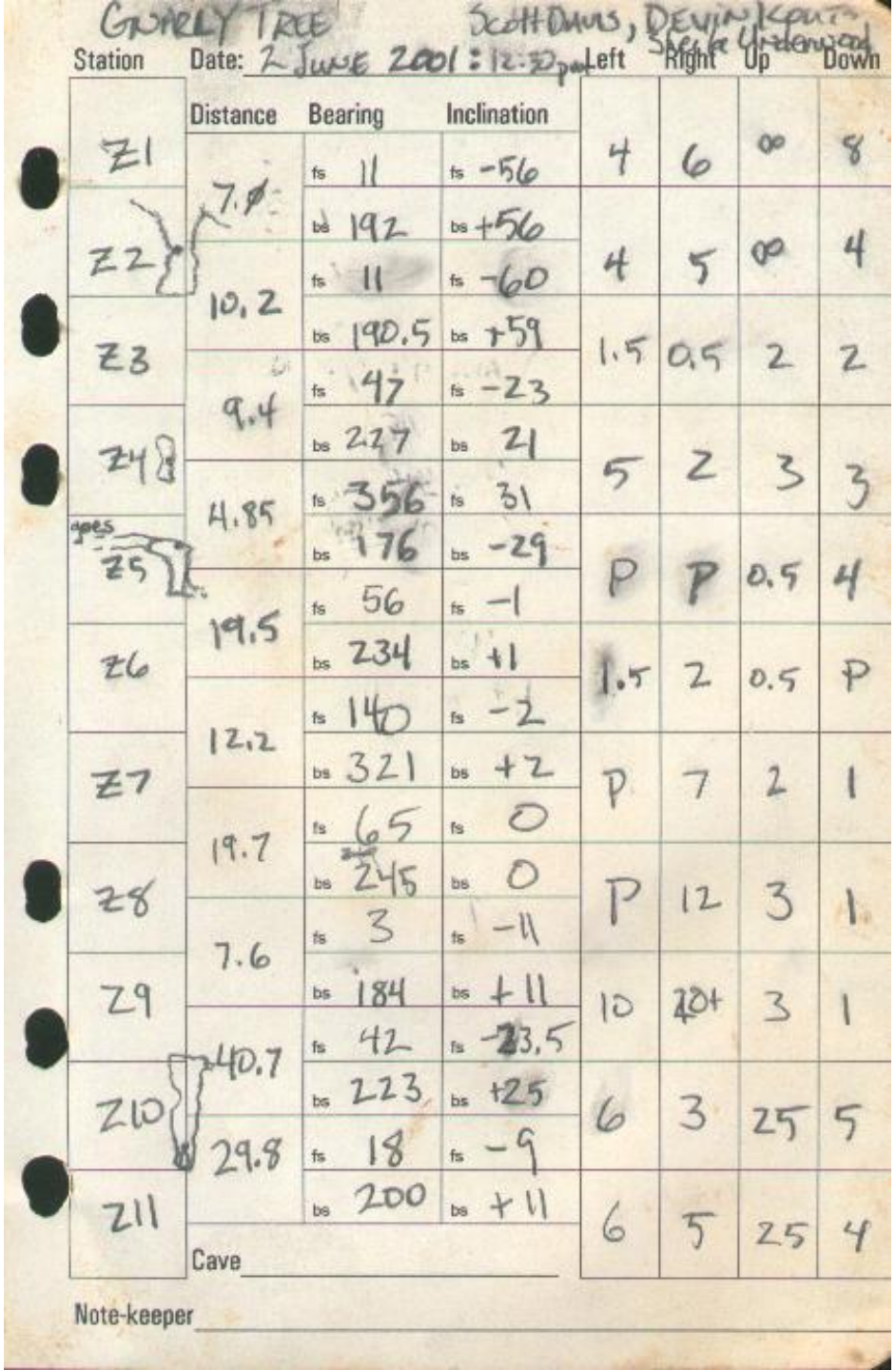
measurements BETWEEN station 8 and 9

measurements AT station 10

note foresights AND backsights

Pre-printed survey page

Another pre-printed page



GURLY TREE — Scott Davis, Devin Koutz, Sheila Underwood

Date: 2 June 2001 : 12:30 pm

Station	Distance	Bearing	Inclination	Left	Right	Up	Down
Z1	7.0	fs 11	fs -56	4	6	∞	8
Z2		bs 192	bs +56	4	5	∞	4
	10.2	fs 11	fs -60				
Z3		bs 190.5	bs +59	1.5	0.5	2	2
	9.4	fs 47	fs -23				
Z4		bs 227	bs 21	5	2	3	3
	4.85	fs 356	fs 31				
goes Z5		bs 176	bs -29	P	P	0.5	4
	19.5	fs 56	fs -1				
Z6		bs 234	bs +1	1.5	2	0.5	P
	12.2	fs 140	fs -2				
Z7		bs 321	bs +2	P	7	2	1
	19.7	fs 65	fs 0				
Z8		bs 245	bs 0	P	12	3	1
	7.6	fs 3	fs -11				
Z9		bs 184	bs +11	10	20+	3	1
	40.7	fs 42	fs -23.5				
Z10		bs 223	bs +25	6	3	25	5
	29.8	fs 18	fs -9				
Z11		bs 200	bs +11	6	5	25	4

Cave _____

Note-keeper _____

SAB 206 Chimneyers Delight • 1/10/98 • 1230 - 1830

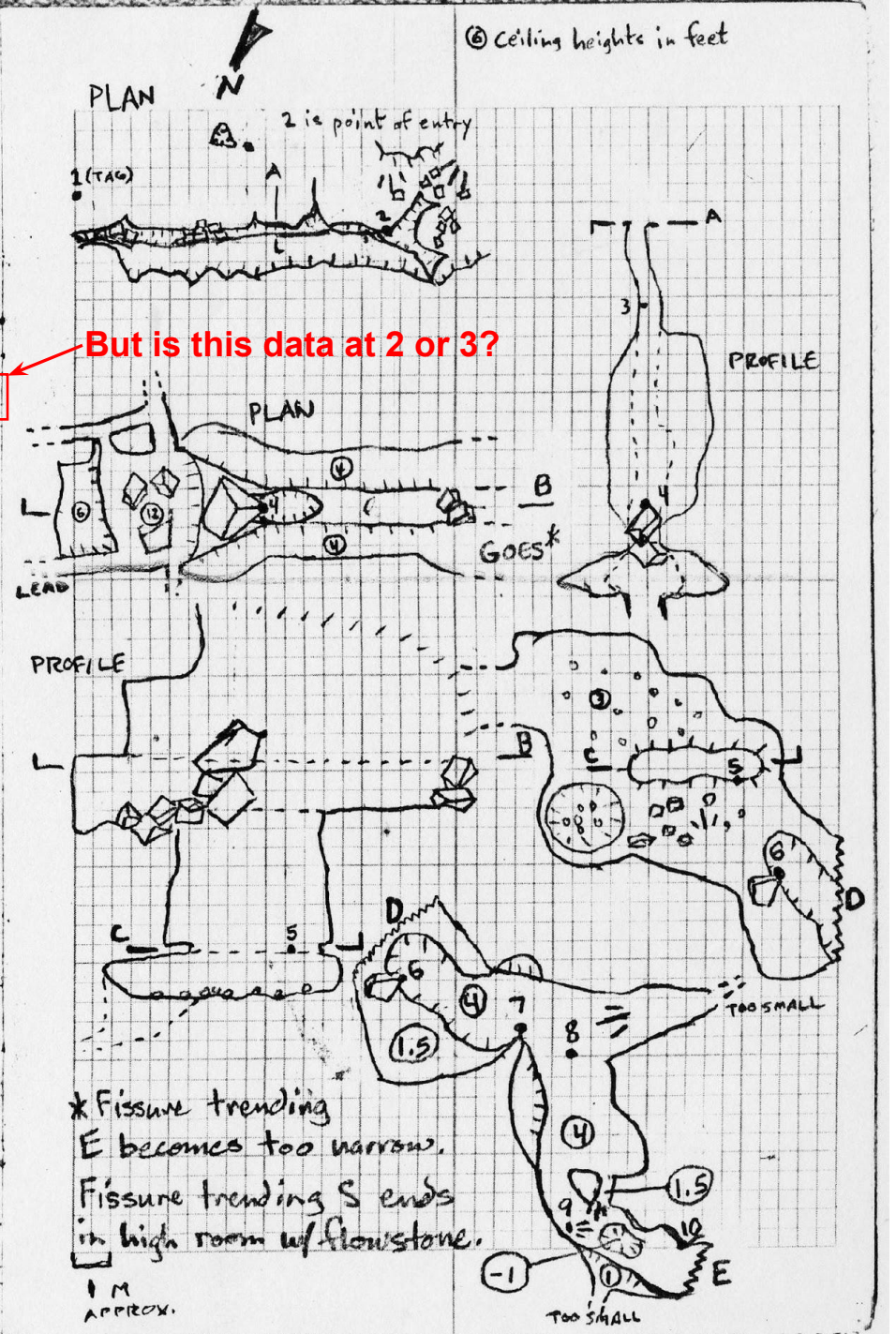
Book: Goff, Ed Backup: Davis Goff, Laura
Inst: Turner, David
Tape: Pickett, Walter

