

بنام خدا

مروری بر زمین شناسی غار

بخش اول "مقدمه و متدولوژی"

قاسم قادری

مرداد ۹۵

برخی مطالعات مرتبط با غار یا غارشناسی

زمین شناسی غار
آب شناسی غار
مورفولوژی غار
غار و سازه های مهندسی
نقشه برداری غار
باستان شناسی غار
حیات گیاهی غار
حیات جانوری غار
ژئوتوریسم پایدار در غار
نگهداری و بهره برداری از غار
حفاظت و محیط زیست غار
پیمایش غار
امداد و نجات در غار
بهداشت محیط و پزشکی غار
روان درمانی (کیو تراپی)
روان شناسی در غار
کاربرد های مدیریت در غار
سایر

زمین شناسی غار

جمع آوری آمار و مدارک و مستندات

نقشه های غار

نقشه برداری از غار

بررسی نقشه های زمین شناسی و عکس های ماهواره ای

تهیه نقشه ها و مقاطع بزرگ مقیاس زمین شناسی

تهیه نقشه غار و قرار گیری آن روی نقشه های بزرگ مقیاس زمین شناسی

سنگ شناسی غار

برداشت های میدانی

نمونه گیری و تهیه مقاطع میکروسکوپی

آنالیز های پراش اشعه ایکس

چینه شناسی غار

لایه بندی و نام گذاری لایه ها

تکتونیک غار

تهیه نقشه های ساختاری با استفاده از عکس های ماهواره ای و برداشت های میدانی

برداشت و تحلیل درزه ها و گسل های بیرون غار

برداشت و تحلیل شکستگی های درون غار

مورفولوژی غار

تحلیل جهت کشیدگی و عمق تشکیل غار

ساختارهای انحلالی درون غار

شکل مقاطع دالان ها و دهلیزها

رسوب شناسی غار

غار نهشته ها

کانی های تشکیل دهنده رسوبات ثانویه

آب شناسی

بررسی منابع آب پیرامون غار

نمونه گیری از آب، انجام آنالیزهای شیمیایی و میکروبیولوژی و انجام تحلیلی های مربوطه

تهیه مدل هیدروژئولوژیکی

میکروپالئونتولوژی و پالئوکلیماتولوژی

انجام نمونه گیری ها، تعیین سن و تحلیل های مربوطه

ژنز یا نحوه تشکیل غار

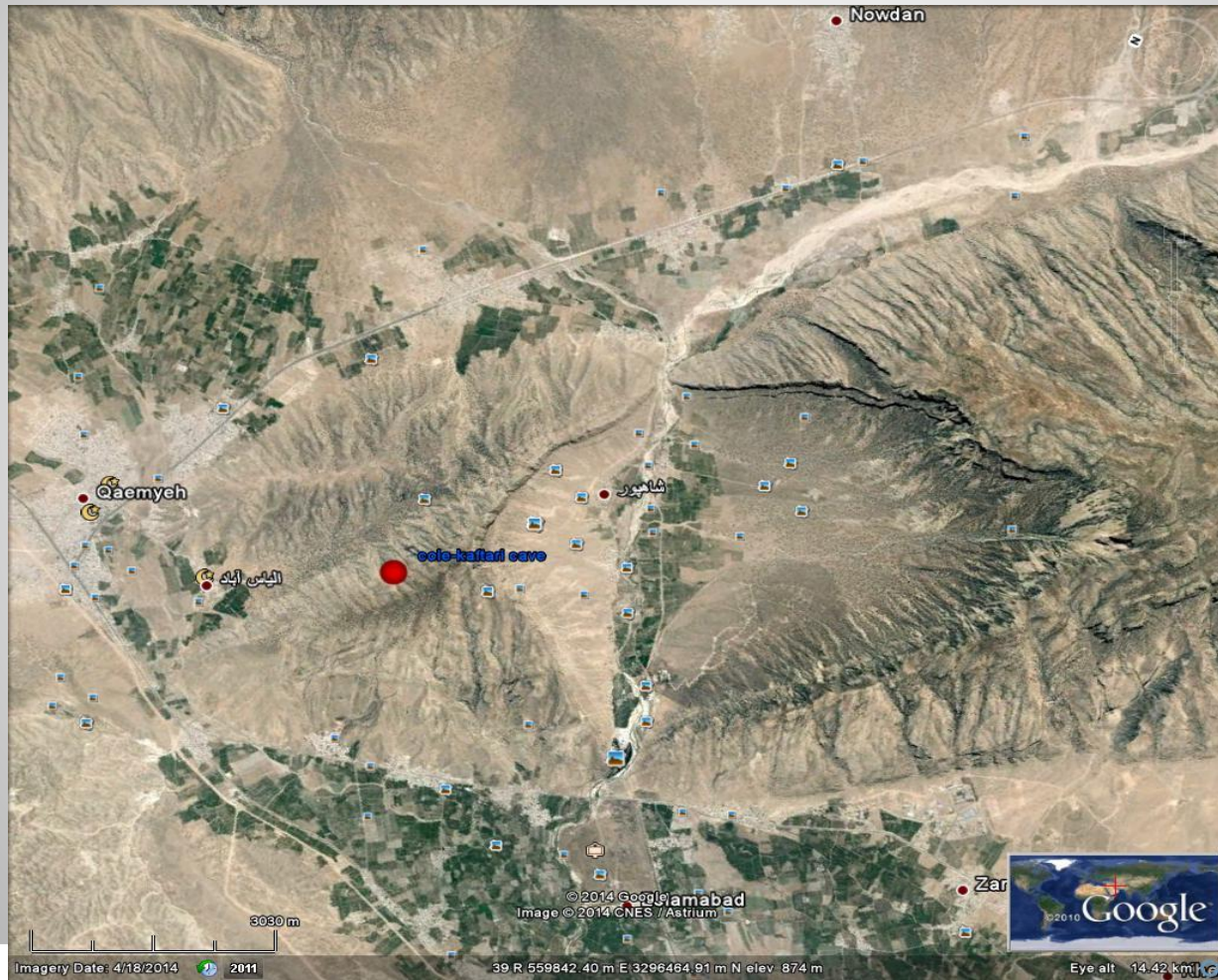
اندازه گیری و ثبت دما و رطوبت و باد در غار جهت تحلیلی های آتی

سنجش از راه دور، **RS , GIS**

جمع آوری آمار و مدارک و مستندات

آمار و اطلاعات
گزارشات پیمایش غار
گزارشات علمی و مقالات مرتبط
نقشه ها و کروکی ها غار
عکس های هوایی و ماهواره ای
نقشه های توپوگرافی
نقشه های زمین شناسی
سایر

بررسی عکس های ماهواره ای

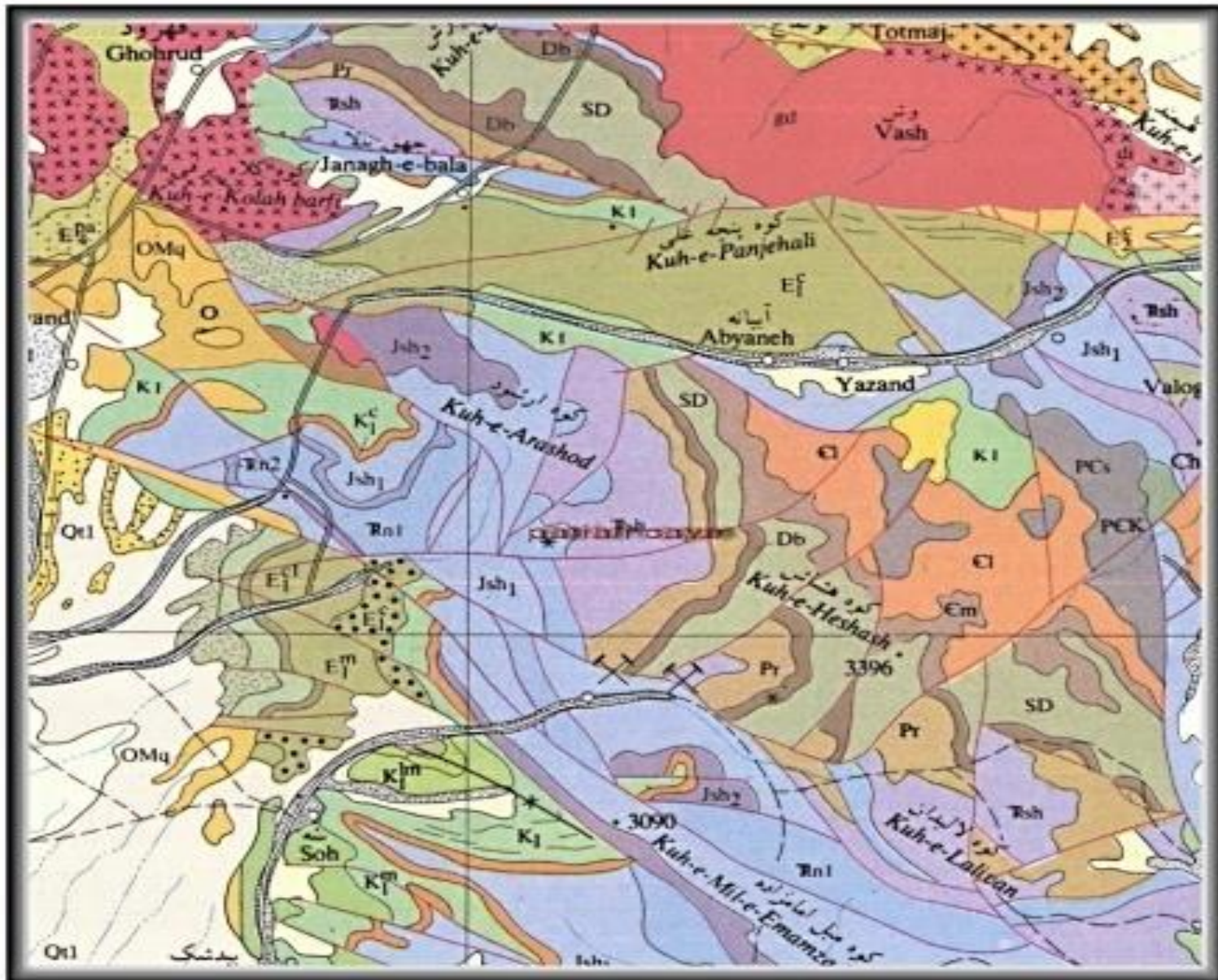


Location

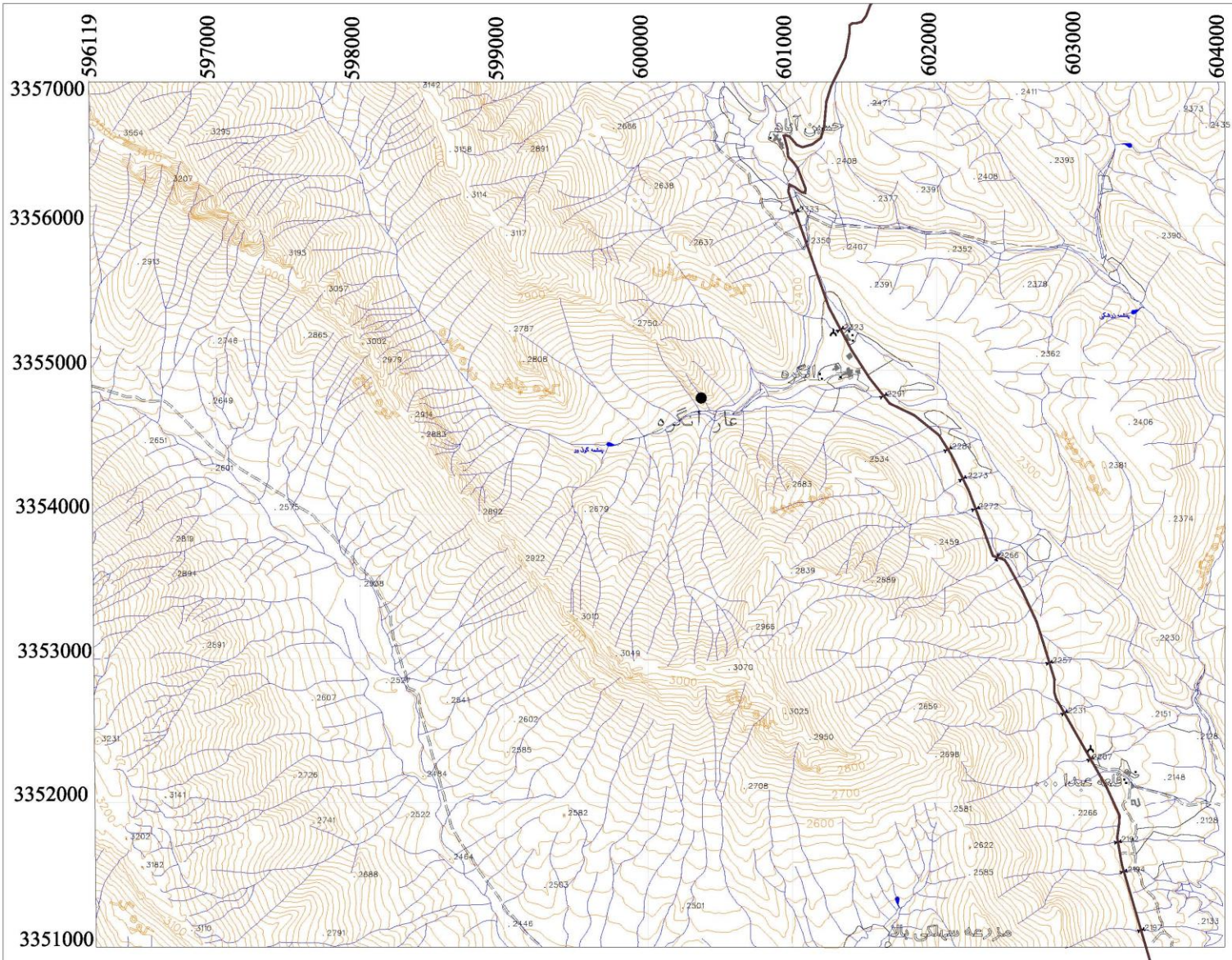
*Prichernomorsky (Black Sea)
artesian basin*



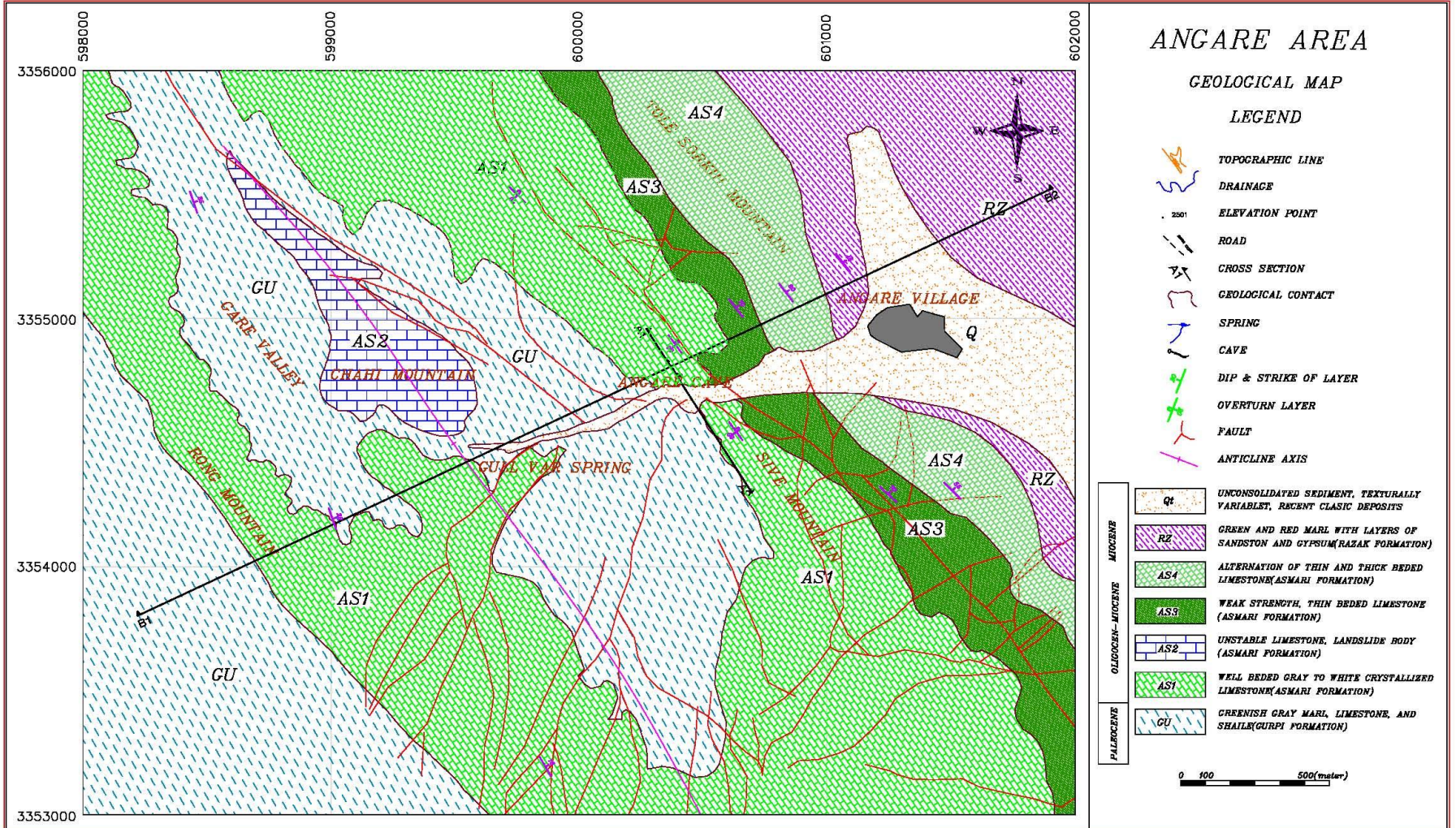
بررسی نقشه های زمین شناسی



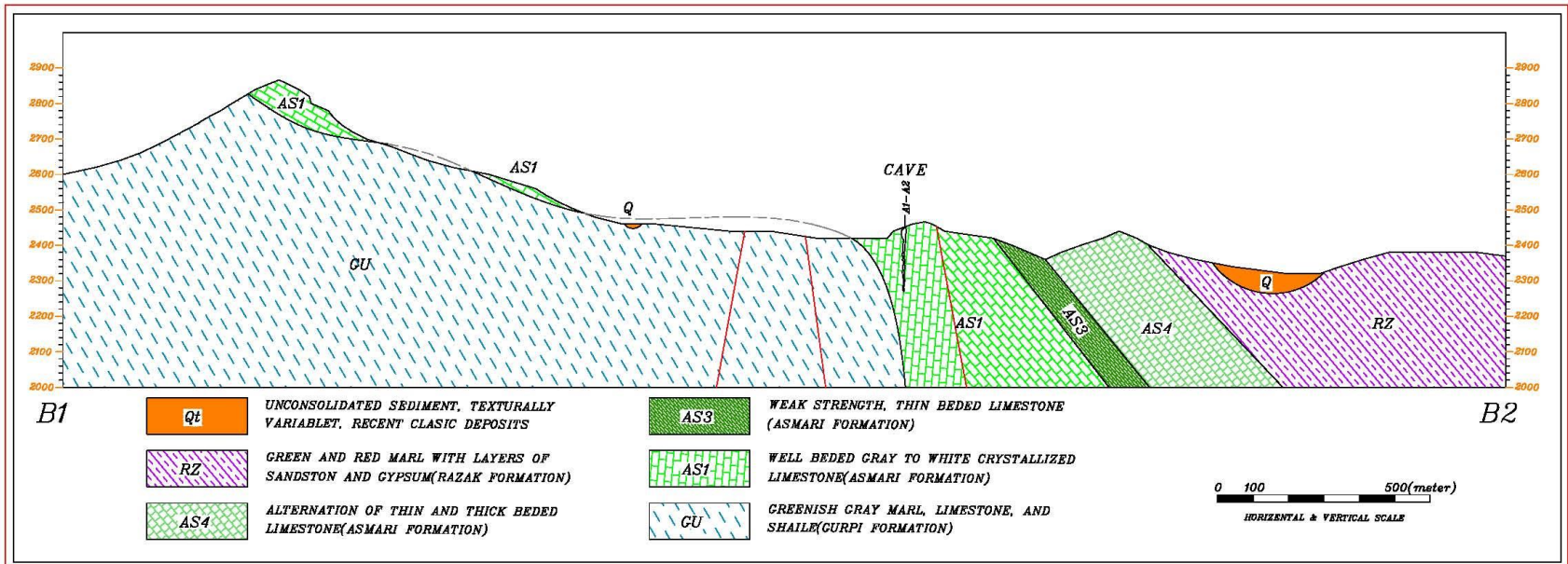
بررسی موقعیت غار بر روی نقشه های ۱:۲۵۰۰۰ پوشش سراسری کشور