	AZ.	INC.	DIST.(M)	L/R(M)	U/D(M)
1-2	310	+1	7.80	—/—	—/—
2-3	270	-70	2.60	.5/.5	—/1
3-4	90	-75	6.65	.1/.3	6/2
4-5	270	-80	5.45	.5/2.5	—/.7
5-6	320	-16	2.70	2/2	.5/.3
6-7	255	+2	2.70	.7/.5	.1/.8
7-8	255	-2	1.40	1/.7	.2/.7
8-9	335	-14	4.54	.6/0	.6/.7
9-10	265	-9	3.01	0/1.5	1/.3
10-11	295	-4	2.70	1/.2	1/.3
11-12	225	+3	2.91	.1/1.5	.7/.7
12-13	285	-3	2.12	.7/.4	.7/.4
13-14	220	+2	5.42	0/1.5	1/.2

But is this data at 2 or 3?

A Different Approach to Note-taking

Fauna: 3 bats (Mex. freetail), cave crickets, spiders in webs, scat, dead mammal (possibly ringtail cat or raccoon)



Date **Cave name** **Page numbers** 1/1

2/10/96 Cave by Rock Quarry

SAB 256 **no county or state**

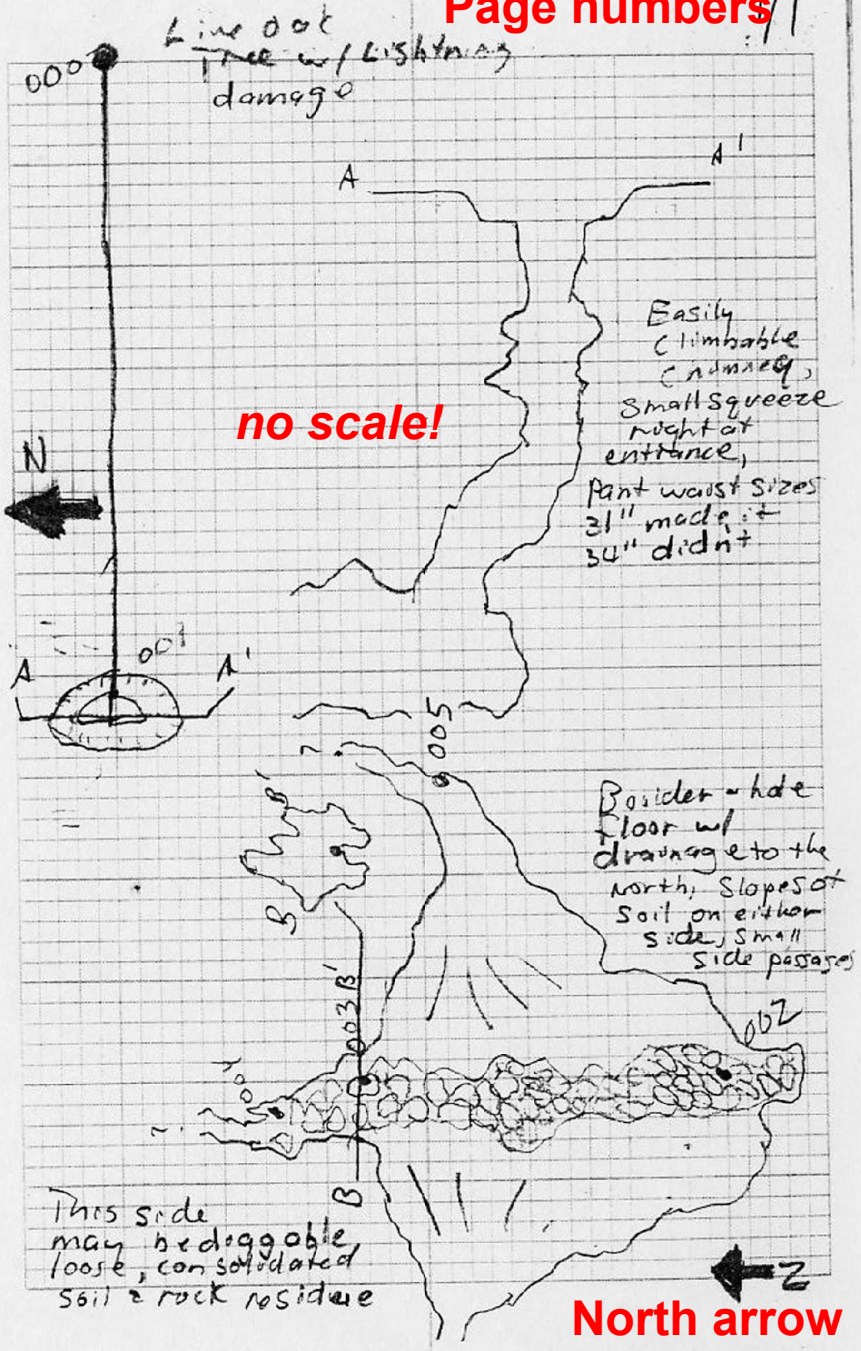
R.D. Milhollin WSS 29962
Dave Engelberger NSS Pending
Shawn Weinstein
Jeff Cloud
Eng. Shiren Wu
Rafel Kedzierski

Survey team (but what jobs did they do?

	DX	Az(For)	Az(Back)	Clino(For)	Clino(Back)
000	—	Due E			
001	36'				
002	12.3'	Vertical			
		349°	173°		-6°
003	9.1'				
		11°	—	0	—
004	3.8				
003					
	7.1'	62°		+5°	
005					
006	5' (est)	342°			
	Crevise that cannot be penetrated	(est)			

units

there seems to be a lot of inclinations missing!

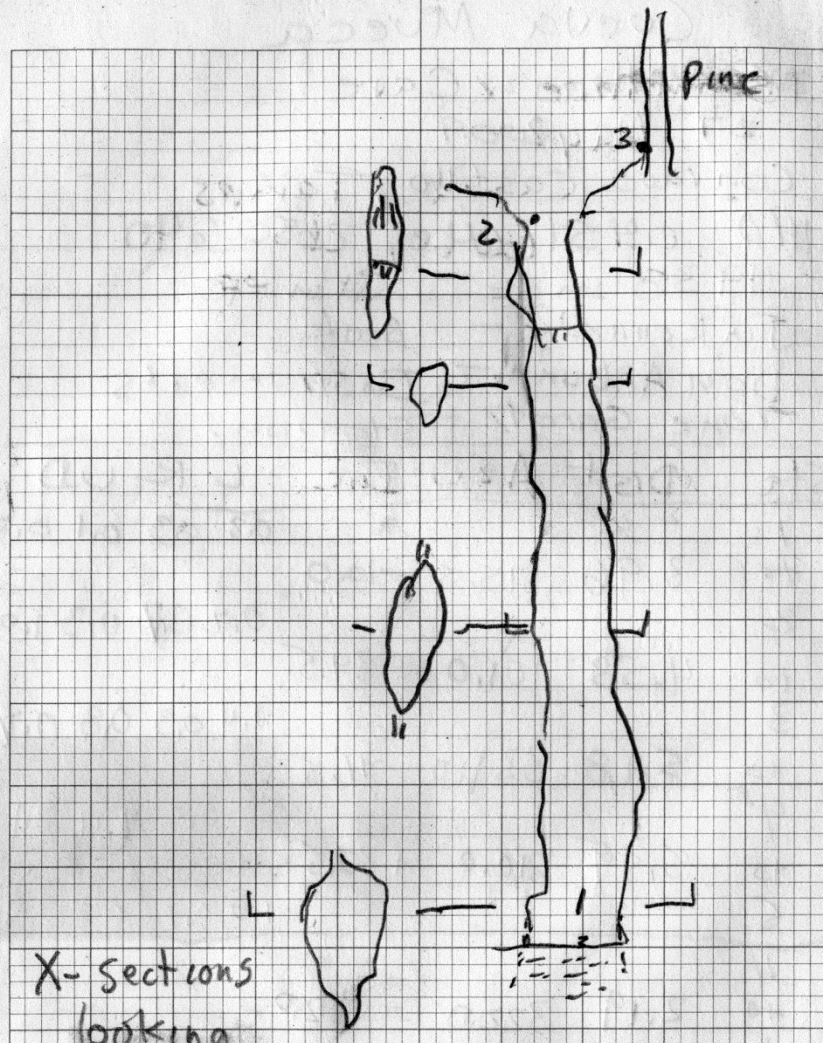


Don't even get me started!

3 Stooges Cave (Cueva tres Stooges)
27 may 2009 12:30 –
14Q 0451873e, 2650071n
1917 m elev. 4.7m epe

Sta	Dist	Azi	Elev	L	R	U	D
1 to 2	17.66	0.0	+90.0				
2 to 3	4.85	265.0	+42.0				

brown and yellow millipede
gnat
harvestmen
snail shells (turritella-like)
Flies
blue millipede
cave crickets



Cueva Mueca

~~Grimace~~ Cave

27 May 2009

Conrado Castillo, Tamps

14Q 0451664e, 2650640 Look! Coordinates!