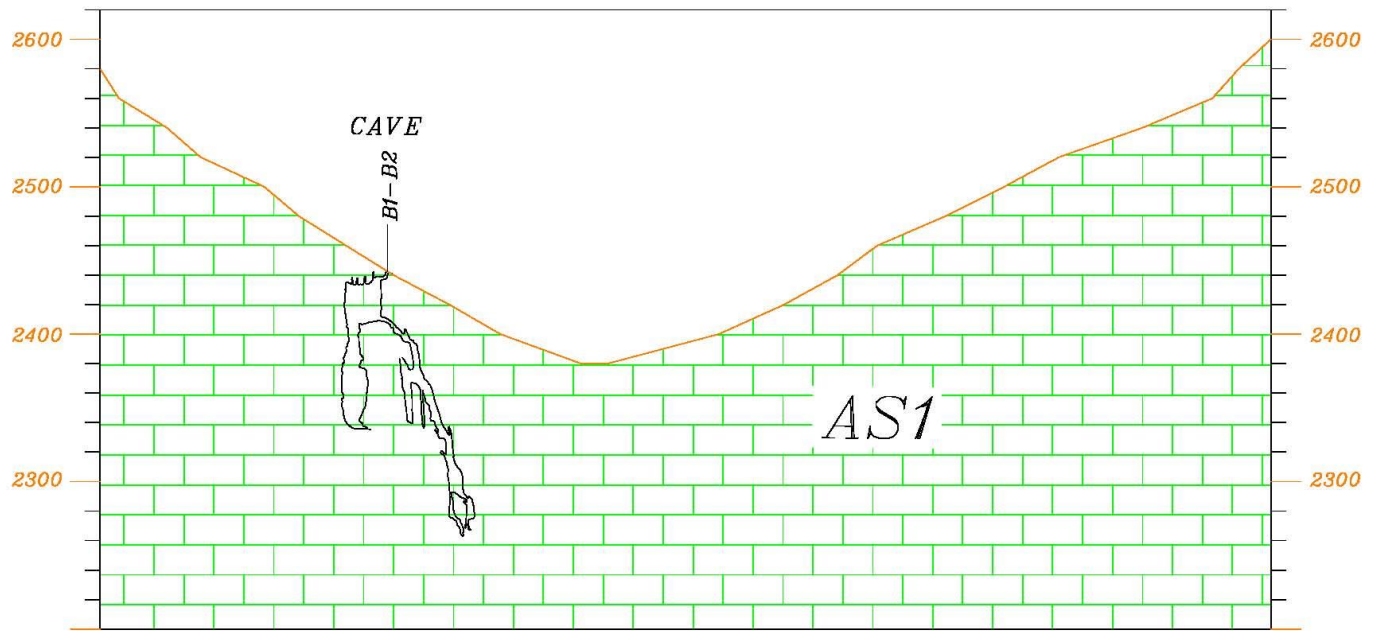
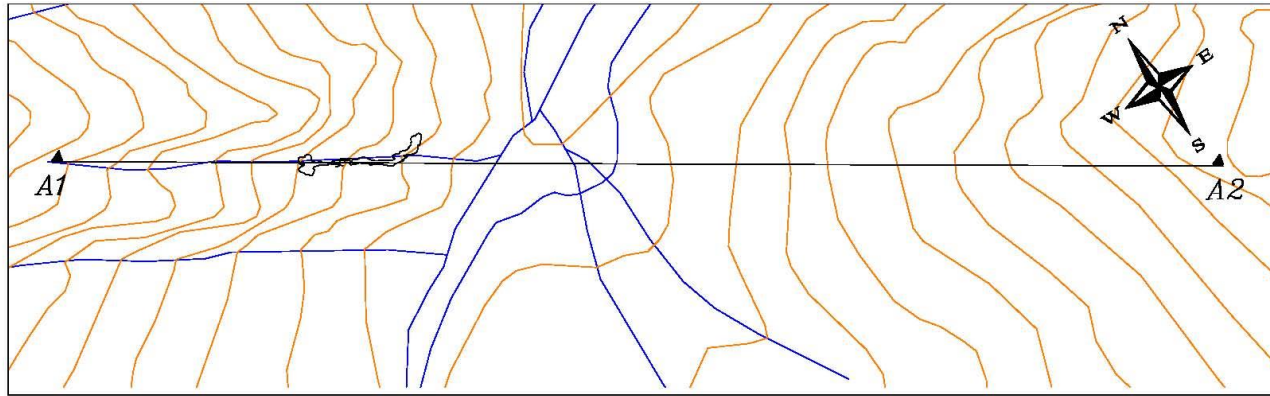


تهیه نقشه ها و مقاطع بزرگ مقیاس زمین شناسی



تهیه نقشه ها و مقاطع بزرگ مقیاس زمین شناسی





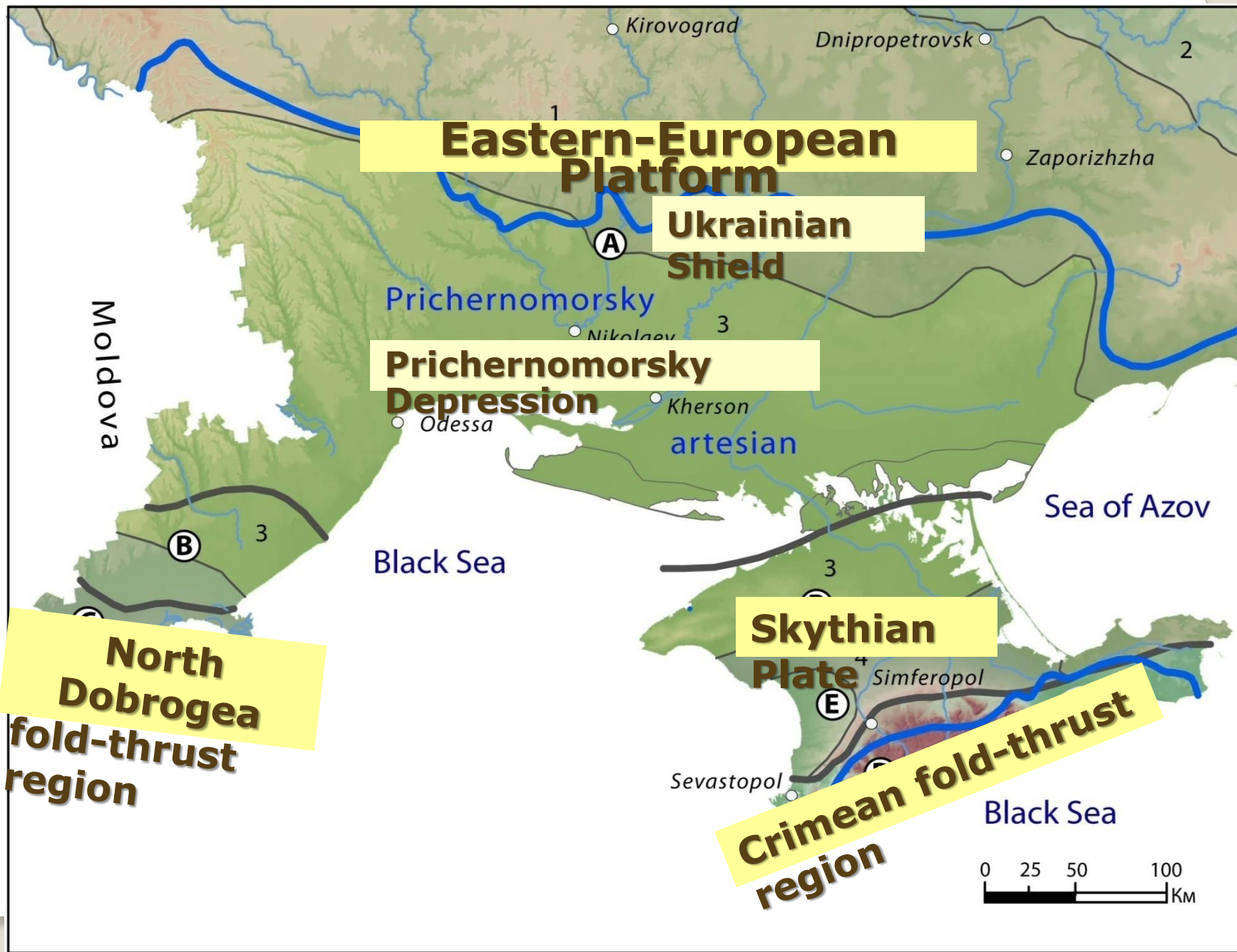
A1



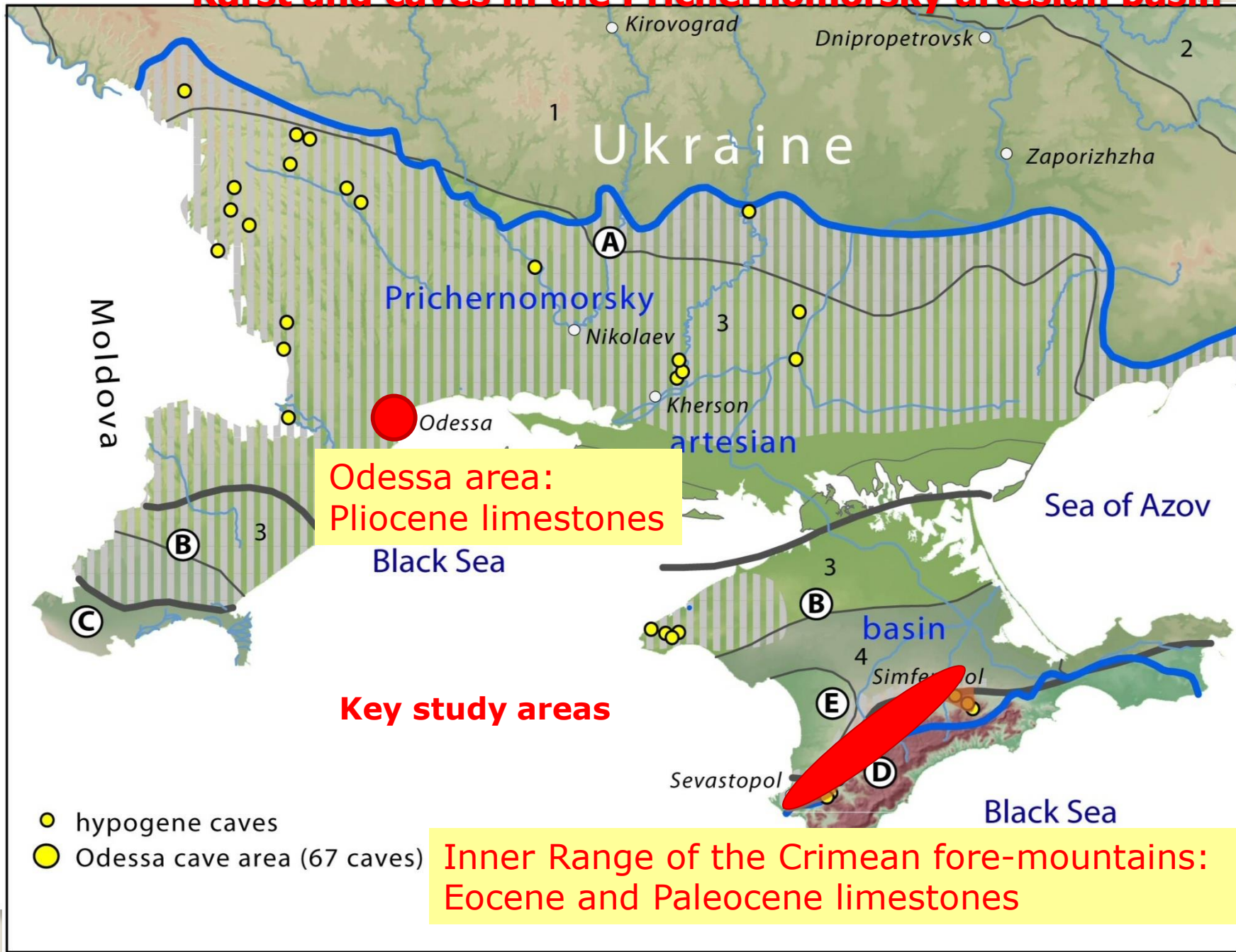
A2

HORIZONTAL & VERTICAL SCALE

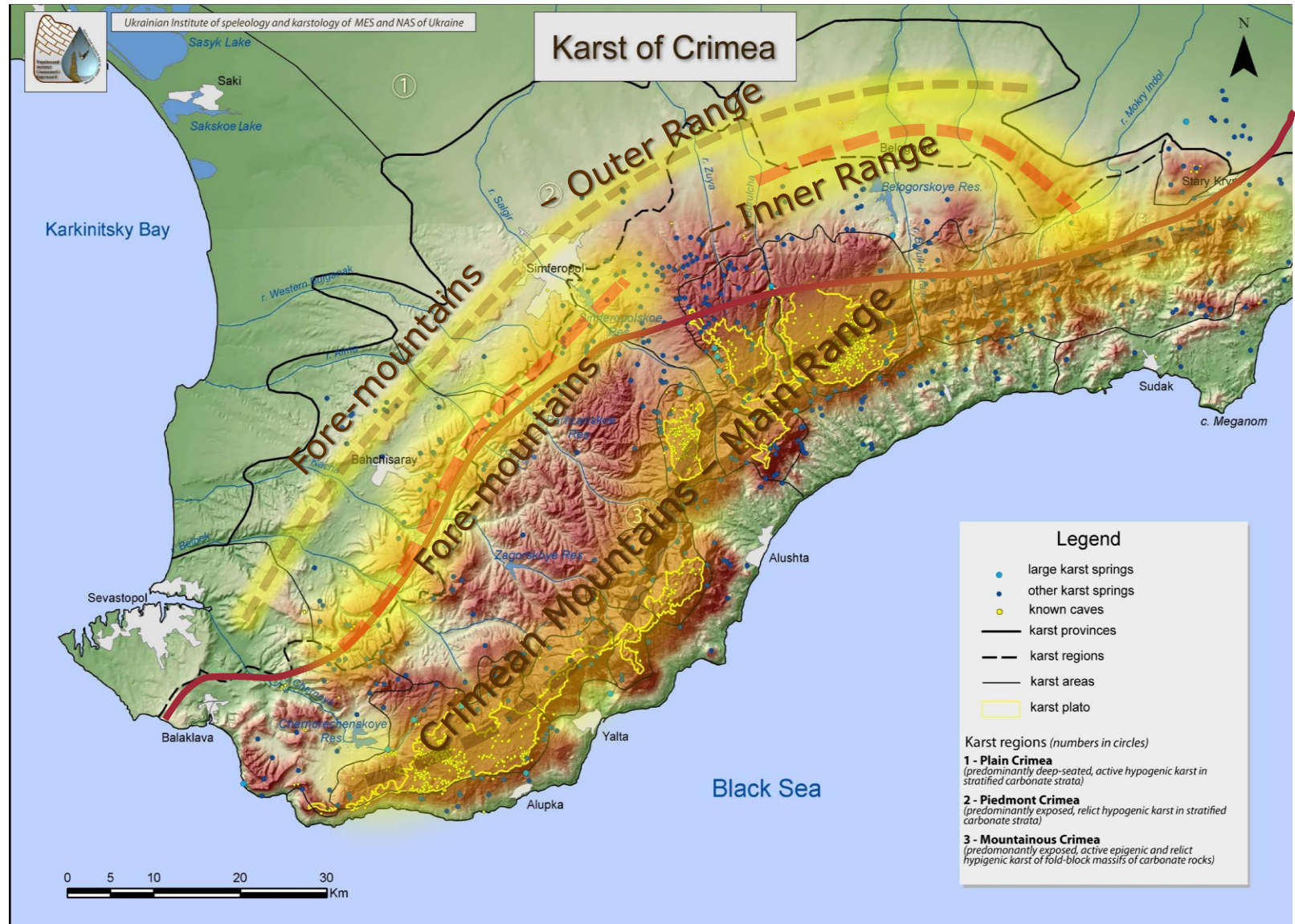
Prichernomorsky artesian basin and its tectonic position



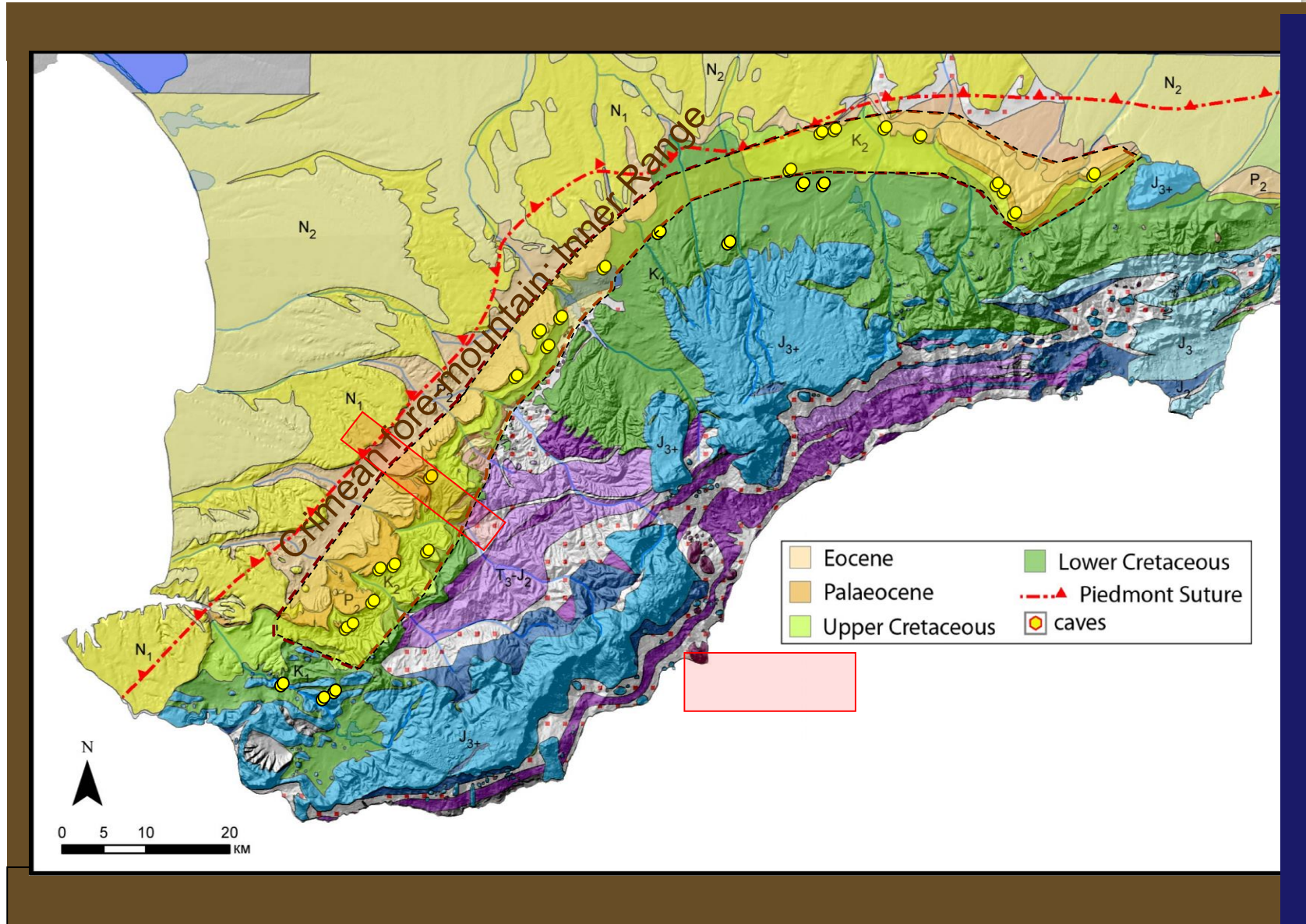
Karst and caves in the Prichernomorsky artesian basin



Crimean Mountains: Geomorphology and Geology

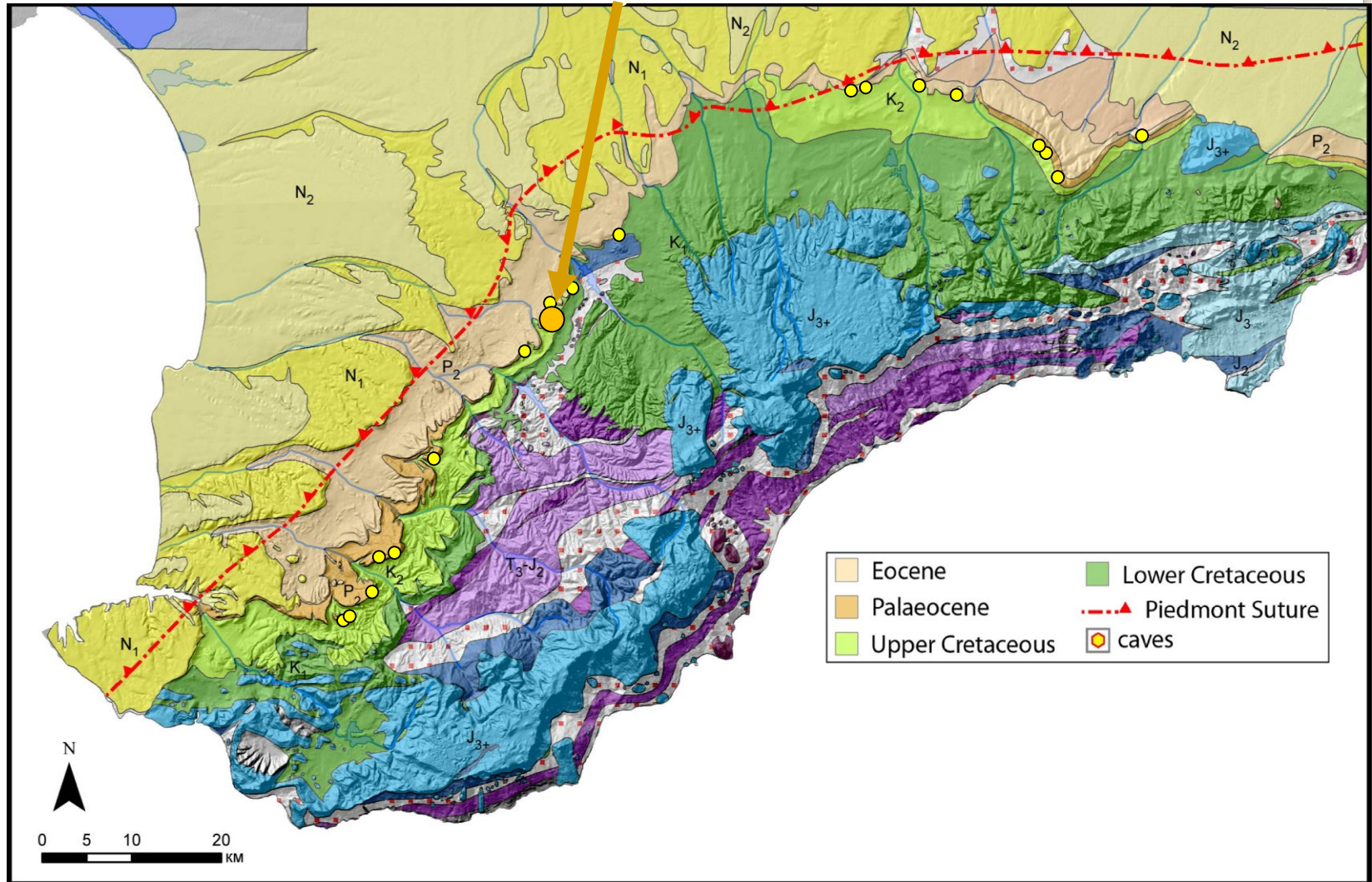


Crimean Mountains: Geomorphology and Geology

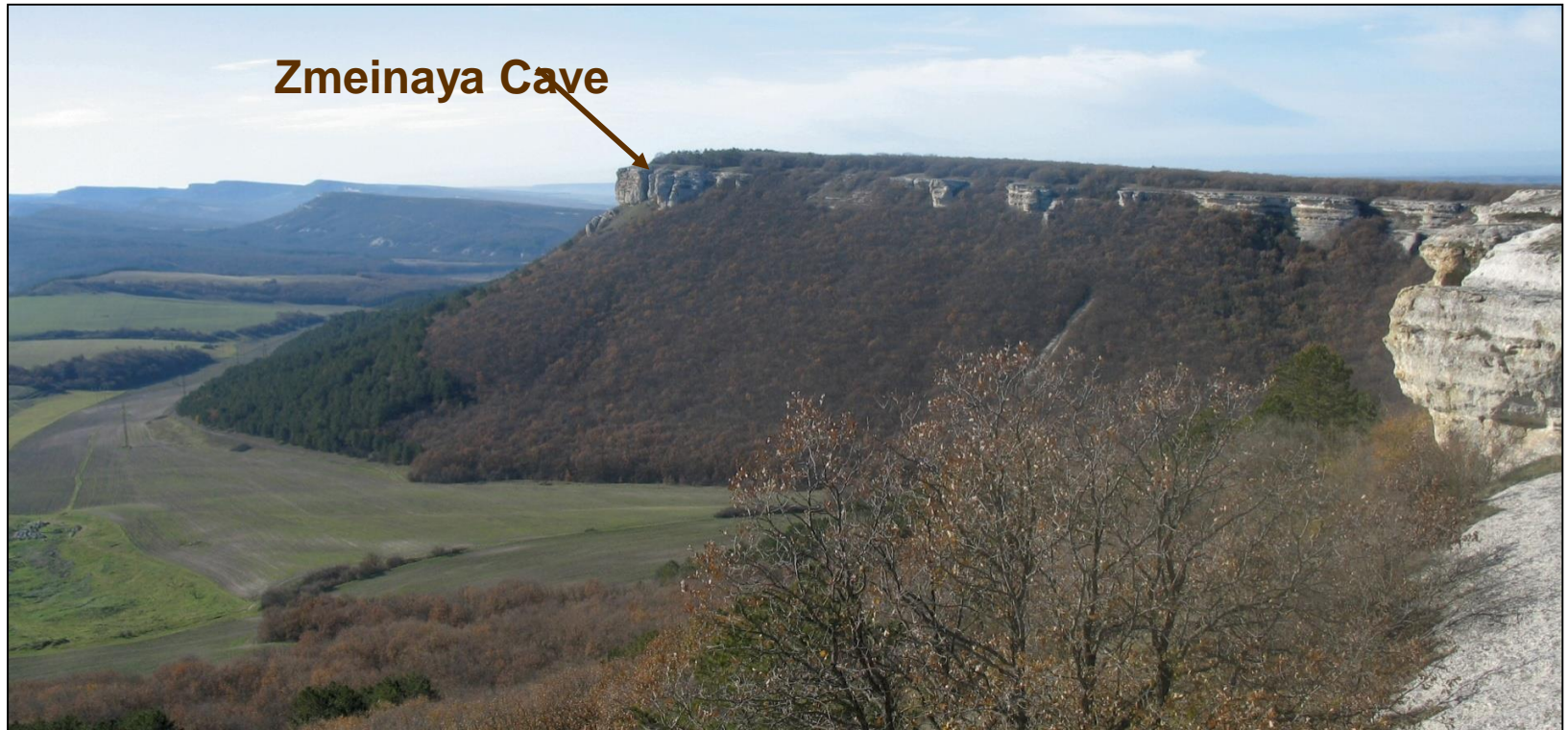


Inner Range of the Crimean fore-mountains: 27 caves in the Eocene and Palaeocene limestones

Zmeinaya Cave: Eocene limestones

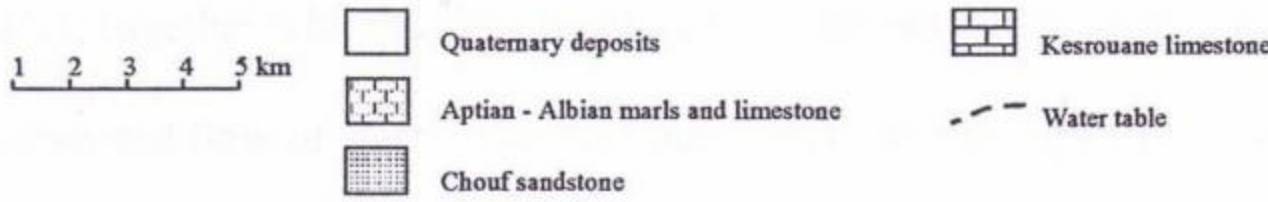
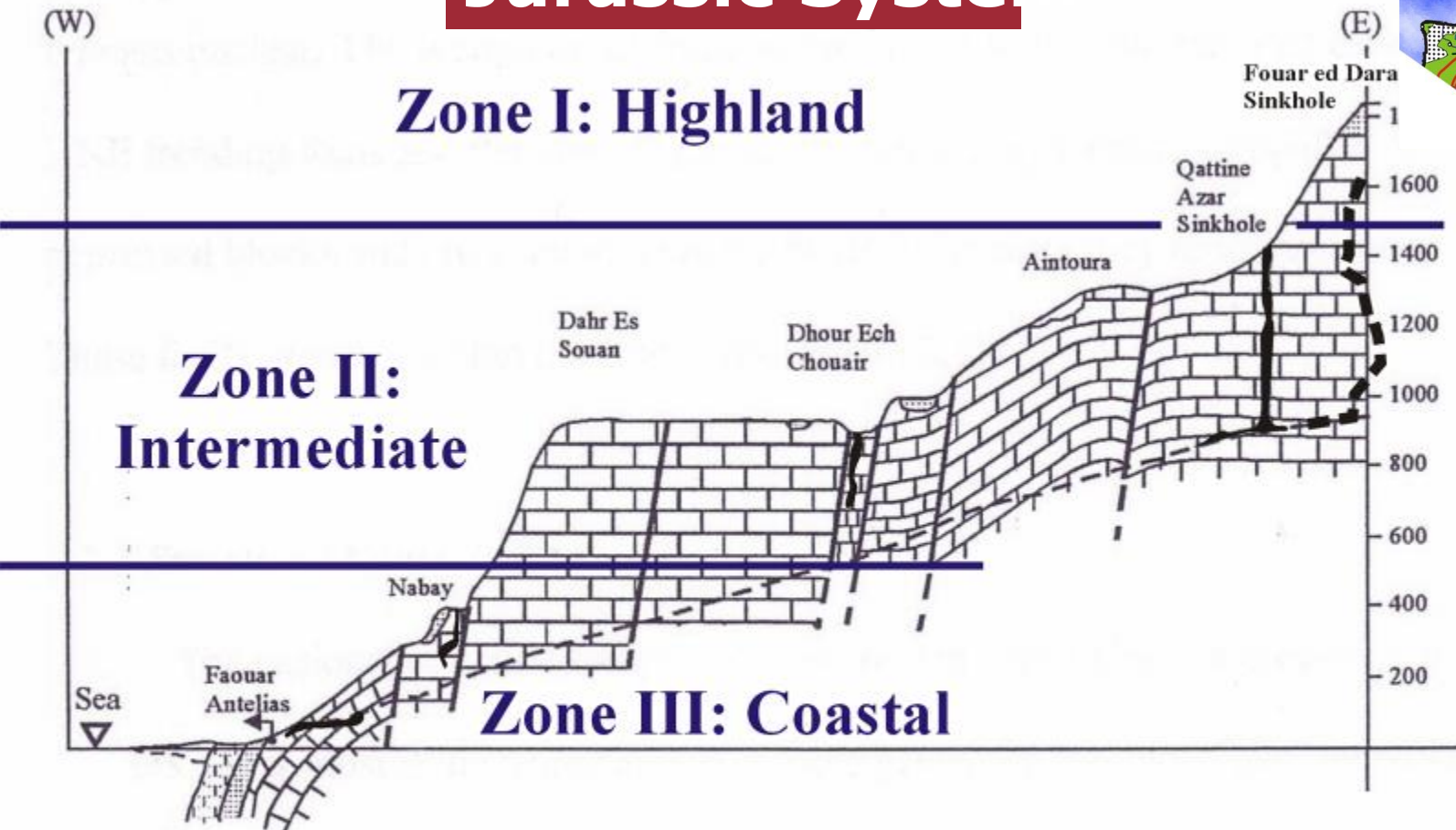
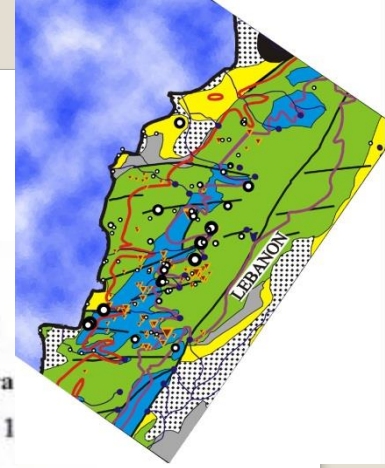


Inner Range of the Crimean fore-mountains: Zmeinaya Cave



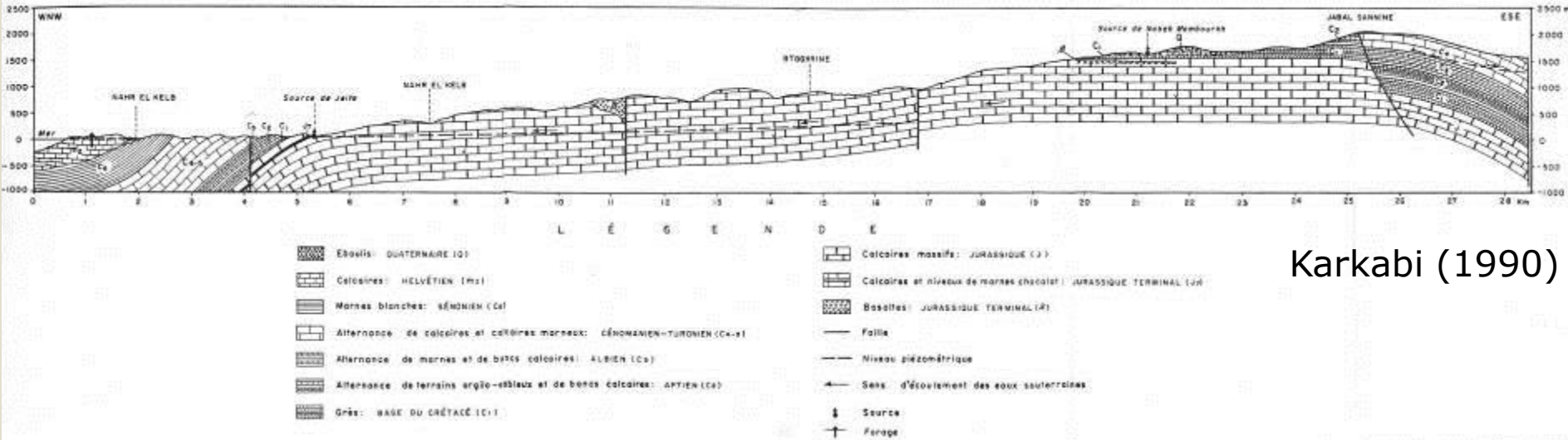
Lebanese karst zones according to relief/altitude, precipitation rates and geology (Nader, 2008)

Jurassic System

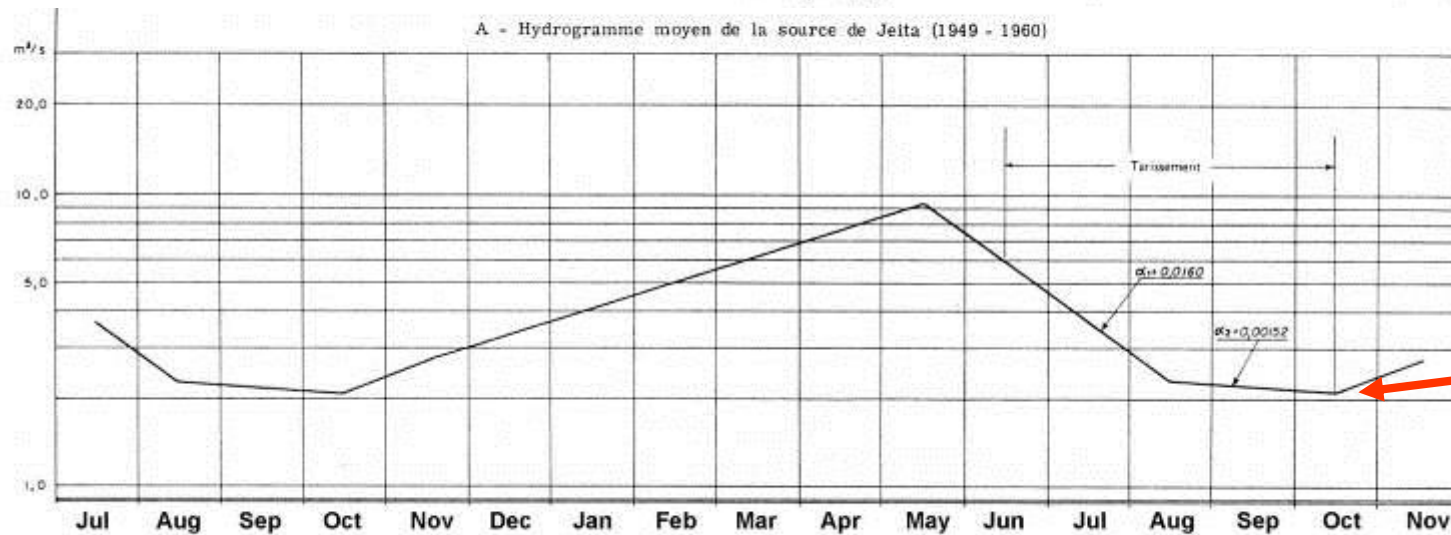


Labaky (1998)

Jeita Cave is located in the Jurassic (coastal) Zone III, near the western flexure of Mount-Lebanon.