1938 m 3.1 m elev

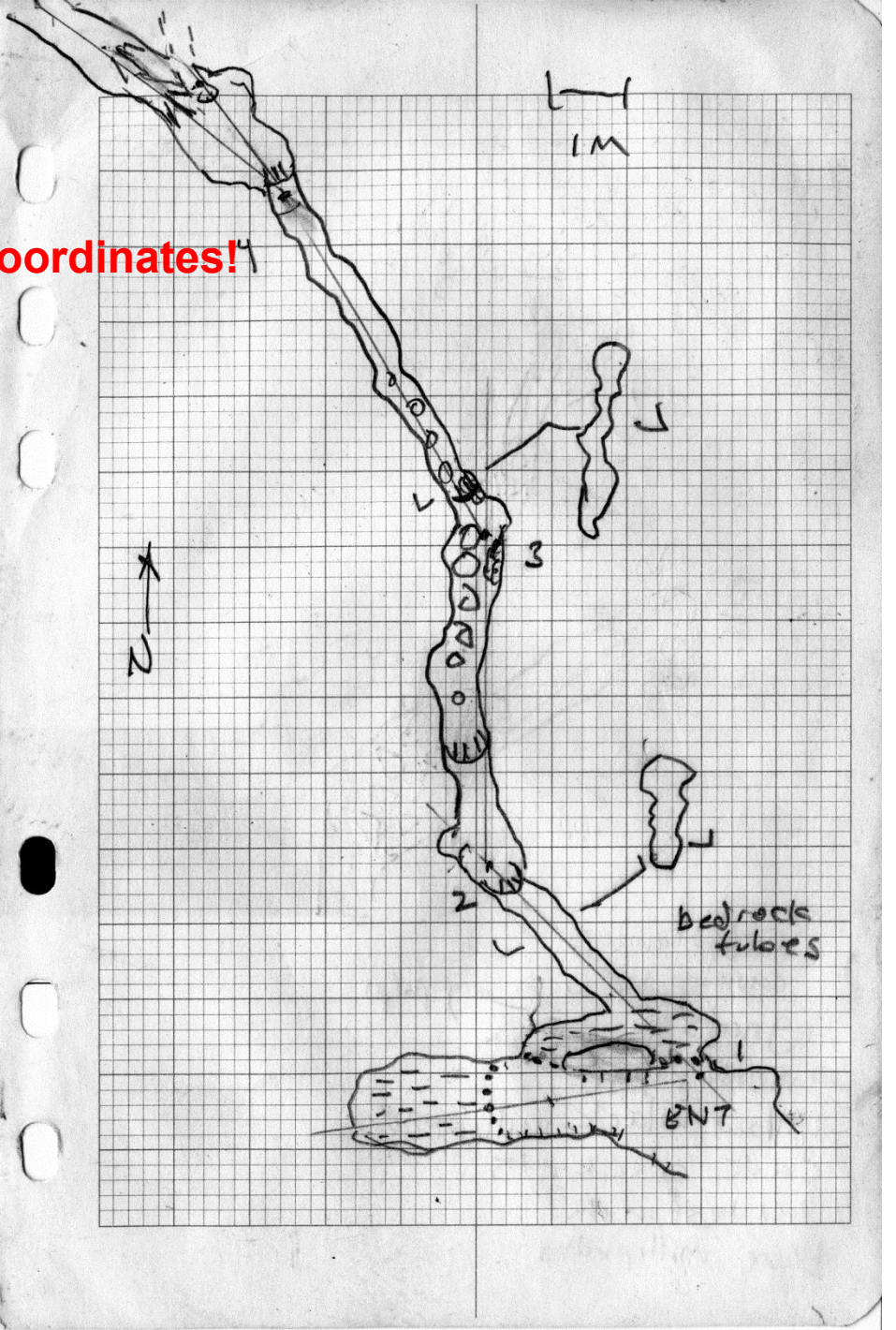
Jn Kennedy – Book

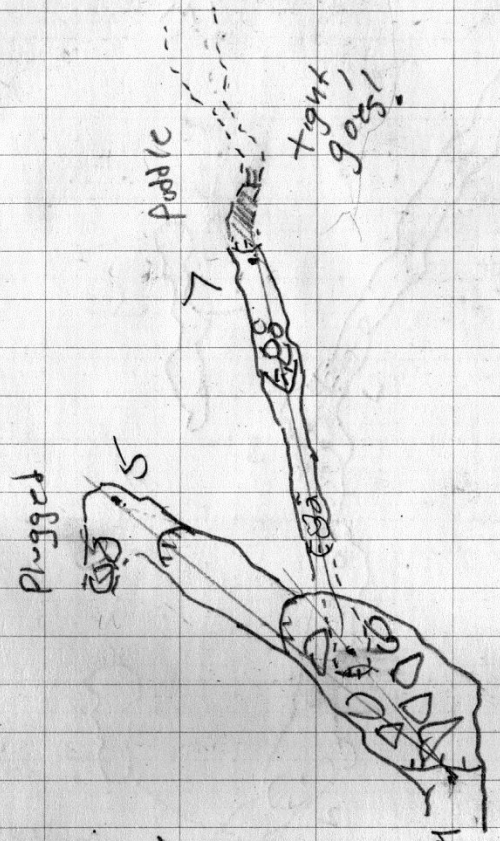
Don Arbunn – Instruments

Tone Garot – Stations

Sta	Dist	Az	Inc	L	R	U	D
1				0.3	0.3	0.1	0.7
to	3.96	315.5	-10.0				
2				0.2	0.6	0.3	1.0
to	4.53	101.0	-34.5				
3				0.4	0.3	0.8	0.7
to	5.18	331.0	-11.5				
4				0.0	0.5	1.4	2.1
to	5.59	310.0	+38.5				
5				1.0	0.3	0.3	1.9
4							
to	2.19	322.0	-42.0				
6				1.0	0.3	0.3	1.9
to	5.37	347.0	-49.5				
7							

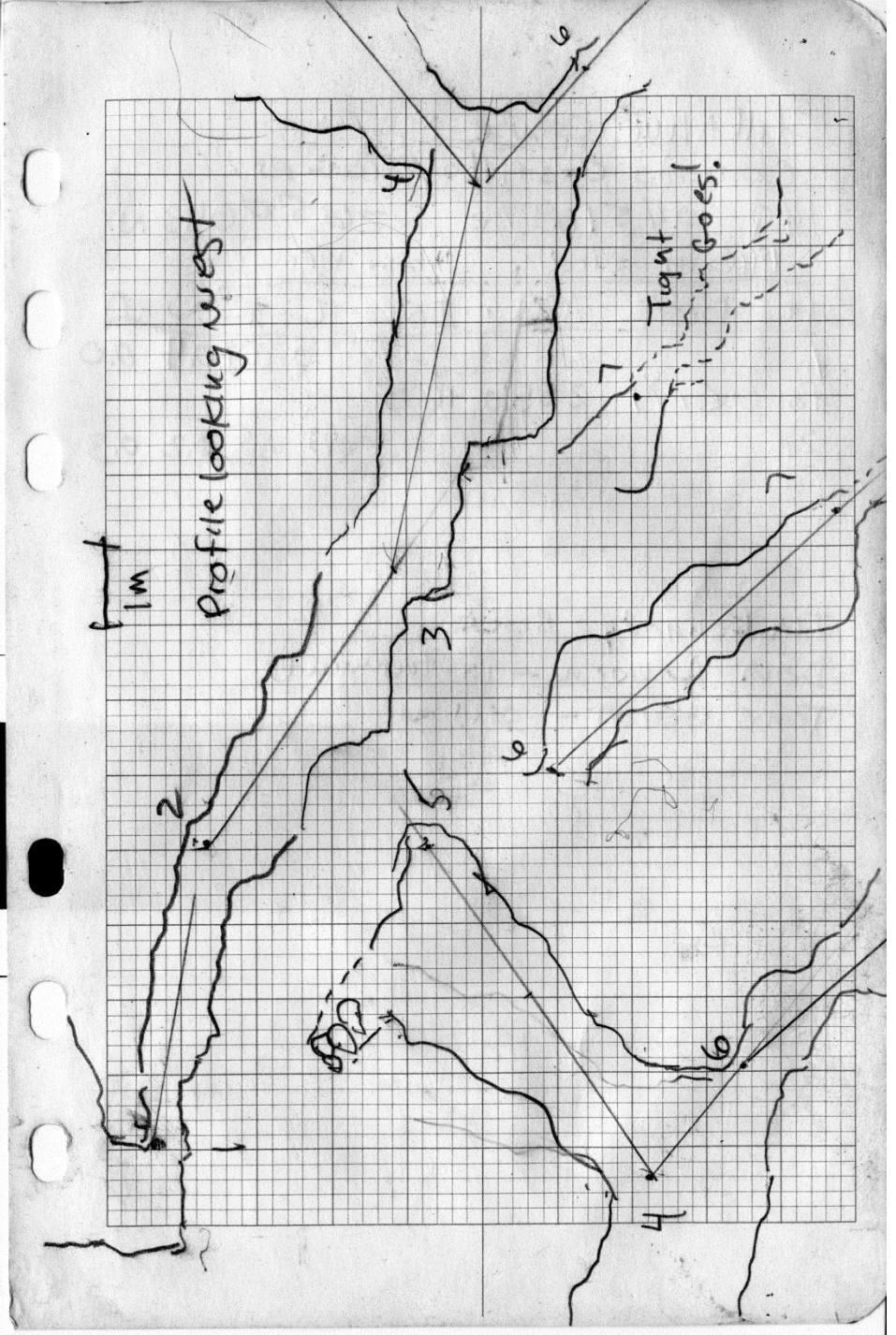
Σ 26.84



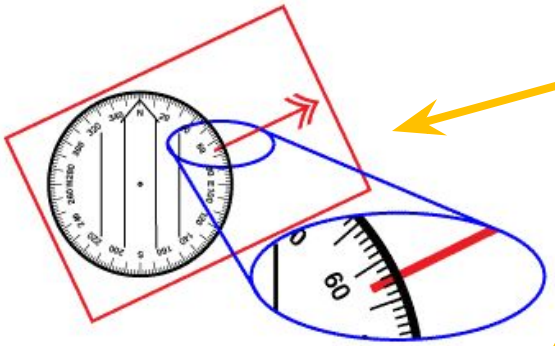


salamanders
cave spider with big palps
gnats
moth popae
Yellow/black millipede
cave crickets
Harvestmen
Blue millipedes

Biological notes

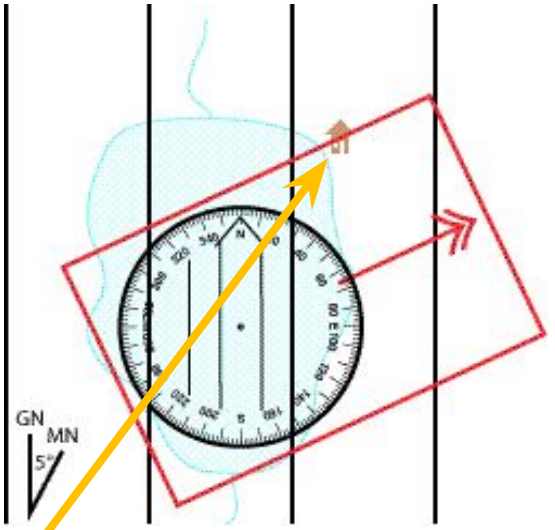


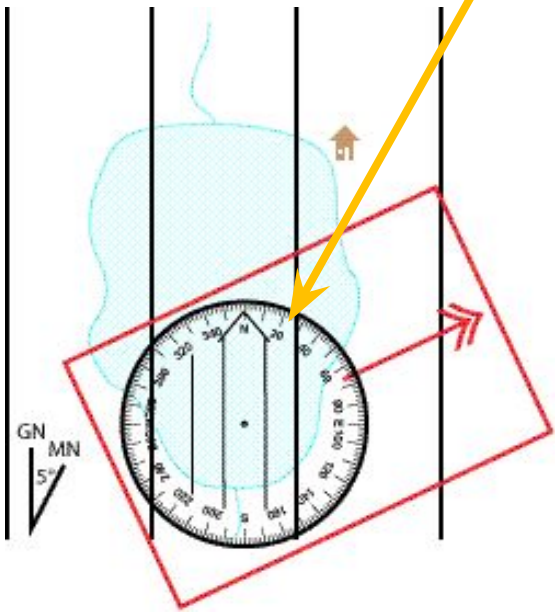
Step by step procedure for plotting with a baseplate compass



Step 1: Adjust the compass to the desired bearing (azimuth).

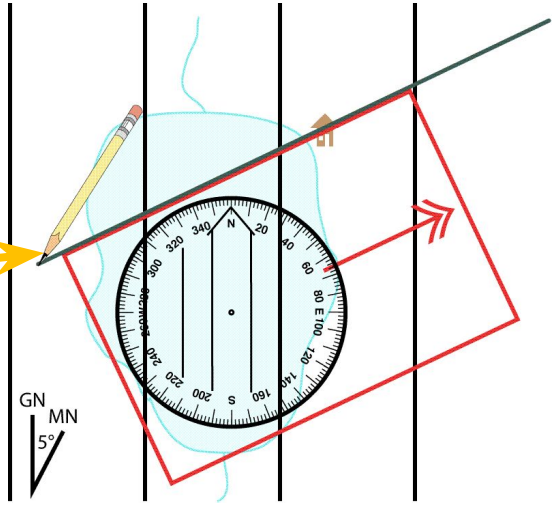
Step 2: Align the compass capsule with the north reference lines on your survey paper. NOTE: The magnetic needle is not used, and may point in any direction. We do not need to orient the survey book with North.





Step 3: Move an edge of the compass to your last plotted station.

Step 4: Draw the azimuth using the edge of the compass baseplate. Use the baseplate scale to measure the shot distance.

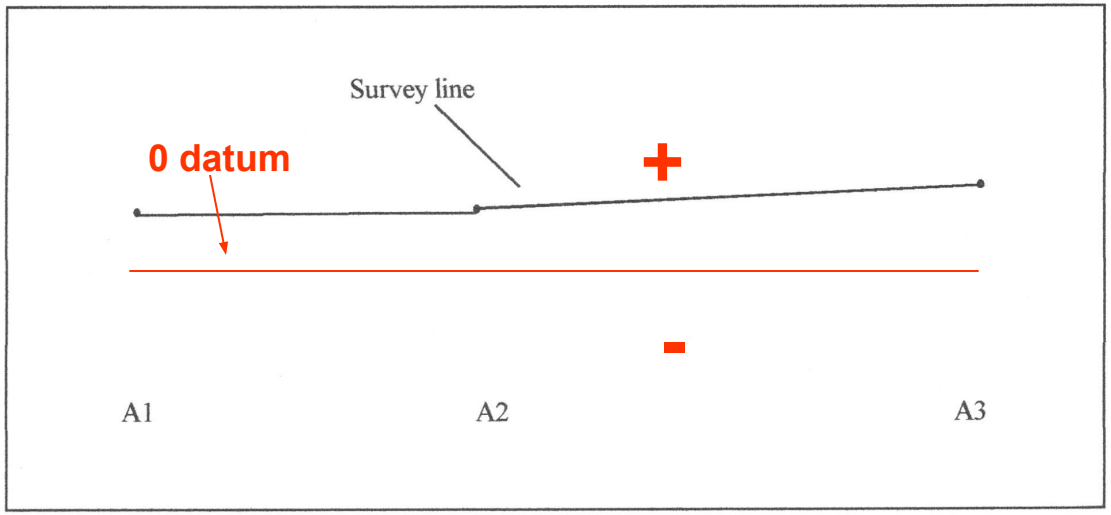


Sketching the profile

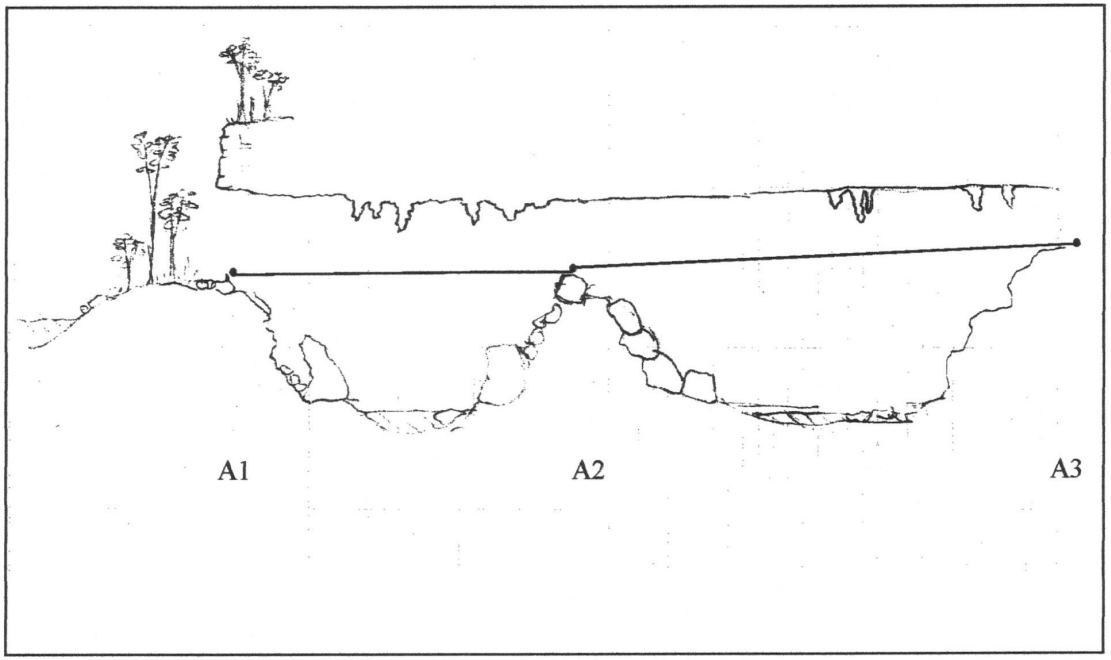
Pick an arbitrary point and align the protractor so that 0 degrees lines up with it. The plus (+) angles will be measured running up the protractor, negative (-) running
down.

Measure the distance the same as you would on the plan and locate the TO station. Plot the line. Add tick marks for the UP and DOWN dimensions.

Add detail as you would with plan view.



With a protractor plot the survey line



Adding ceiling heights and detail to profile plot


A nice plan view to scale
But lacking some metadata
Awesome cross-section s!
Porcupine skeleton
Dead Porcupine
Goat skulls
Tight lead
goes 2mt
rodent bones neotoma?