Karkabi (1990)



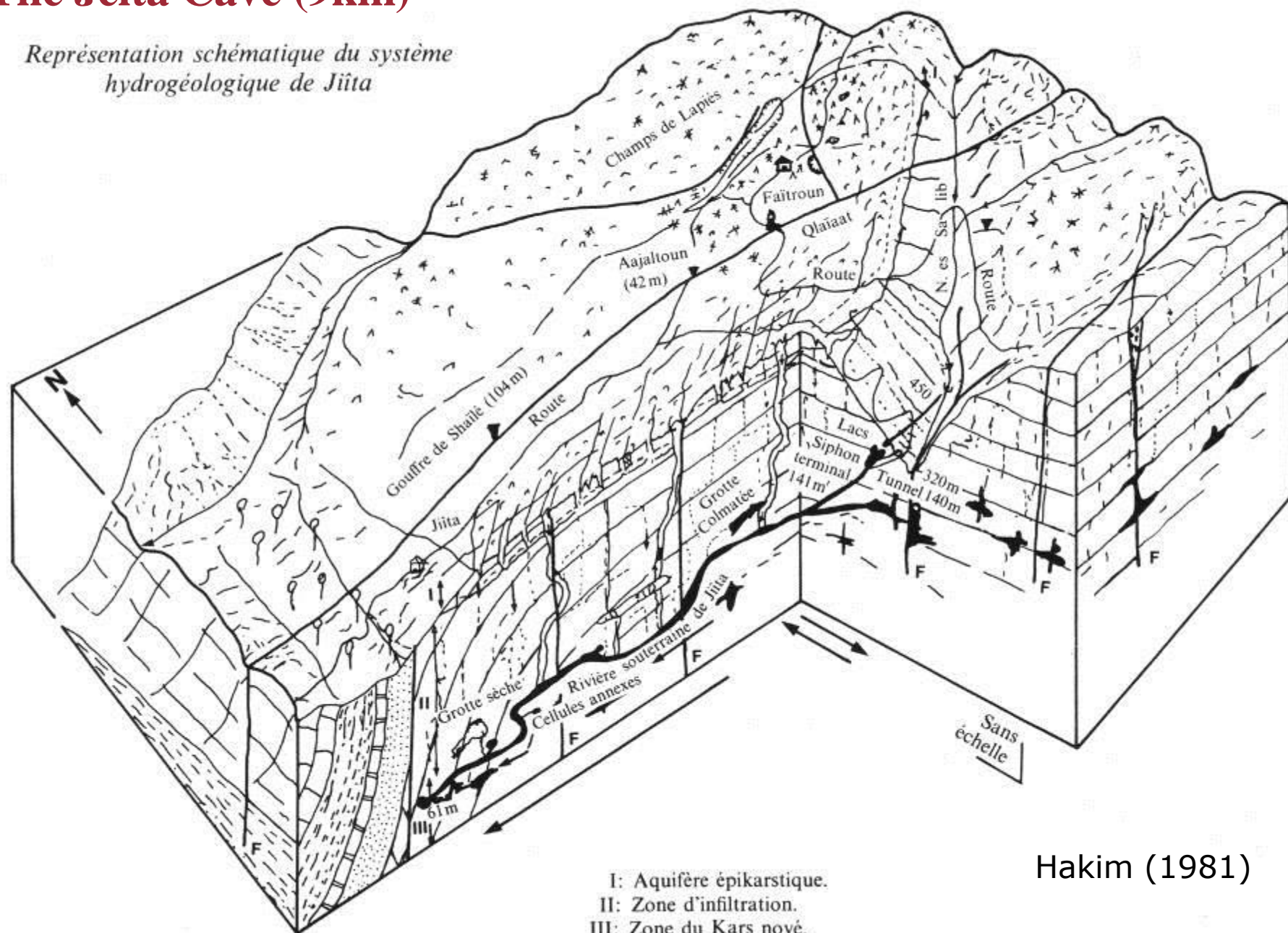
$Q = 2.3 \text{ m}^3/\text{s}$

Karkabi (1990)

Yearly $Q = 140 \text{ Mm}^3$

The Jeita Cave (9km)

Représentation schématique du système hydrogéologique de Jiïta

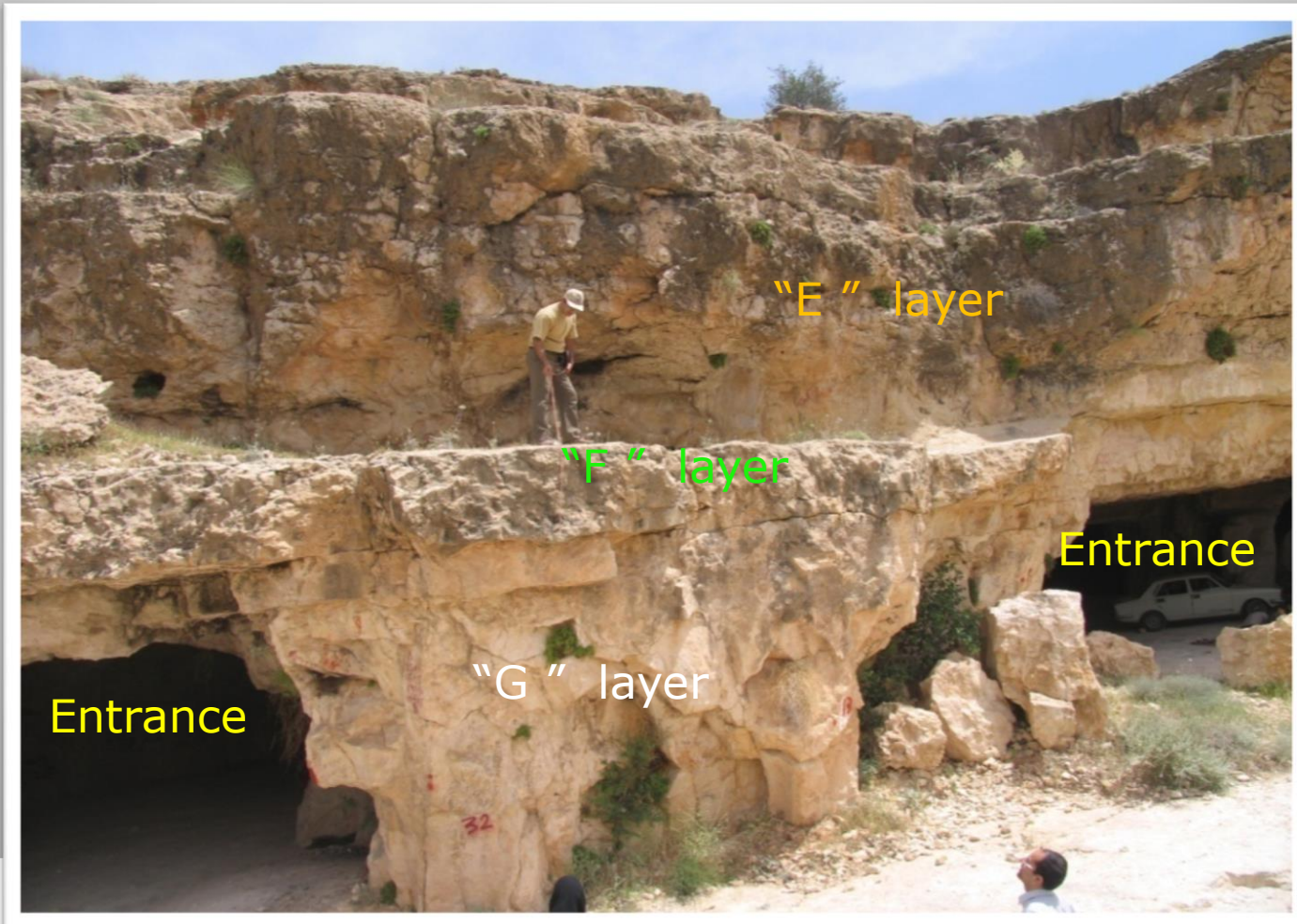


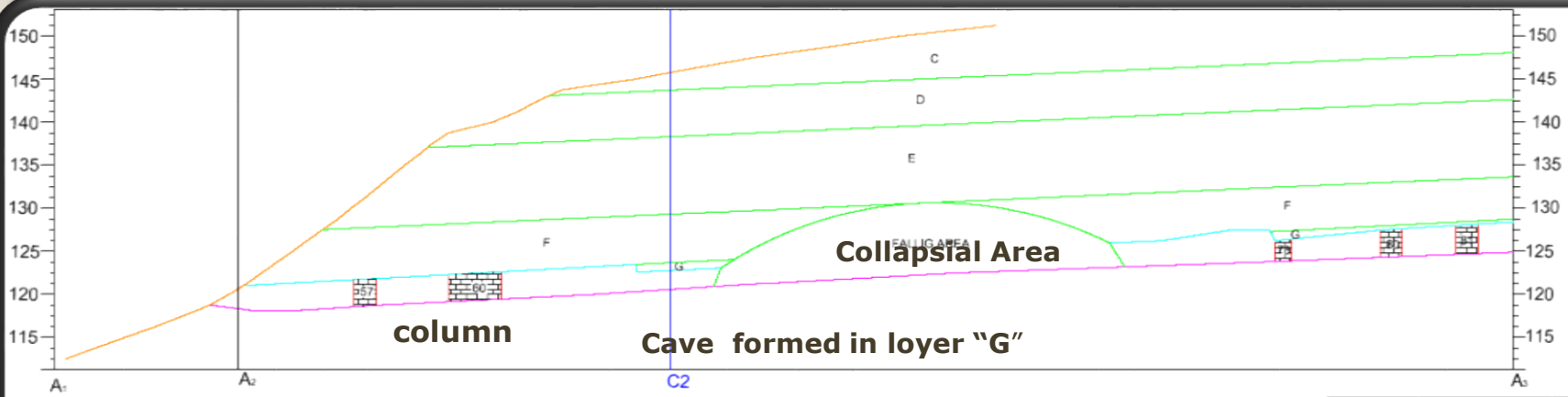
I: Aquifère épikarstique.
II: Zone d'infiltration.
III: Zone du Kars noyé.

Hakim (1981)

سنگ شناسی غار
برداشت های میدانی
نمونه گیری و تهیه مقاطع میکروسکوپی
آنالیز های پراش اشعه ایکس

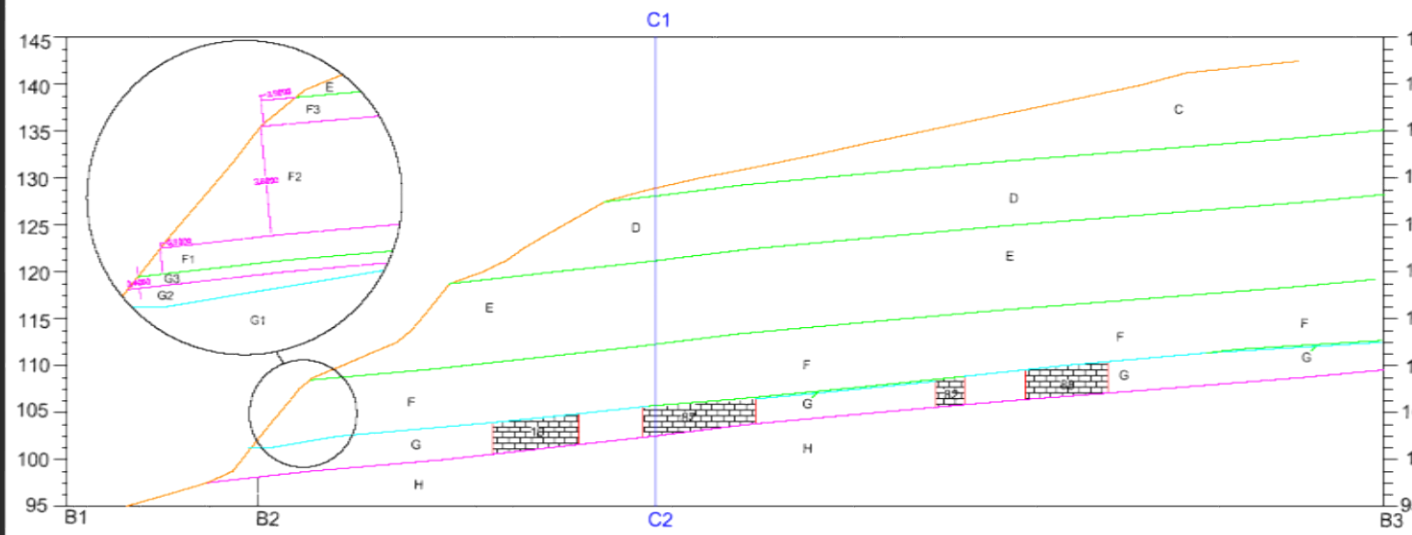
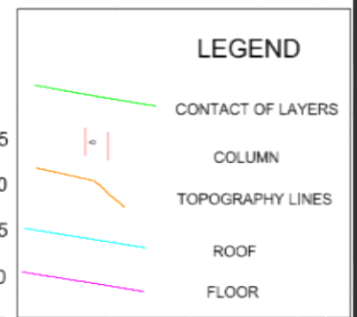
چینه شناسی غار
لایه بندی و نام گذاری لایه ها





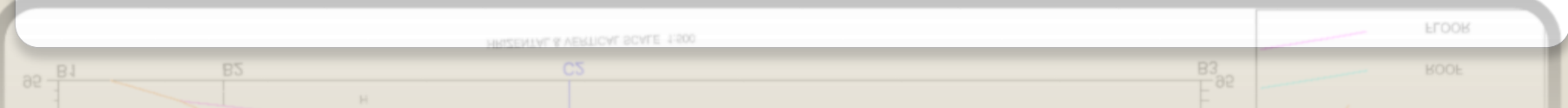
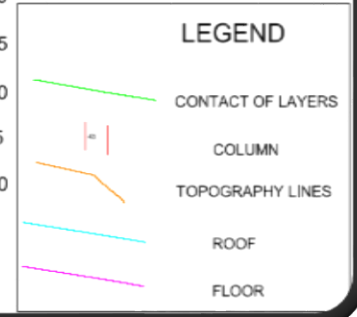
HRIZENTAL & VERTICAL SCALE 1:500

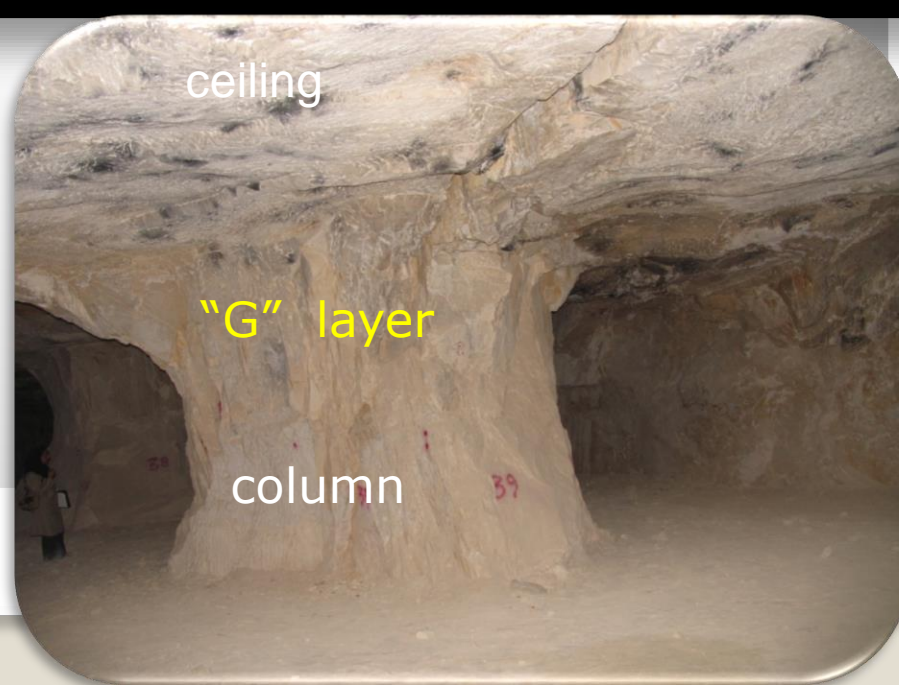
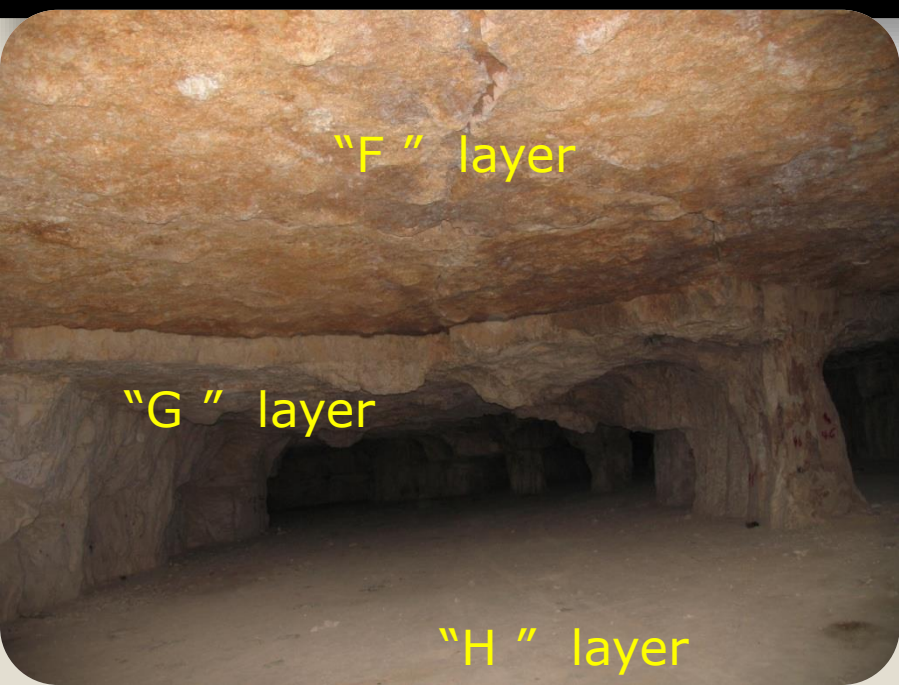
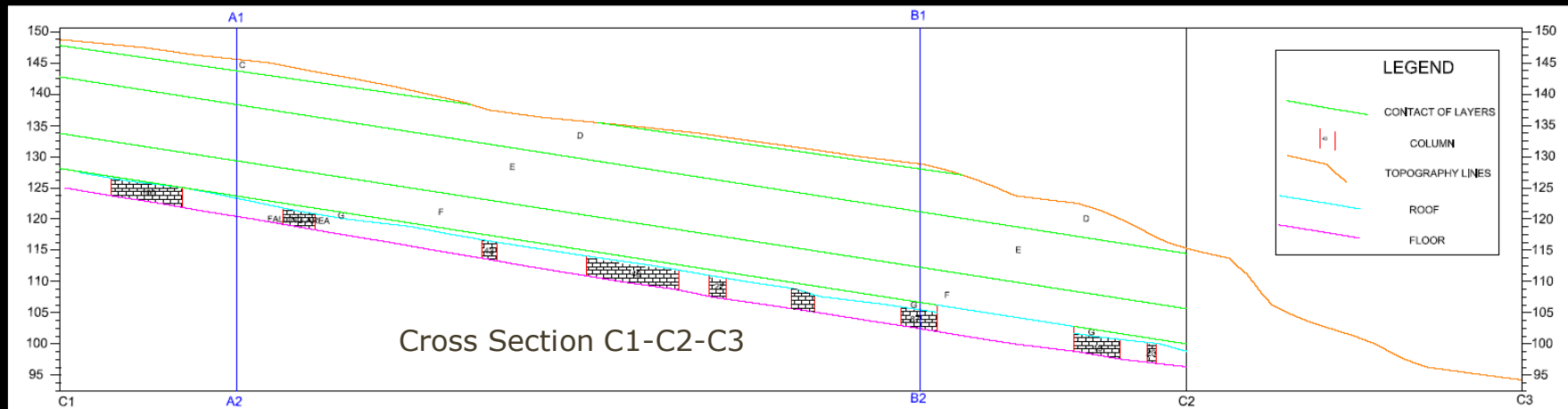
Cross Section A1-A2-A3