Falling Animal Cave
Uvalde Co. Tx
Feb 22, 2014

Ben Hutchins - sketch
Yaz Avila - pt. / b.s.
Bryce Smith - f.s.

pg 1 of 5
FA survey FA1 - FA19
65.68 m

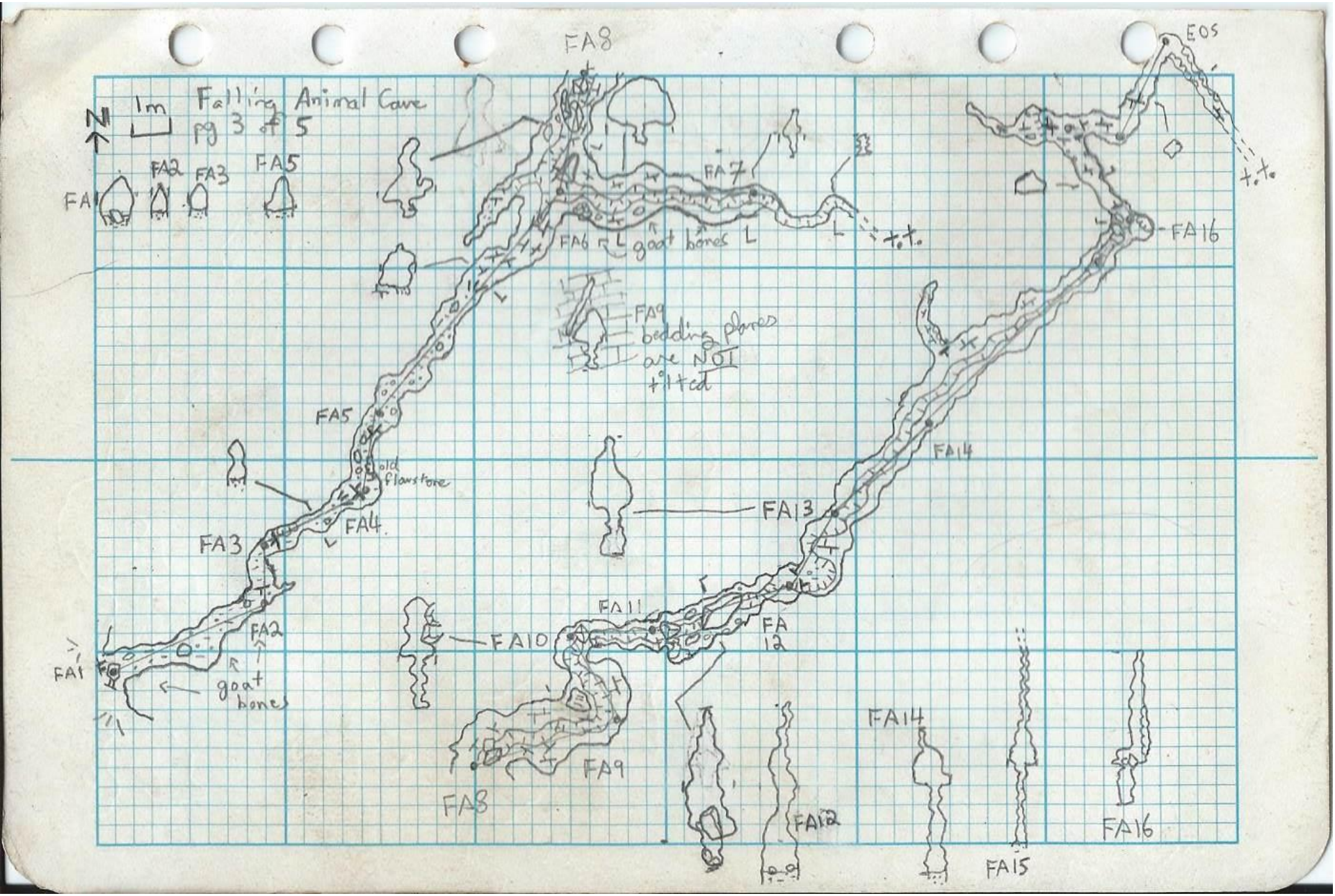
An example of good note keeping and sketching.

Cave Falling Animal Page 2 of 5

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance (m)	Azimuth	Vertical Angle					
FA1	4.33	fs 66	fs ~~2.5~~ 4	.5	.6	1	1/2	
		bs 246	bs ~~-6~~ ~~-4.5~~					
FA2	1.66	fs 0	fs 7	.4	0	.4	.3	
		bs 179	bs -5					
FA3	3.01	fs 64	fs -4	0	.4	.3	.4	
		bs 242	bs 4					
FA4	2.05	fs ~~8.5~~ 10.5	fs -7	.6	.2	.3	.5	
		bs ~~194~~ 191	bs ~~10~~ 8					
FA5	7.50	fs 50.5	fs -8	.2	.6	.4	.5	
		bs 231	bs 8					
FA6	5.03	fs 90	fs ~~-7~~ ~~10.5~~	P	P	.7	.8	
		bs ~~260.5~~ 268	bs 7					
FA7		fs	fs	0.1	.6	.4	1	
		bs	bs					
FA6	3.18	fs 12	fs +1					
		bs 194	bs +1					
FA8	3.94	fs 68 72 71	fs -4	0.4	1	1.2	1.4	
		bs 248 | 248	bs 5.5					
FA9	2.50	fs 331	fs -5	1	0	.6	1.6	
		bs 149.5	bs 5					
FA10	33.20	Total Survey this page						