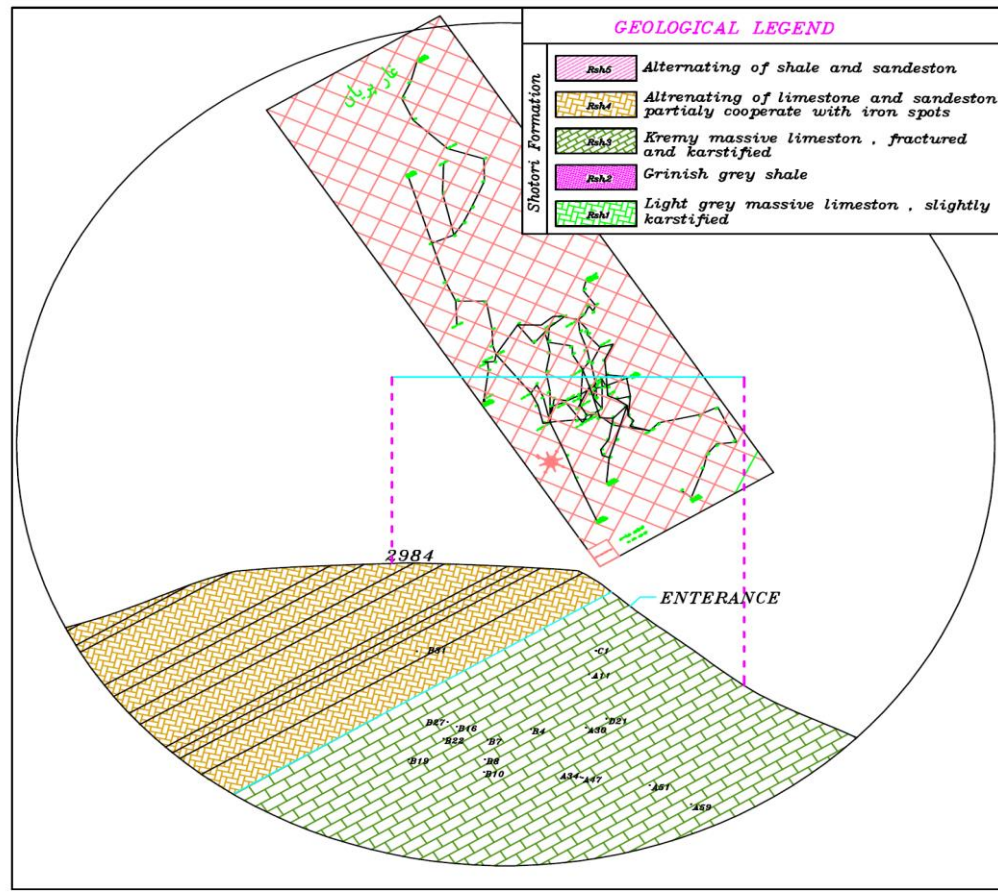
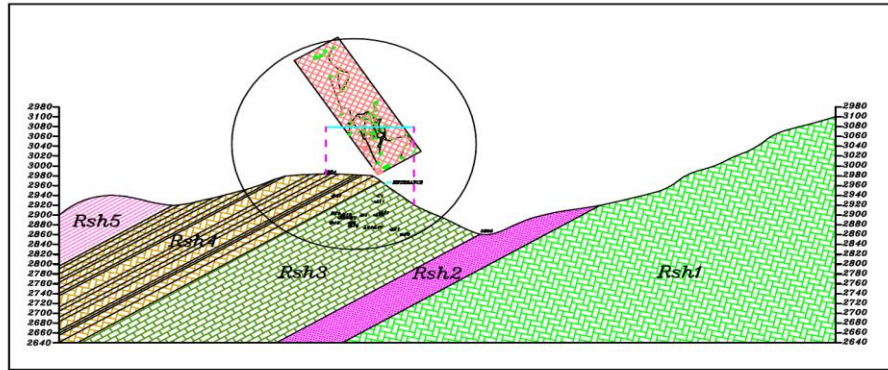
HRIZENTAL & VERTICAL SCALE 1:500

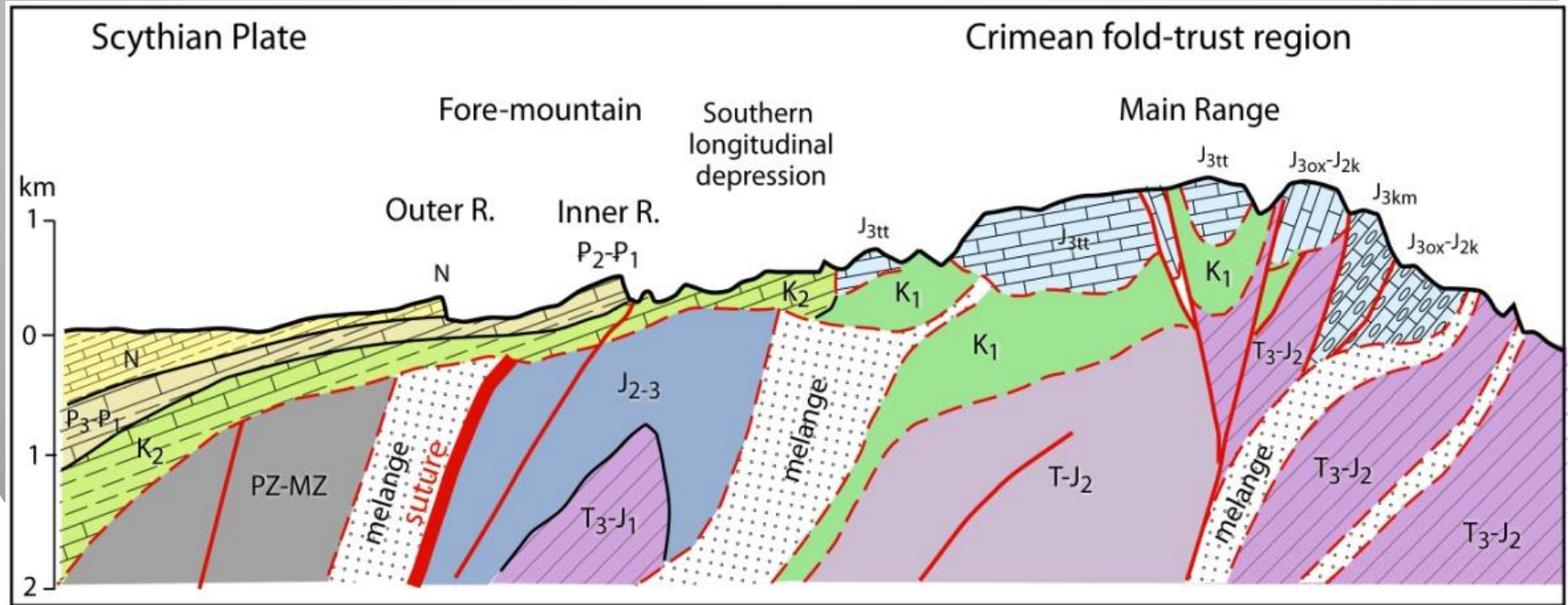
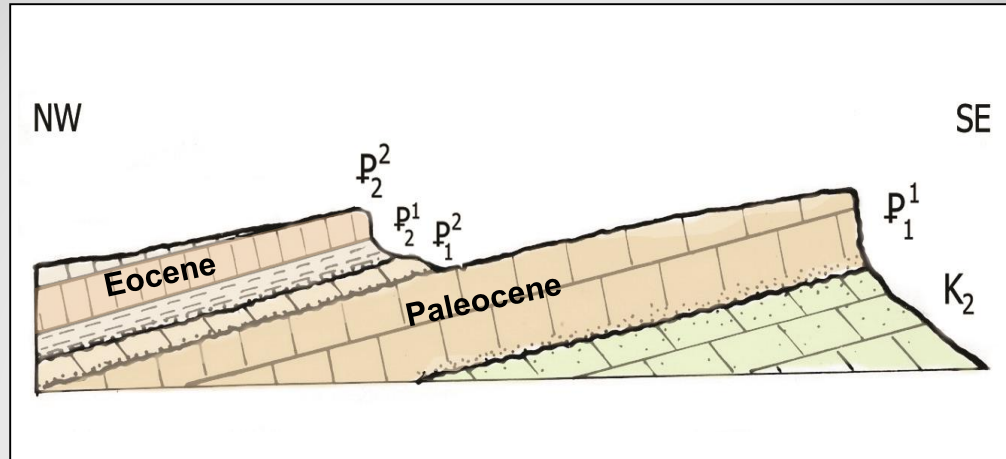
Cross Section B1-B2-B3



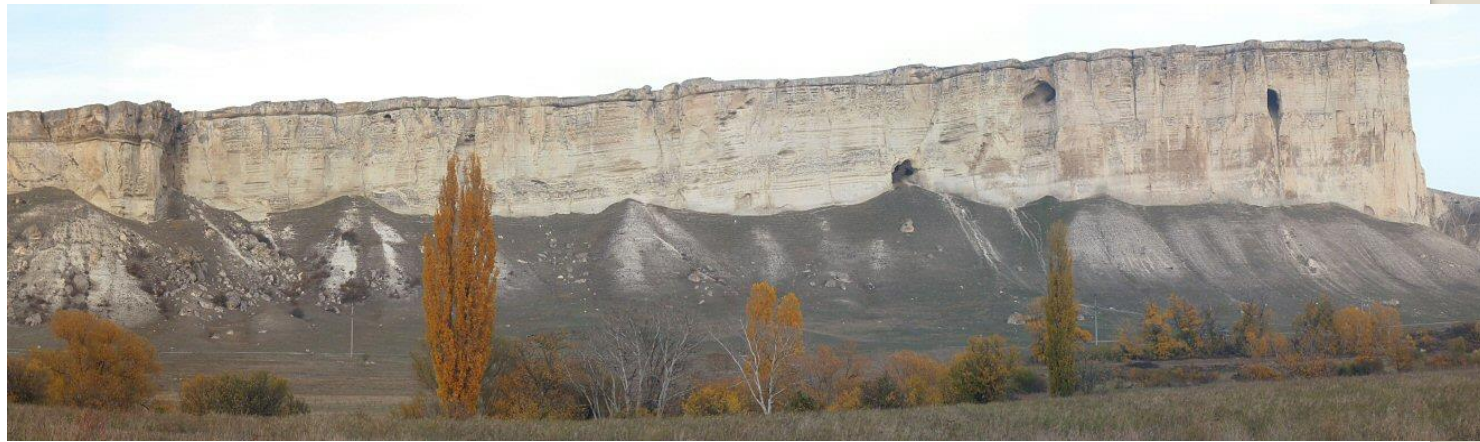
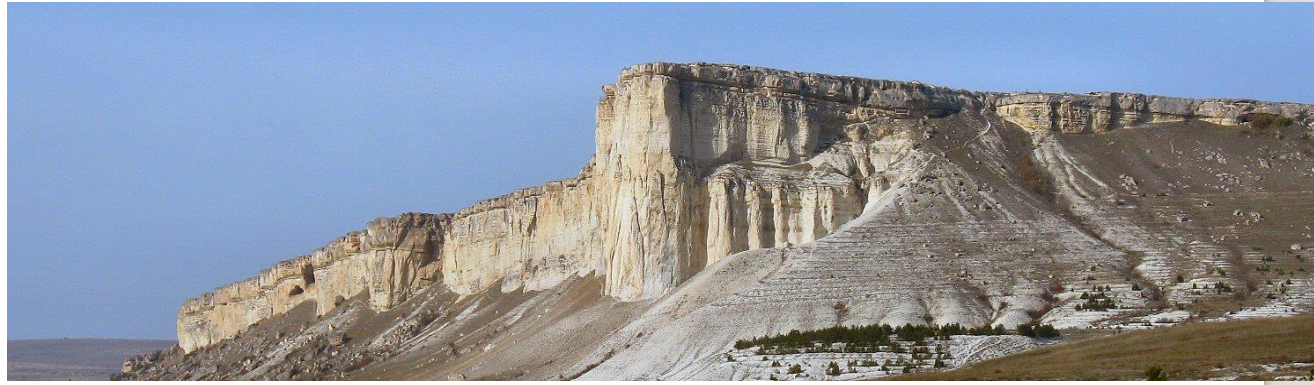


نماد	ضخامت حقیقی	جنس
Rsh5		شیل سبز رنگ با لایه های فرعی ماسه سنگ گاهی آهن دار ولایه های نازک آهک و دولومیت
Rsh4	5.0	آهک کرم روشن خرد شده
	7.4	آهک کرم روشن
	2.9	آهک خاکستری تیره
	2.9	تناوب آهک روشن و آهک تیره
	11.2	آهک کرم رنگ خرد شده
	14.0	تناوب آهک تیره با آهک ماسه ای
	23.2	آهک ماسه ای آهن دار به رنگ قهوه ای
	7.4	آهک خاکستری تیره
	35.1	تناوب آهک خاکستری با ماسه سنگ آهندار قرمز رنگ
	20.7	تناوب آهک خاکستری با ماسه سنگ
	10.8	آهک تیره با لایه های فرعی آهک کرم رنگ
Rsh3	184.0	آهک خرد شده به رنگ کرم روشن دارای درز و شکاف و آثار برش گسله و کارن های سطحی
Rsh2	62.0	شیل سبز رنگ با لایه های فرعی ماسه سنگ و آهک
Rsh1		آهک کرم روشن با لایه بندی ضخیم و دارای غار های کوچک



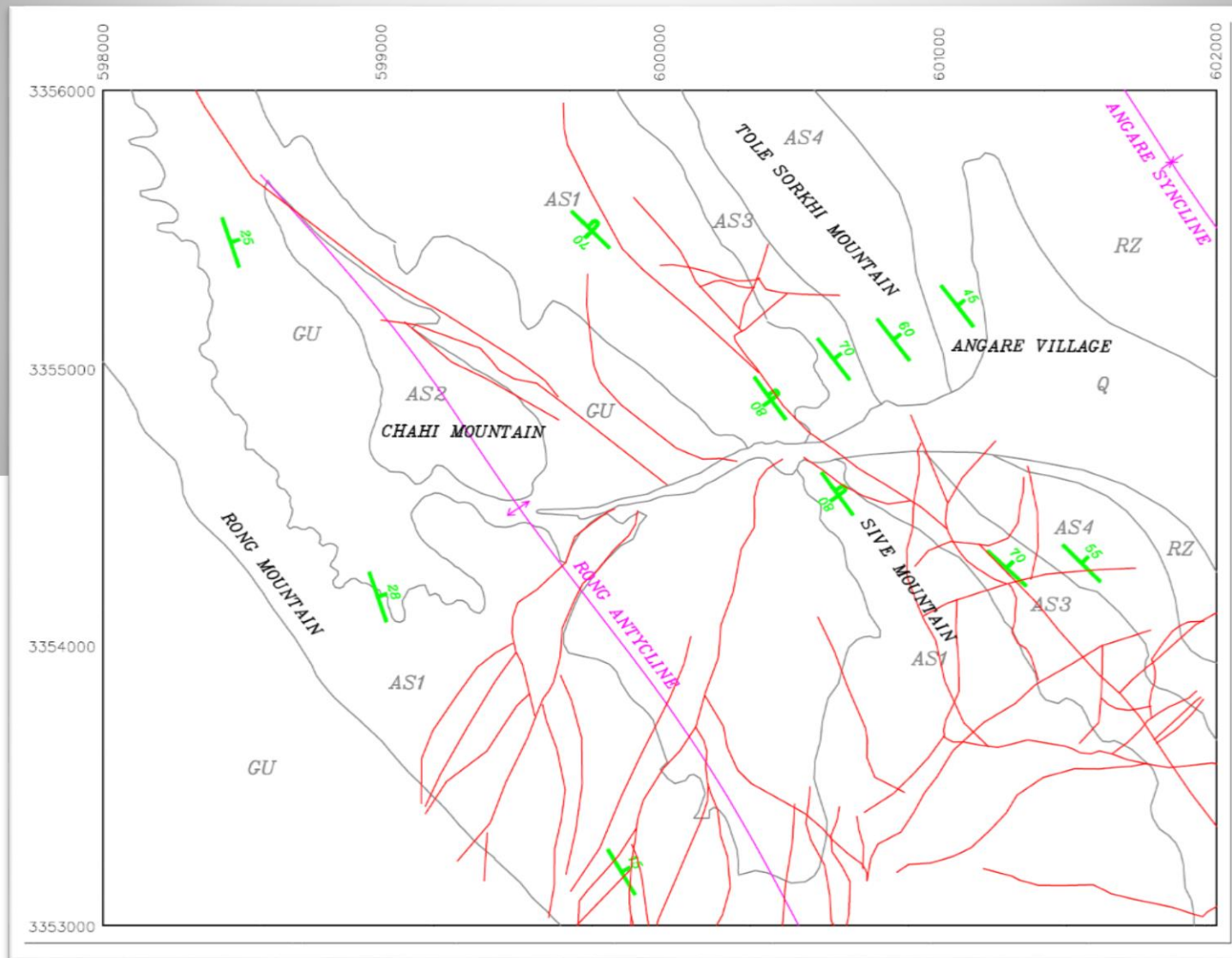


Inner Range of the Crimean fore-mountain: the east sector











تهیه نقشه های ساختاری با استفاده از عکس های ماهواره ای و برداشت های میدانی



PARDISS CAVE

LEGEND

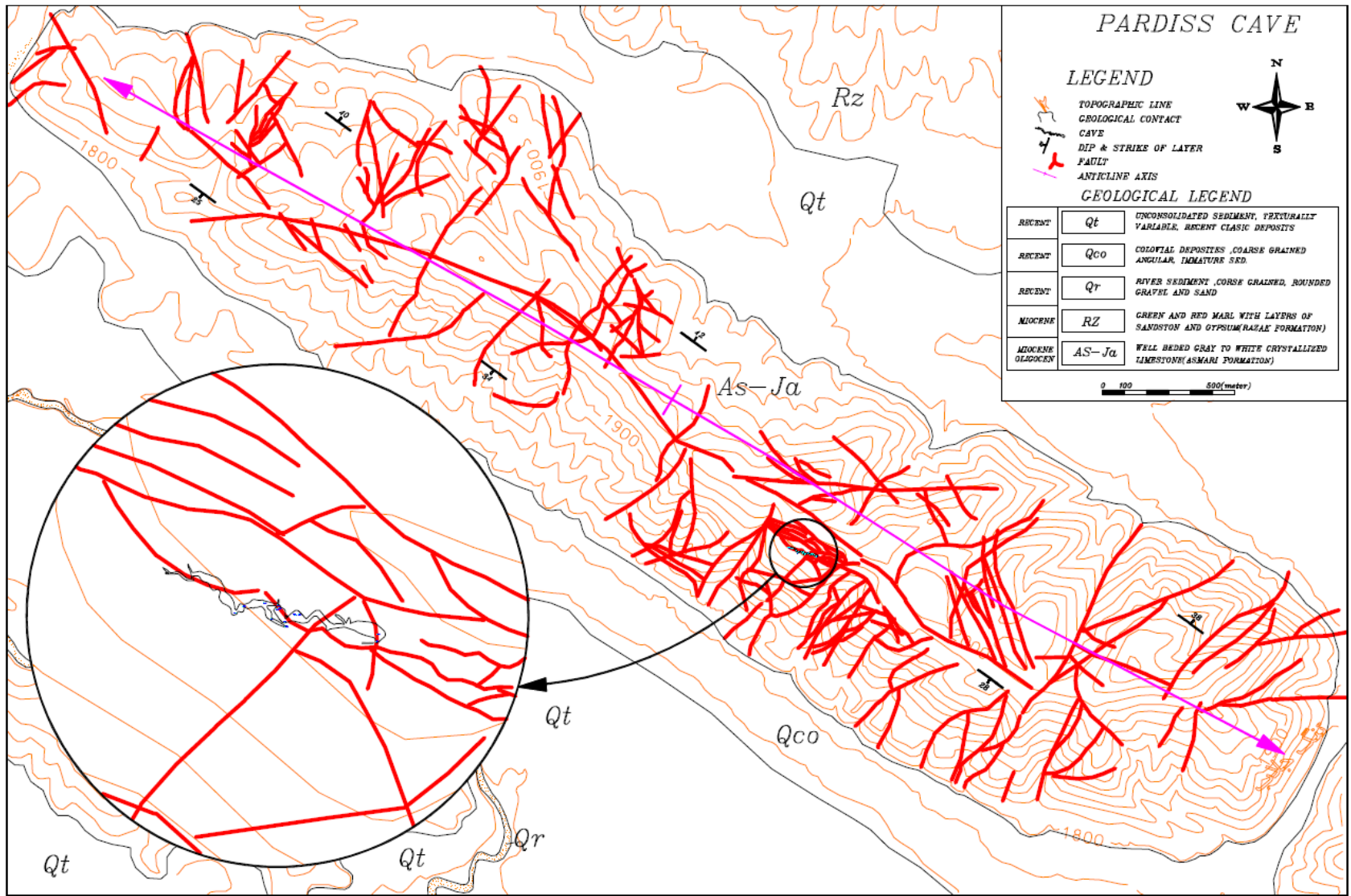
-  TOPOGRAPHIC LINE
-  GEOLOGICAL CONTACT
-  CAVE
-  DIP & STRIKE OF LAYER
-  FAULT
-  ANTICLINE AXIS



GEOLOGICAL LEGEND

RECENT	Qt	UNCONSOLIDATED SEDIMENT, TEXTURALLY VARIABLE, RECENT CLASTIC DEPOSITS
RECENT	Qco	COLLUVIAL DEPOSITS, COARSE GRAINED ANGULAR, IMMATURE SED.
RECENT	Qr	RIVER SEDIMENT, COARSE GRAINED, ROUNDED GRAVEL AND SAND
MIOCENE	RZ	GREEN AND RED MARL WITH LAYERS OF SANDSTON AND GYPSUM(RAHAE FORMATION)
MIOCENE OLIGOCENE	AS-Ja	WELL BEDDED GRAY TO WHITE CRYSTALLIZED LIMESTONE(ASMARI FORMATION)

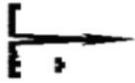
0 100 500(meter)






3250

A1

B1



LEGEND

-  MAJOR JOINTS OF ROOF
-  MAJOR JOINTS OF FLOOR
-  BENCH MARK
-  BORE HOLE
-  COLUMN

3200

A2

B2

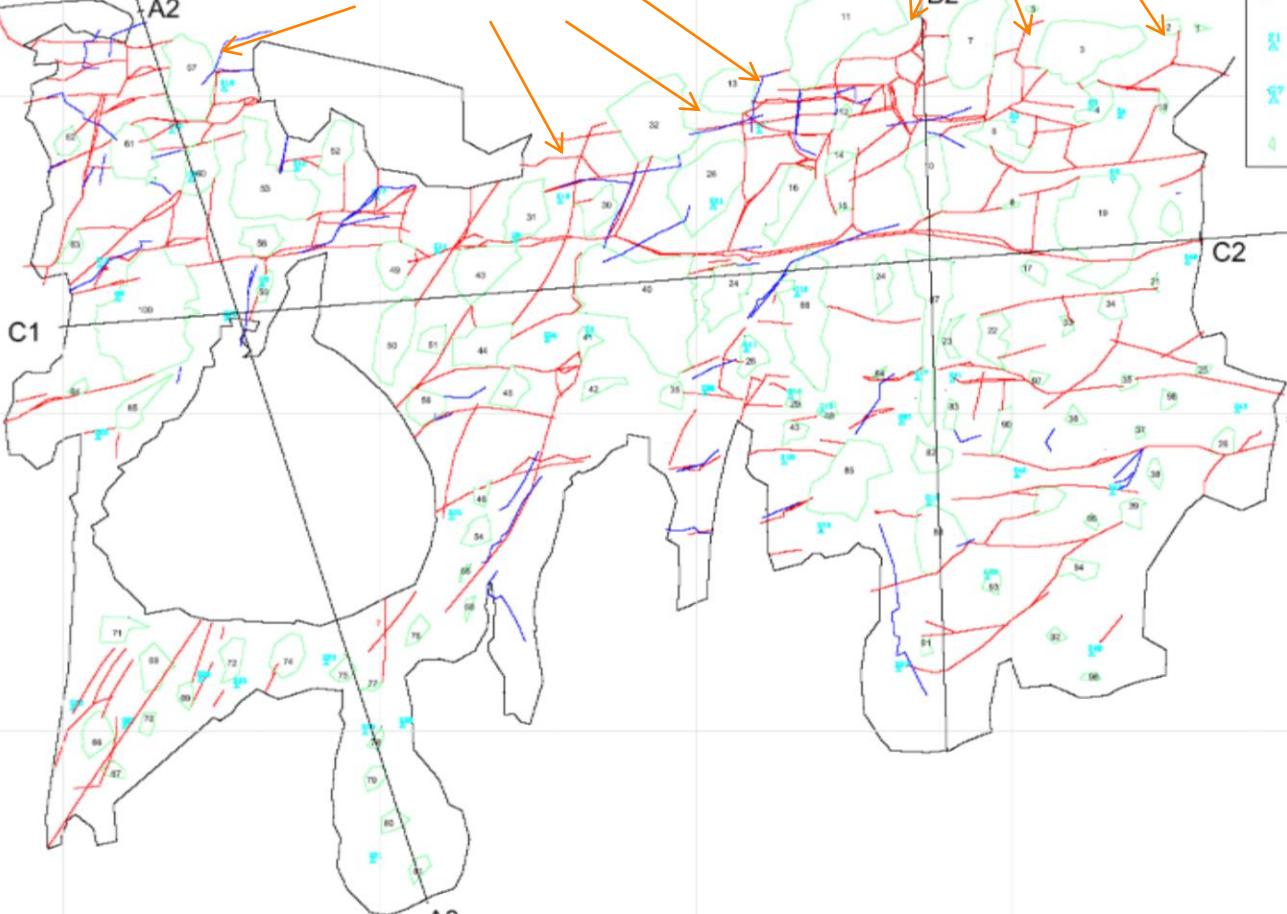
5150

C1

C2

C3

5100



0110

0120

A3

0200

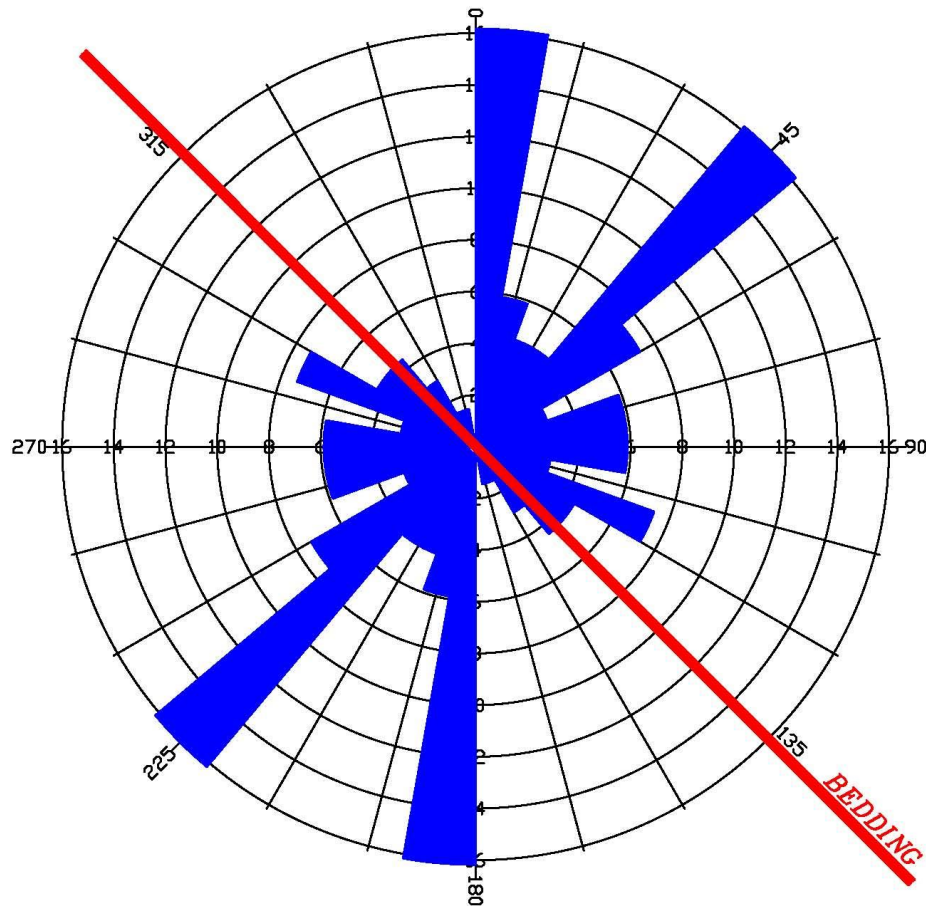
0250

0300

برداشت و تحلیل درزه ها و گسل های بیرون غار

ANGARE CAVE

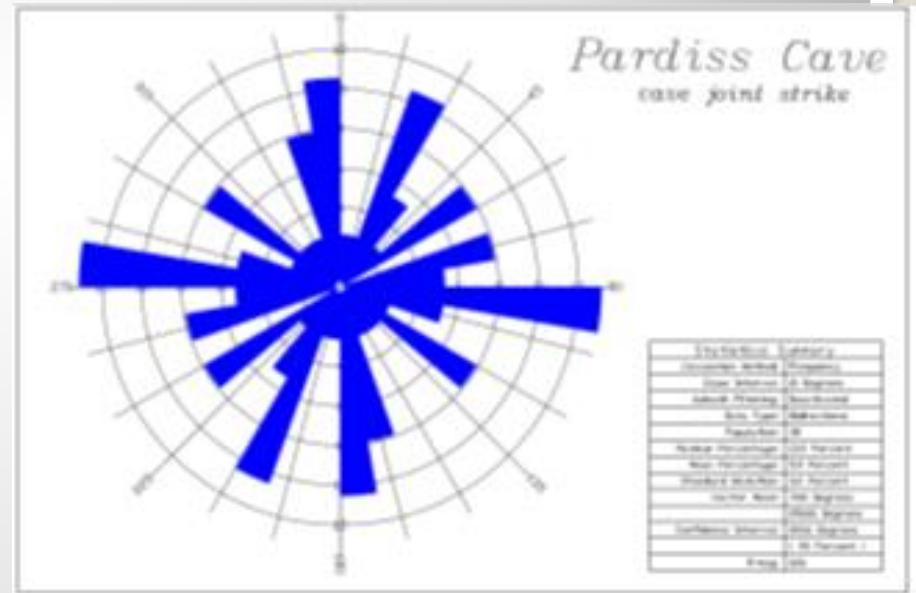
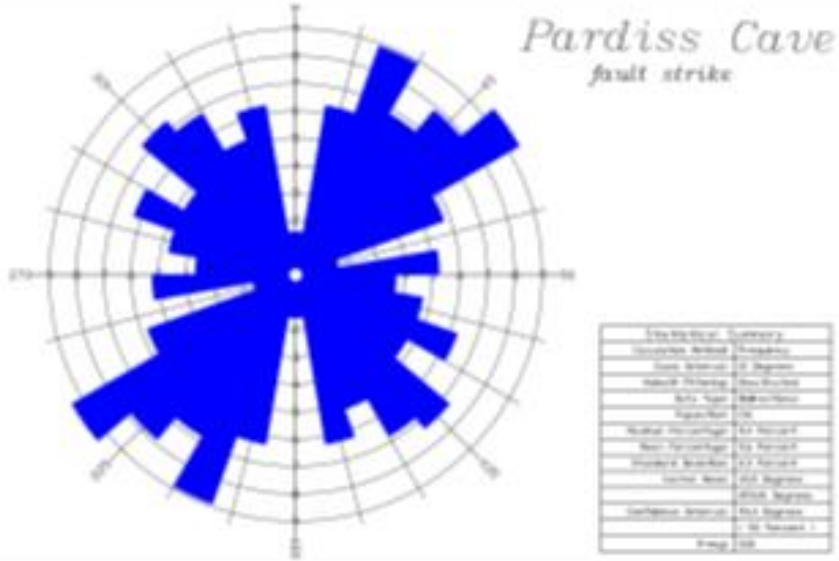
ROSE DIAGRAM OF FAULT



Statistical Summary	
Calculation Method:	Frequency
Class Interval:	10 Degrees
Azimuth Filtering:	Deactivated
Data Type:	Bidirectional
Population:	68
Maximum Percentage:	16.2 Percent
Mean Percentage:	5.9 Percent
Standard Deviation:	4.2 Percent
Vector Mean:	46.9 Degrees
	226.89 Degrees
Confidence Interval:	43.5 Degrees
	< 95 Percent >
R-mag:	0.22

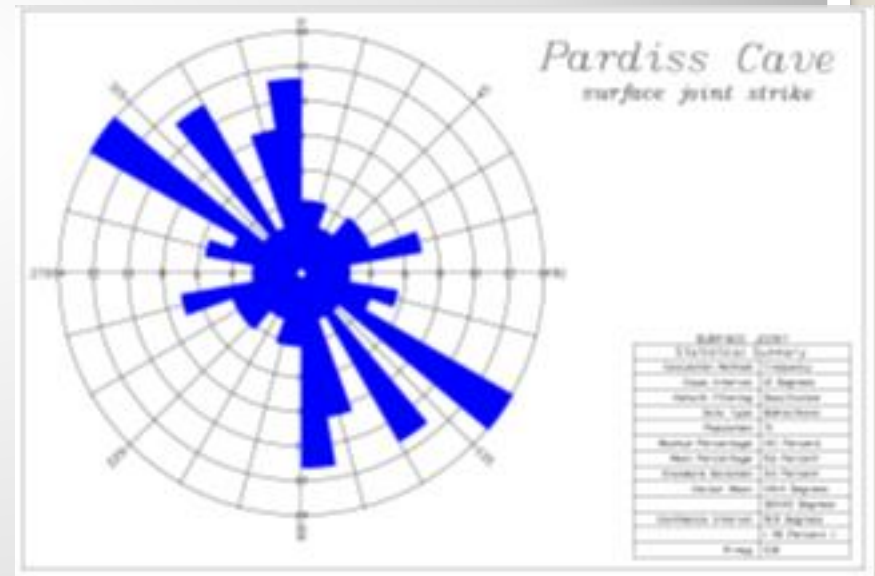
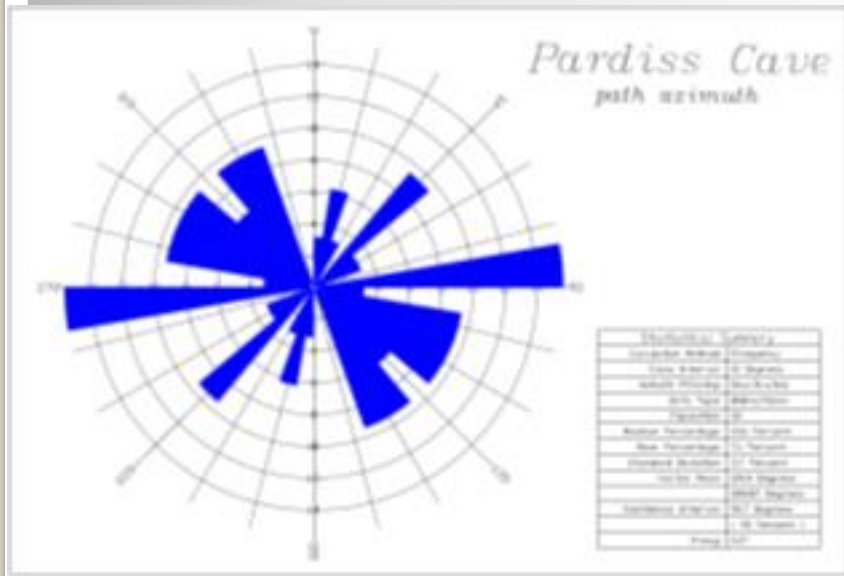
نمودار گل سرخی گسل های تاقدیس پردیس