33.20
24.48
8
65.68

Feb 22, 2014

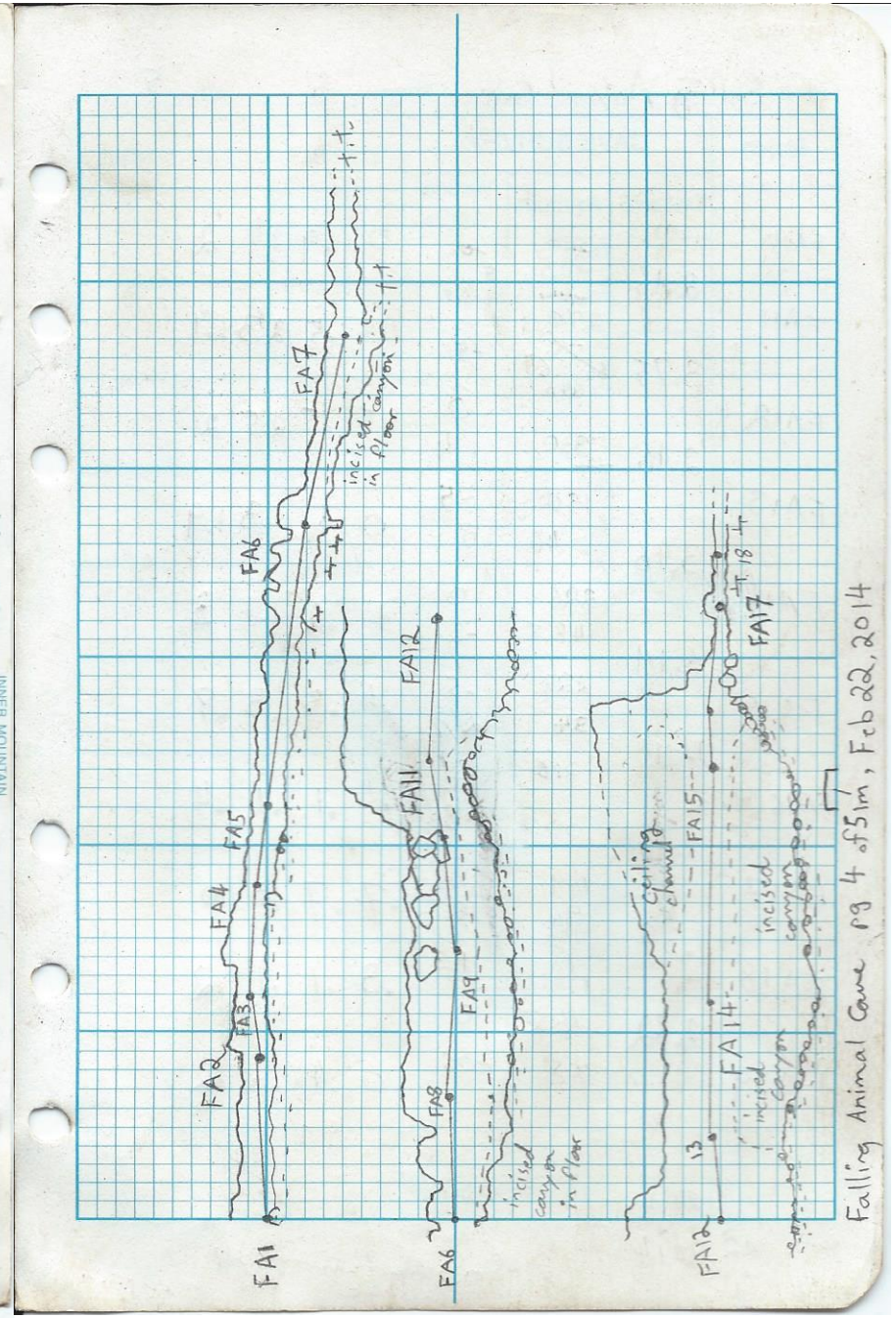

Falling Animal Cave
pg 3 of 5
1m
N
FA1
FA2
FA3
FA5
FA8
EOS
FA7
FA6
goat bones
FA16
FA9
bedding planes
are NOT
tilted
FA5
old flowstone
FA4
FA3
FA14
FA13
FA11
FA10
FA12
FA2
FA1
goat
bones
FA14
FA9
FA8
FA12
FA15
FA16

Cave Falling Animal Cave Page 5 of 5

Station	CAVE SURVEY			L	R	U	D	Notes
	Distance m	Azimuth	Vertical Angle					
FA10	2.16	fs ~~91.5~~ 89.5	fs ~~10~~ 5	0	.9	1.4	2	
		bs ~~267~~ 270	bs -6.5					
FA11	3.75	fs ~~75~~ 64	fs -5	0.5	.5	2.3	1.1	
		bs 243	bs 3					
FA12	2.16	fs 330	fs 4	.5	.5	2.5	2	
		bs 150	bs -5					
FA13	3.46	fs 46	fs 0	0	1	1.3	1.9	
		bs 226	bs 0					
FA14	6.14	fs 48.5	fs -2	1	.2	1.1	3	
		bs 228	bs .5					
FA15	1.49	fs 34	fs 2/4	.4	.3	.3	.8	
		bs 213	bs df.					
FA16	2.93	fs 330	fs -8	.4	.1	.1	.4	
		bs 149	bs 8					
FA17	1.37	fs 96	fs 12	.7	.7	.5	0	
		bs df	bs df					
FA18	2.82	fs 16	fs 0	.3	.1	.1	.2	
		bs eos	bs eos					
FA19		fs	fs	0	.4	.2	.2	
		bs	bs					
	24.48	Total Survey this page						

Feb 22, 2014

+8m scooped, unsurveyed passage

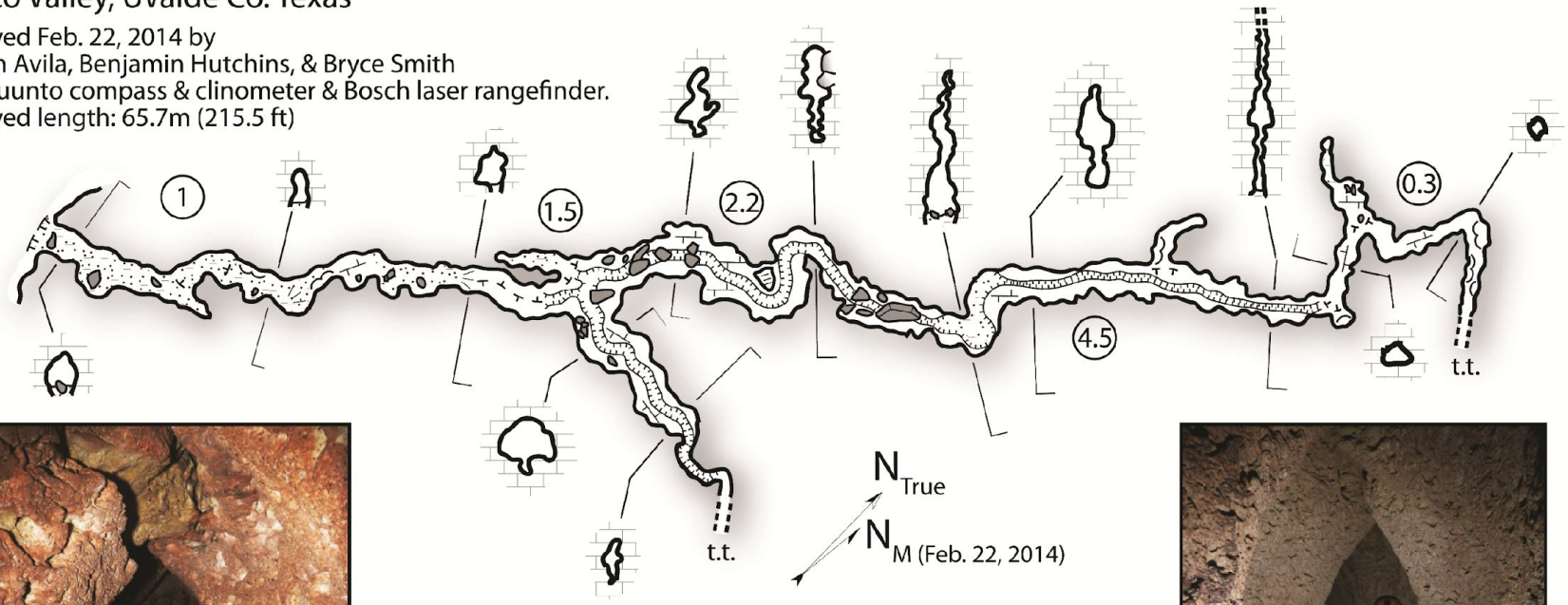


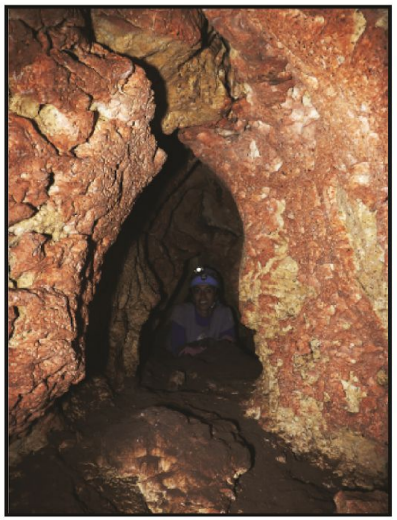
Falling Animal Cave pg 4 of 5m, Feb 22, 2014