نمودار گل سرخی درزه های اطراف دهانه غار

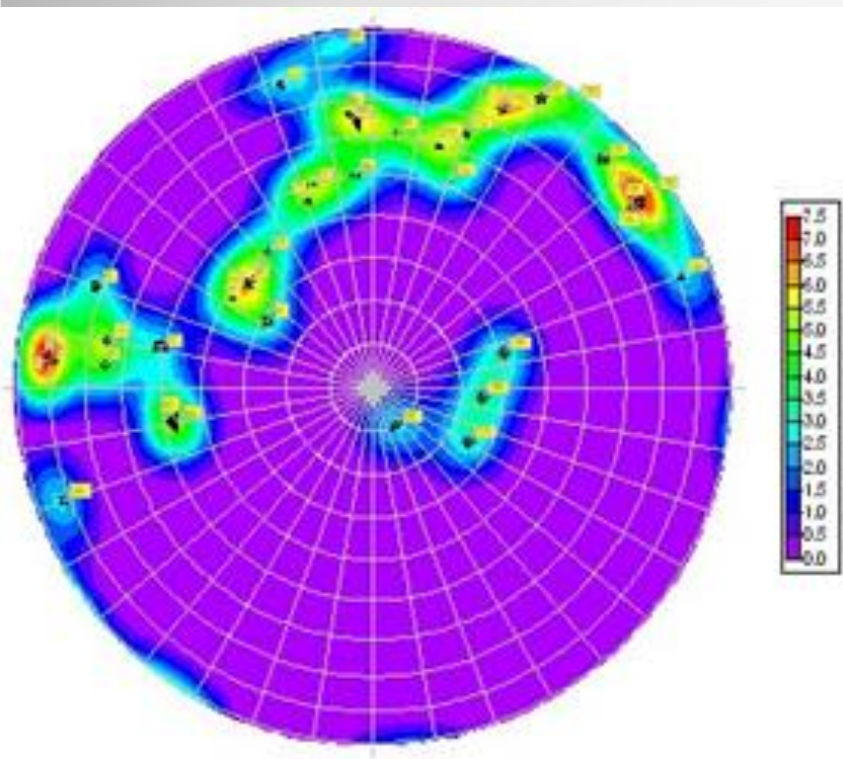


نمودار گل سرخی مسیر های غار

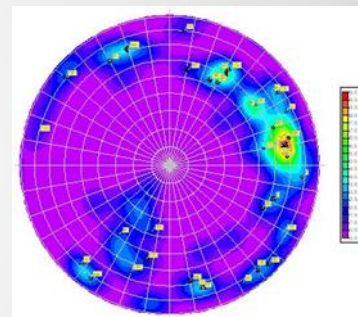
نمودار گل سرخی شکستگی های درون غار

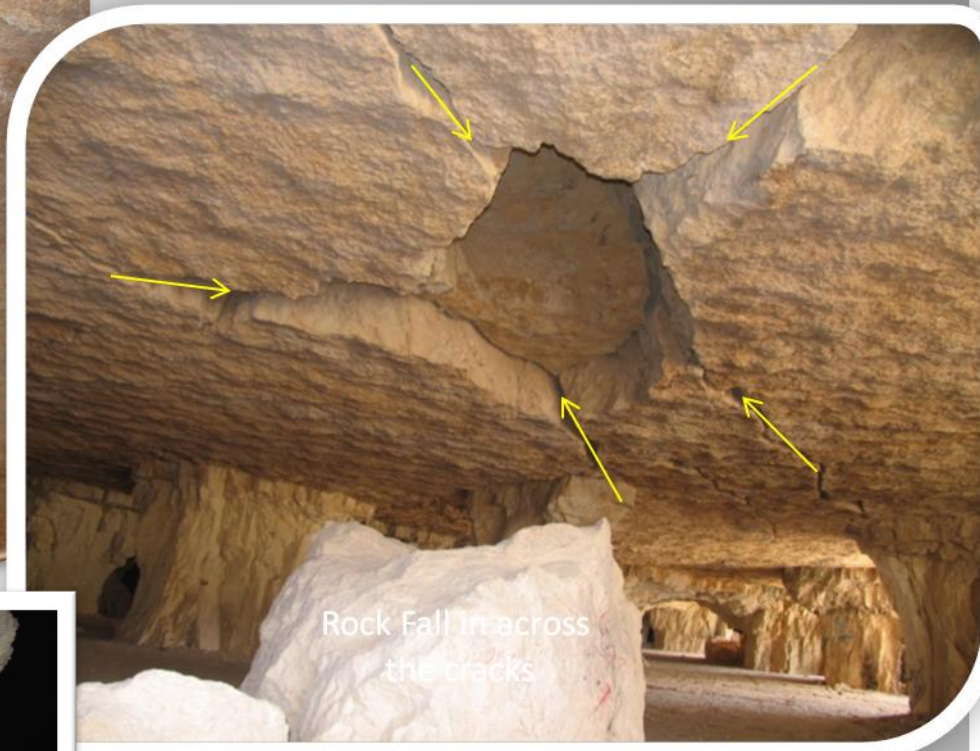


استریوگرام درزه ها و شکستگی های موجود در درون غار



استریوگرام درزه ها و شکستگی های موجود در سطح زمین اطراف دهانه غار












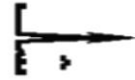
5200

A1

B1

LEGEND

-  IN COMPRESS
-  NON SYSTEMATIC JOINTED
-  IN COMPRESS JOINTED
-  CRUSHED ZONE
-  BENCH MARK
-  BORE HOLE
-  COLUMN



A2

B2

5200

C1

C2

C3

5150

A3

5100

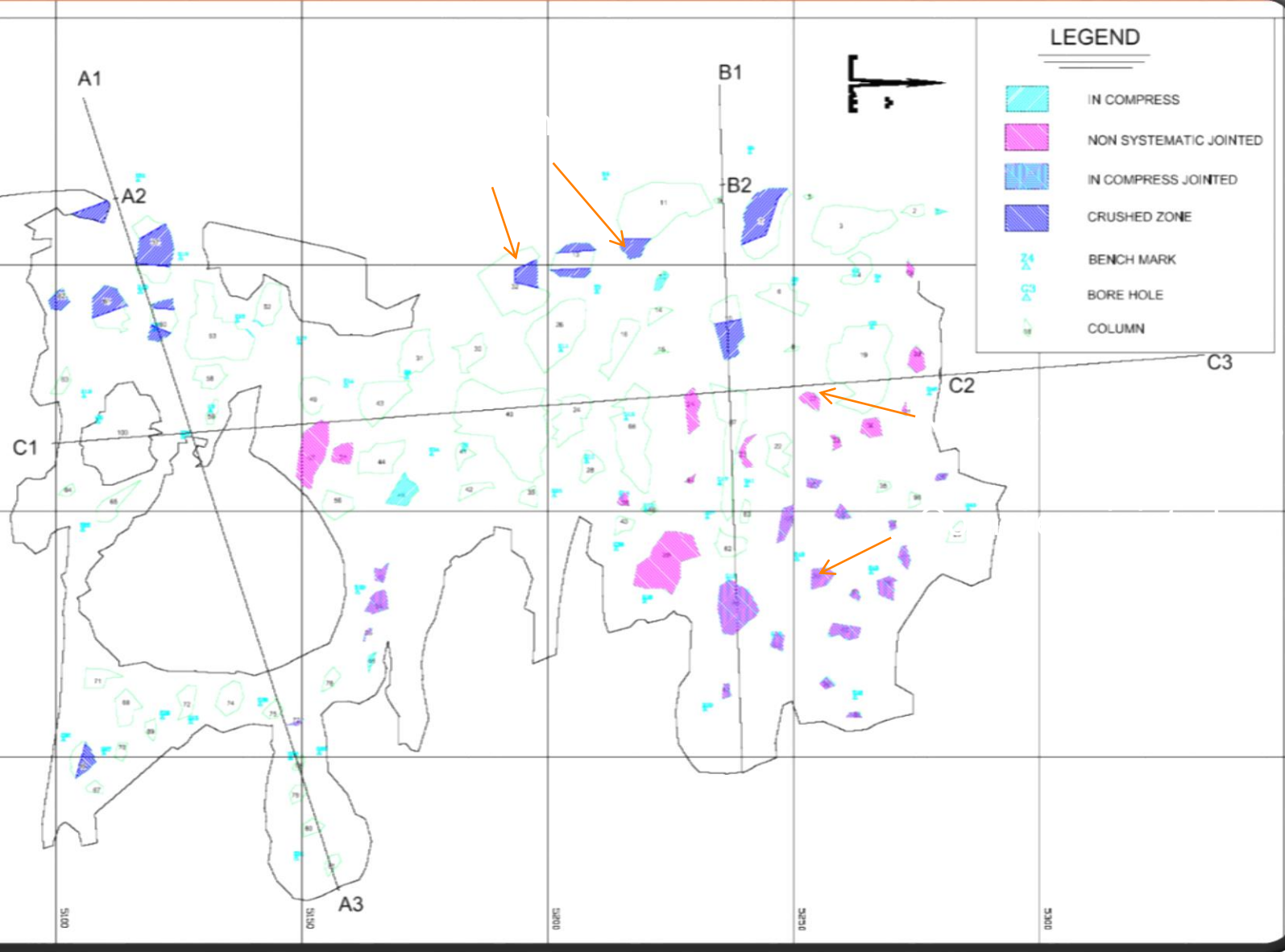
5100

5150

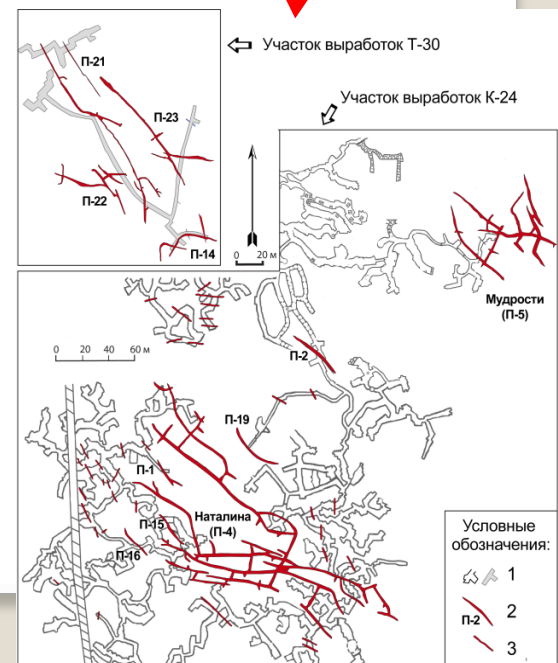
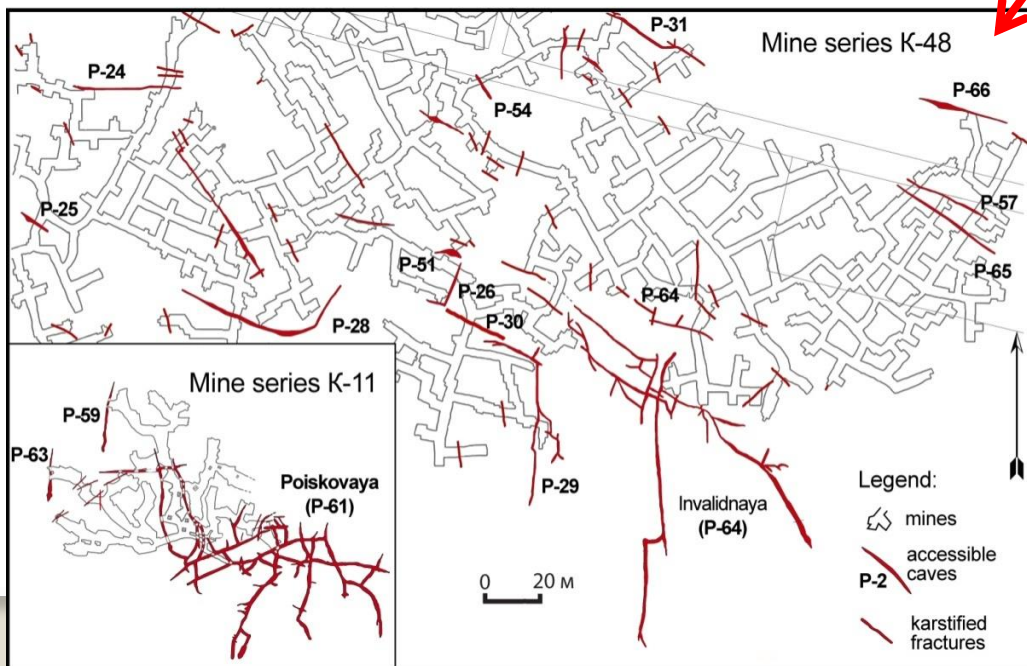
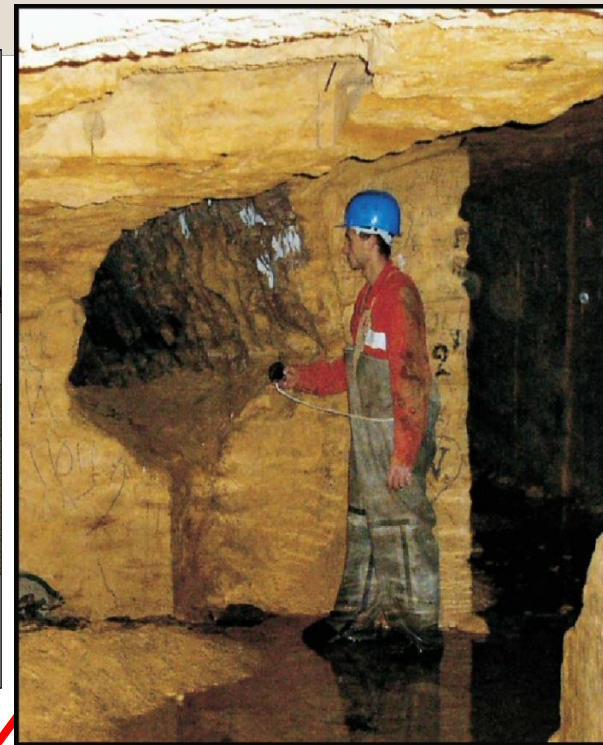
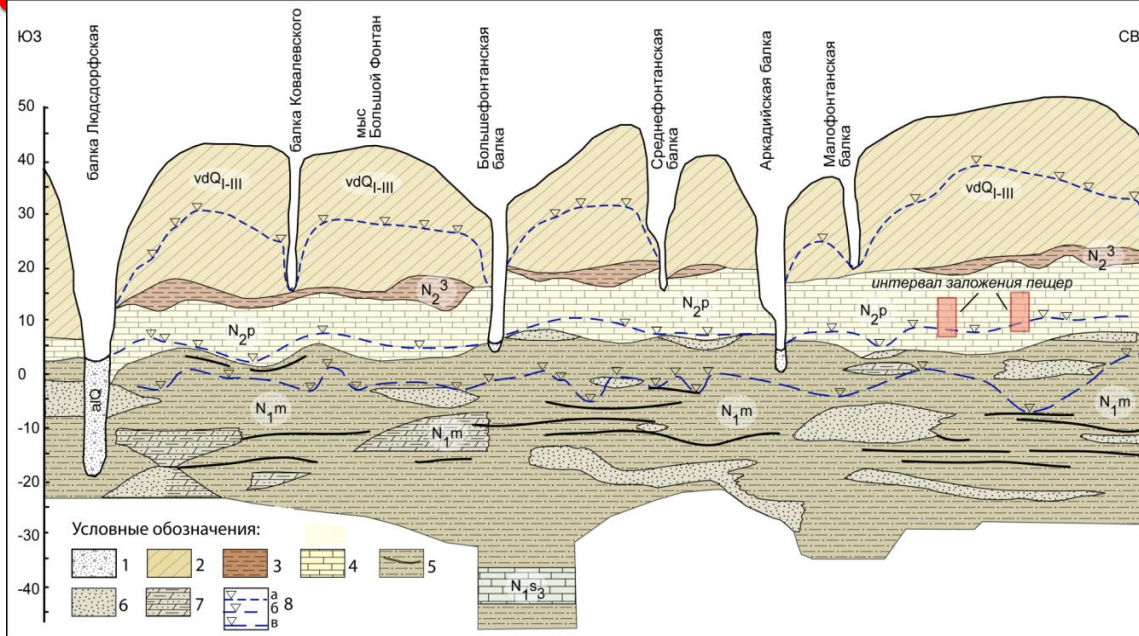
5200

5250

5300



Odessa cave area



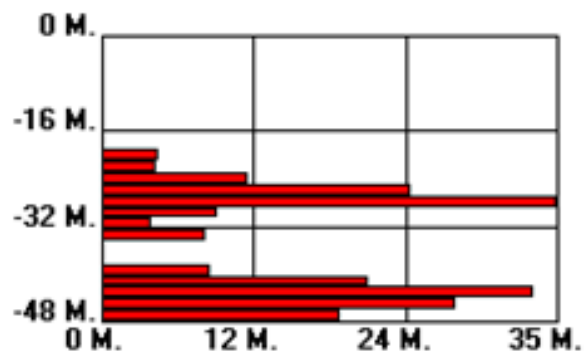
داده های آماری نقشه برداری

Number Of Files=1	Station Aliases= 0	
Included Length= 4597.9 Feet	1401.5 Meters	0.87 Miles
Total Surveyed= 4597.9 Feet	1401.5 Meters	0.87 Miles
Horizontal Length=3890.0 Feet	1185.7 Meters	0.74 Miles
Cave Depth=361.3 Feet	110.1 Meters	
Surface Length=585.5 Feet	178.5 Meters	
Surface Width= 685.8 Feet	209.0 Meters	
Surface Area= 401583.6 Ft^2	37308.3 M^2	
Cave Volume= 3510610.6 Ft^3	99409.4 M^3	
Average Diameter= 27.6 Feet	8.4 Meters	
Wall Area= 426180.8 Ft^2	39593.5 M^2	
Floor Area=111401.1 Ft^2	10349.5 M^2	
Average Inclination= 25.8 Deg.		

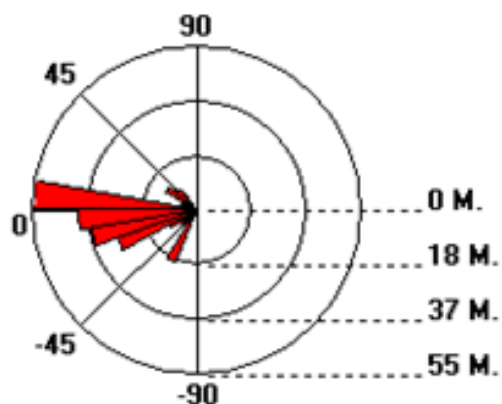
Highest Station= A1	0.0 Feet	0.0 Meters
Lowest Station= A59	-361.3 Feet	-110.1 Meters
North Most Station=B31	500.7 Feet	152.6 Meters
South Most Station=A55	-185.2 Feet	-56.4 Meters
East Most Station=B31	348.6 Feet	106.3 Meters
West Most Station=C1	-236.9 Feet	-72.2 Meters