Falling Animal Cave

Blanco Valley, Uvalde Co. Texas

Surveyed Feb. 22, 2014 by
Yazmin Avila, Benjamin Hutchins, & Bryce Smith
with Suunto compass & clinometer & Bosch laser rangefinder.
Surveyed length: 65.7m (215.5 ft)

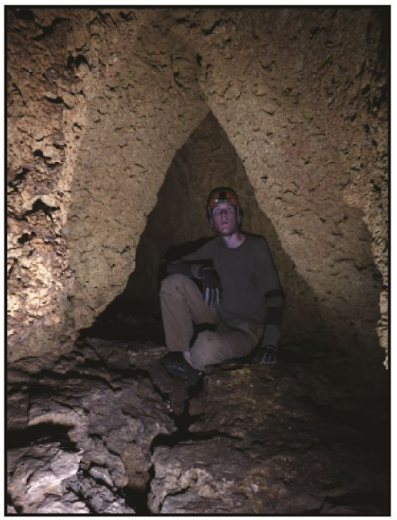




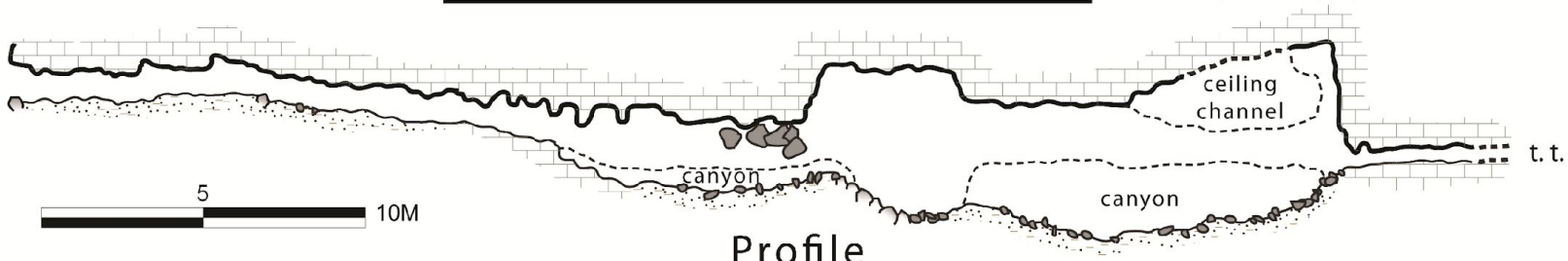
Yazmin Avila admires pink mineral deposits near the entrance. Photo by Benjamin Hutchins.

Legend

- dripline
- ledge
- ceiling height change
- ceiling channel
- (2.2) ceiling height (m)
- t.t. too tight
- bedrock
- bedrock column
- sediment
- breakdown
- flowstone
- slope



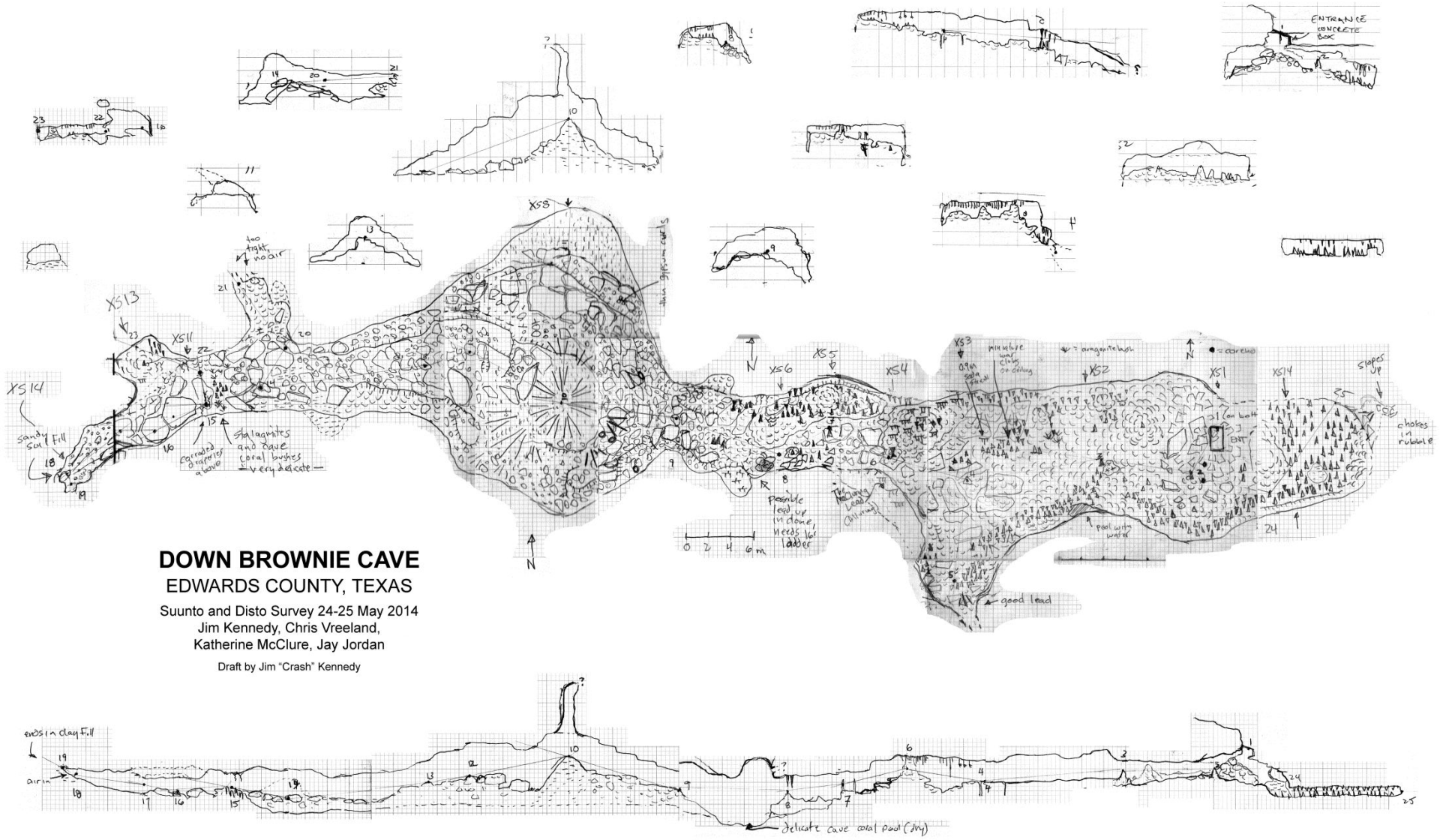
Bryce Smith in comfortable passage above a narrow canyon. Photo by Benjamin Hutchins.



Profile

Cartography by Benjamin Hutchins, 2014.


PLAN 2
lead
PLAN 1
= aragonite slash
XS1
XS2
XS3
XS4
XS5
XS6
XS8
PLAN 3
Page 2 of 7



DOWN BROWNIE CAVE

EDWARDS COUNTY, TEXAS

Suunto and Disto Survey 24-25 May 2014
Jim Kennedy, Chris Vreeland,
Katherine McClure, Jay Jordan

Draft by Jim "Crash" Kennedy

Let’s get out there and survey!