تحليل جهت كشيدگي و عمق تشكيل غار

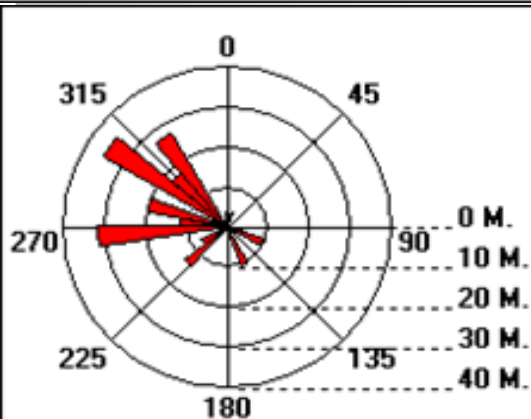
منحنی طول غار نسبت به عمق

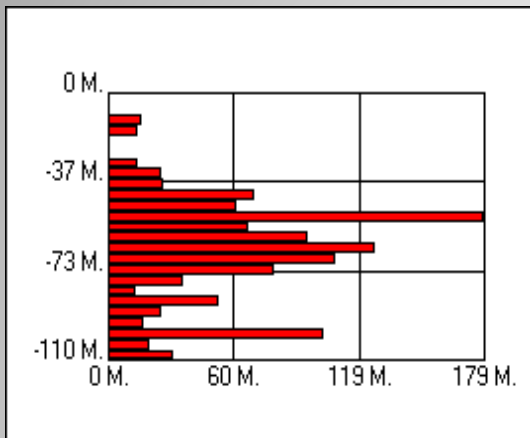


میزان شیب معابر

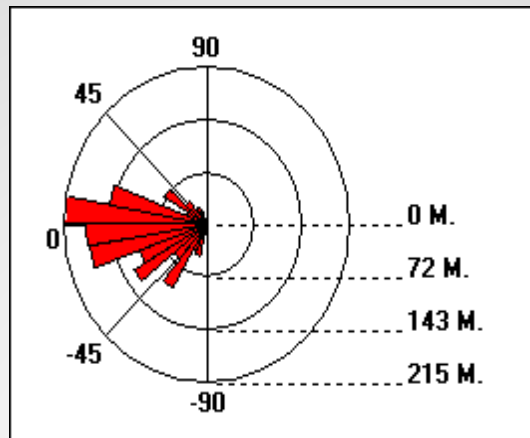


جهت كشيدگي غار

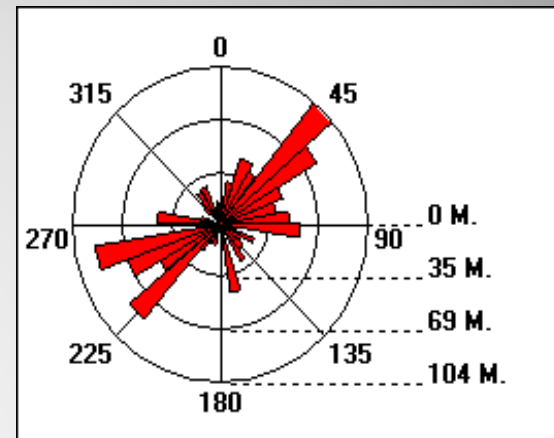




شکل ۱۰



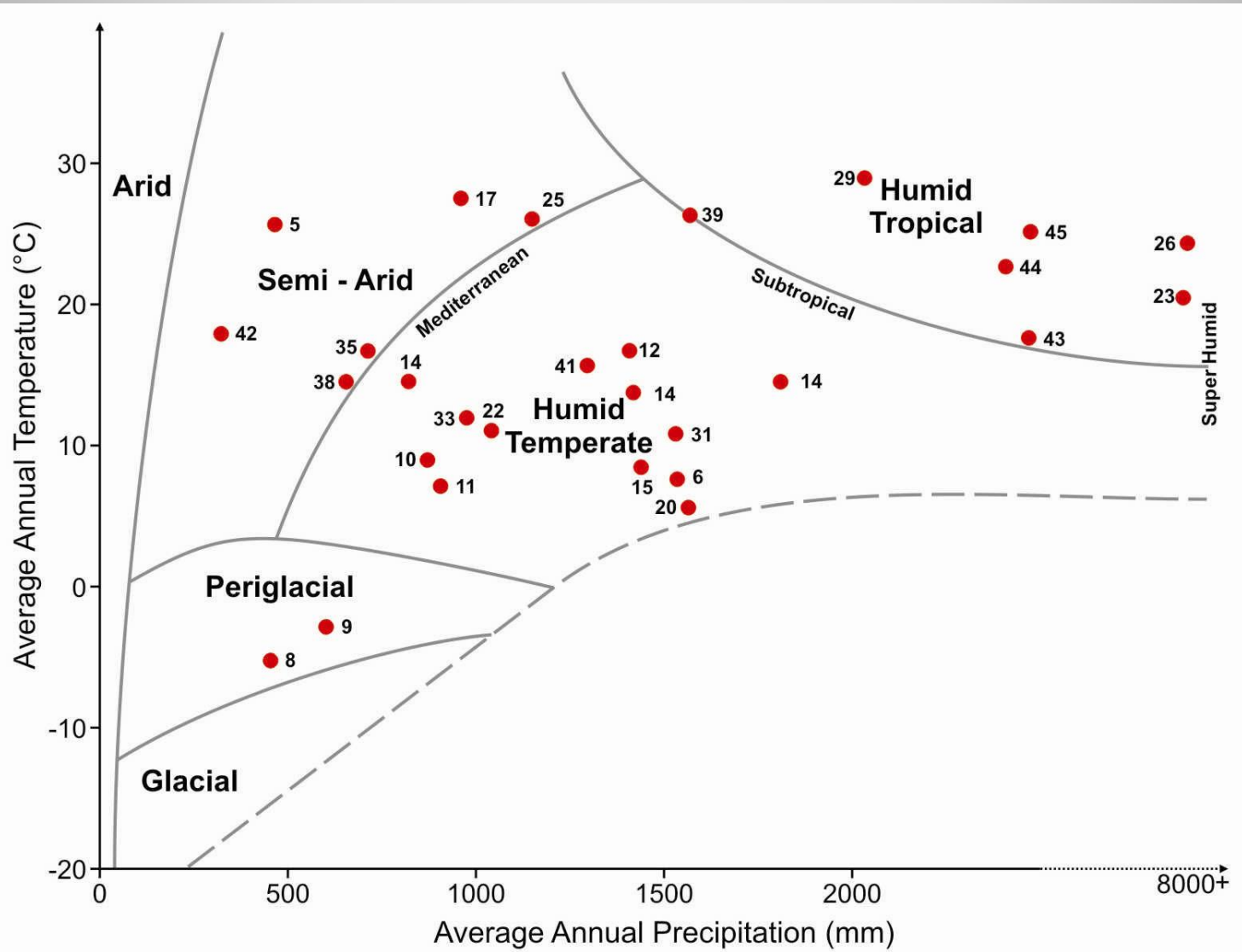
شکل ۹



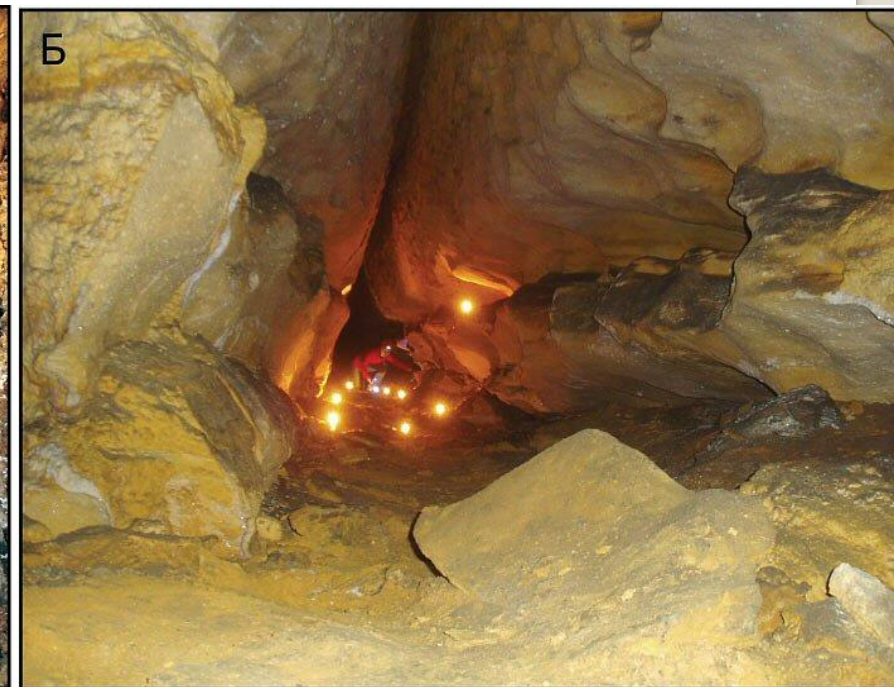
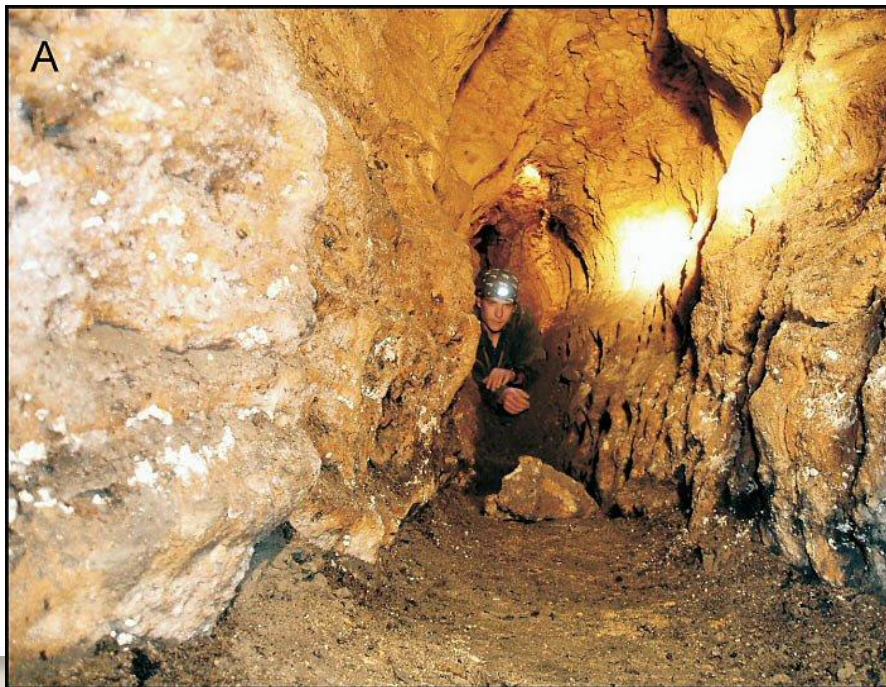
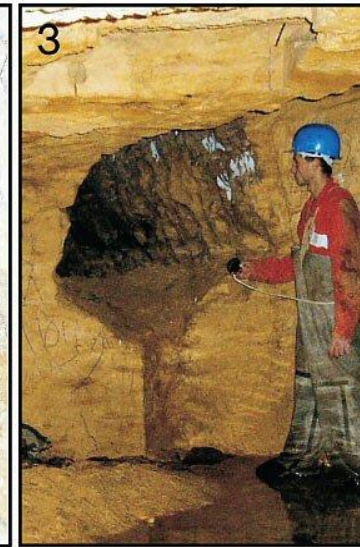
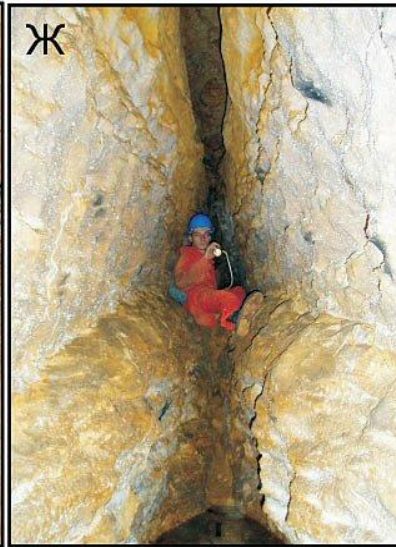
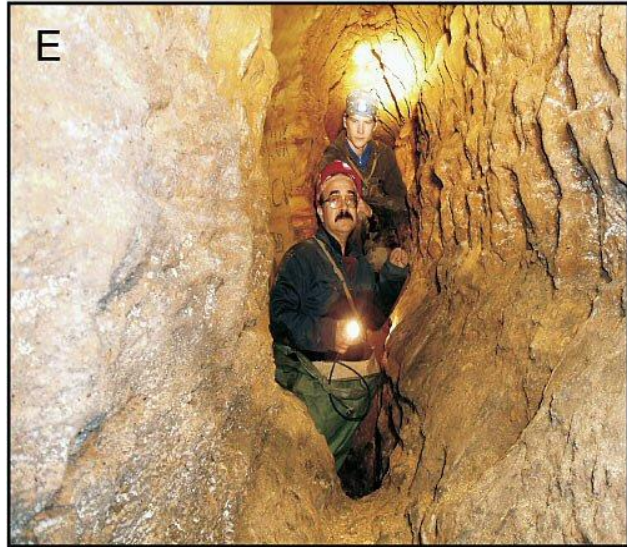
شکل ۸

شکل ۸ - نمودار گل سرخی مسیر های نقشه برداری شده در غار پریان ترسیم شده با استفاده از نرم افزار کمپاس
 شکل ۹ - نمودار شیب مسیر های نقشه برداری شده در غار پریان ترسیم شده با استفاده از نرم افزار کمپاس
 شکل ۱۰ - نمودار مسیر های نقشه برداری شده در غار پریان نسبت به عمق ترسیم شده با استفاده از نرم افزار کمپاس

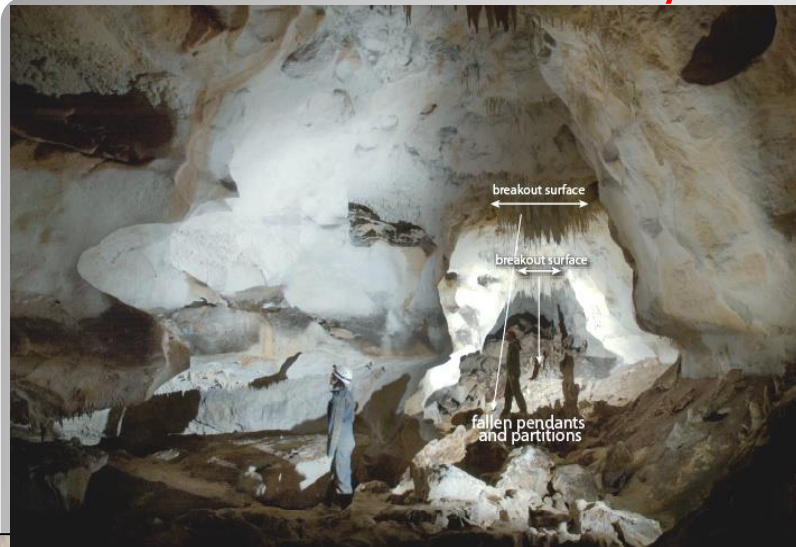
توجه به اقلیم



Odessa cave area



Tavrskaya Cave: Morphotypes of passages



Side niches and conduits

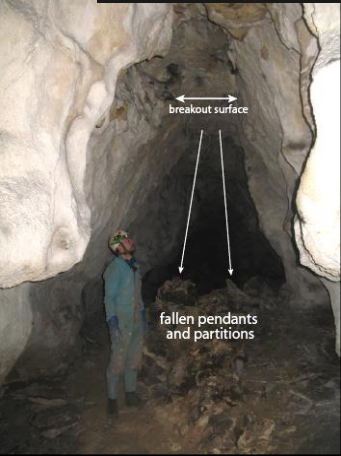
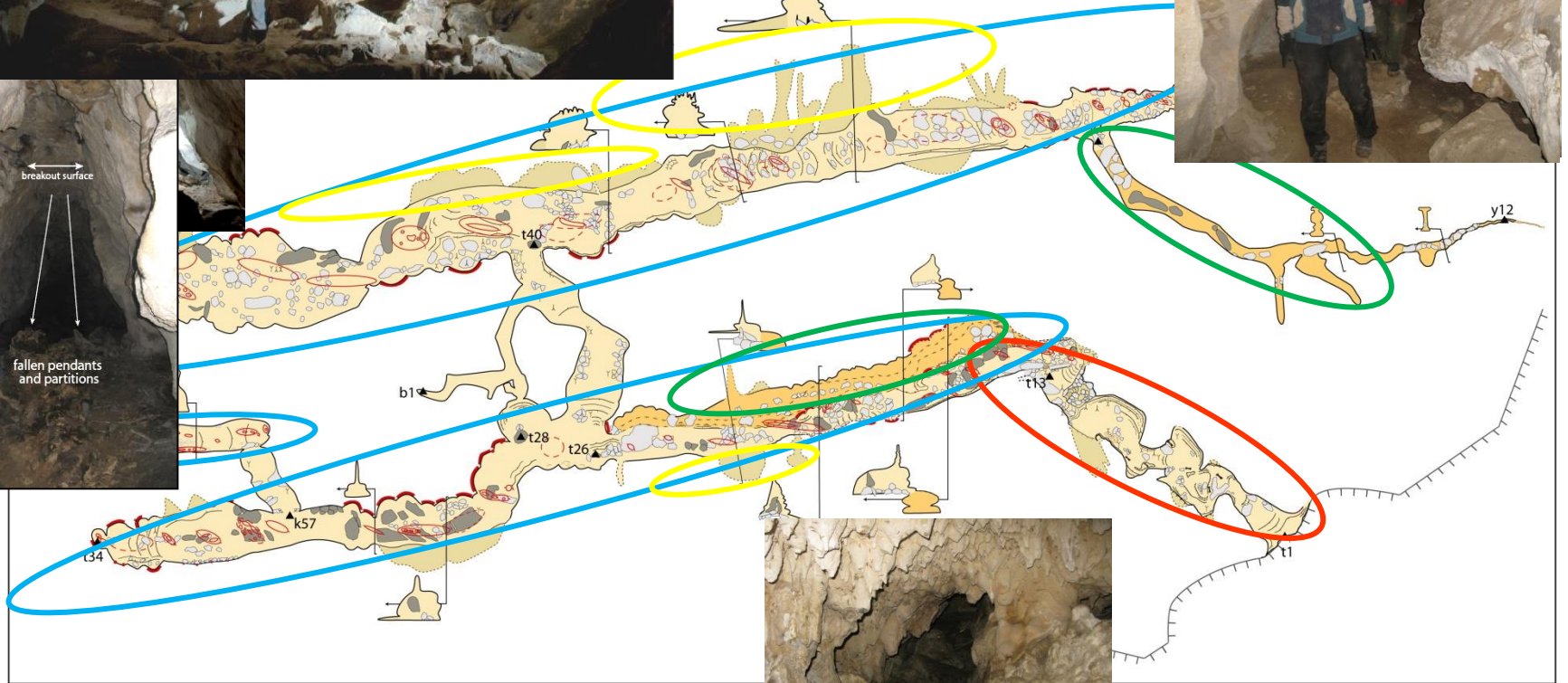


Rift-like passage



Map

Tavrskaya
Crimean Fore-Mountain



Entrance Series

Karst Landforms

- Surface Landforms
 - Solutional Sculpturing (Karrens)
 - Landforms with – relief
 - Doline, Poljes, Shaft, Cutters
 - Landforms with + relief
 - Pinnacle, Residual hills, Cone, Tower
 - Drainage
 - Karst valley, spring
- Underground Landforms

ساختارهای انحلالی بیرون غار

Bay of
Halong
Vietnam



Tsingy de
Bemaraha
Madagascar





Glacio-karst in
Pyrénées-Mount
Perdu.

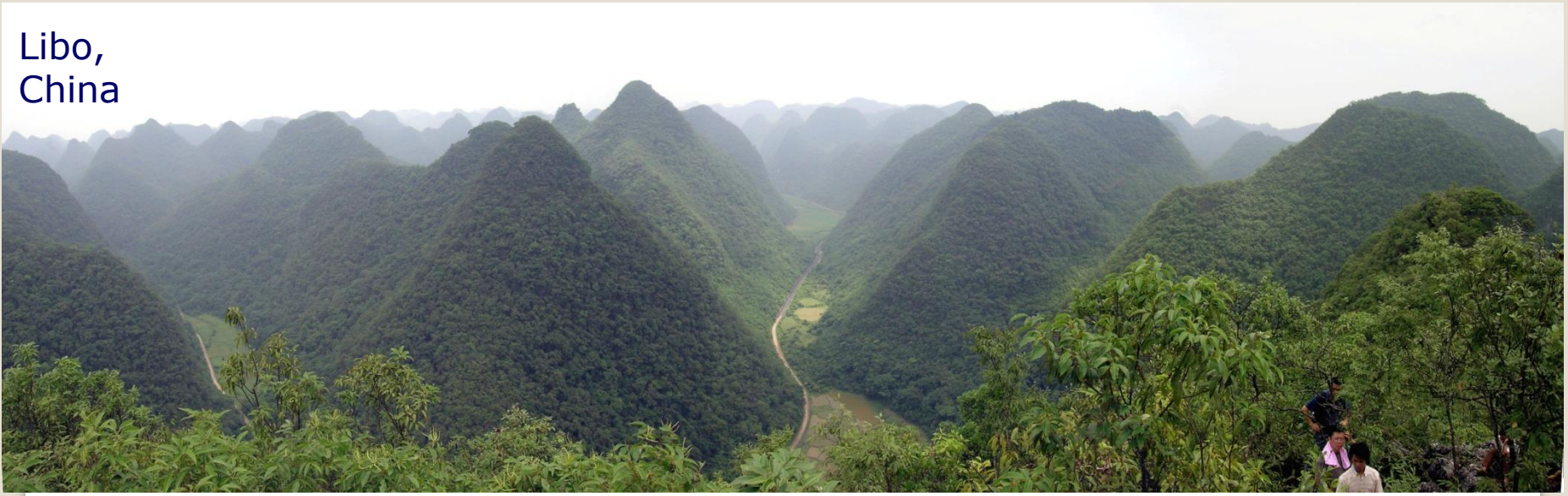
France-Spain
transnational WH site

~100 m high wall
karren in quartz
conglomerate.

Cultural WH site at
 Meteora, Greece



Libo,
China



Hierapolis-
Pamukkale
, Turkey





Dodo, dry canyon
**Northwest Territories,
Canada.**

Photo by Derek Ford



Lena Pillars,
Sinyaya valley,
Siberia

© A. Buterin

Tropical - subtropical, arid - semiarid karsts of Australia

Geikie Gorge

Exhumed Devonian Reef



Nullarbor Plain



Windjana
Gorge

ساختارهای انحلالی درون غار

شکل کلی غار

- Isolated cave غارهای منفرد
- Protocave غارهای اولیه
- Integrated cave system غارهای کامل

شکل کلی غار های منفرد

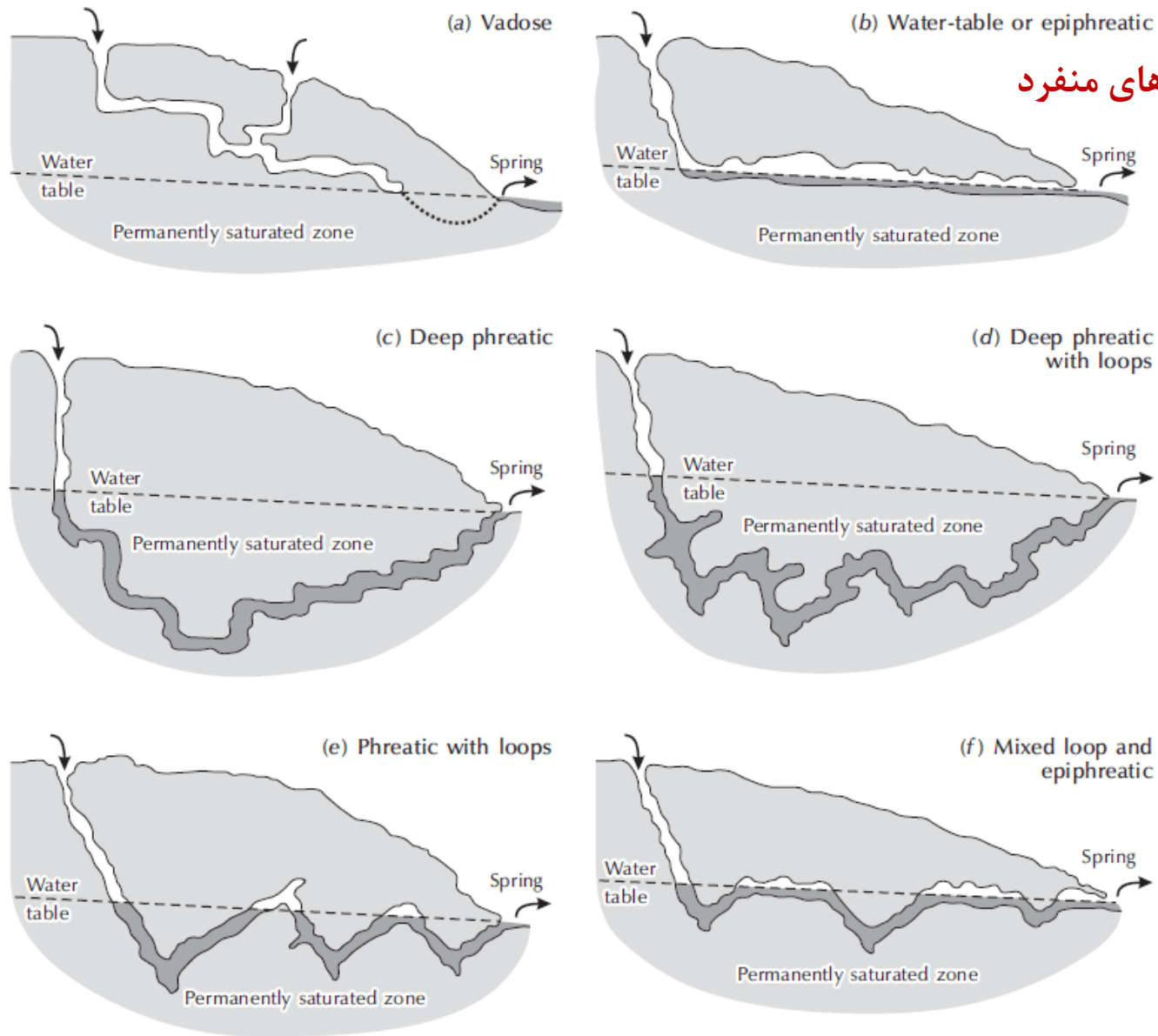


Figure 8.18 Types of caves.
Source: Adapted from Ford and Ewers (1978)

- Passages:

- Single conduit passages
- Maze Passages

- Passages:

- Single conduit passages

- Linear Passages

- Angulate Passages

- Sinuous Passages

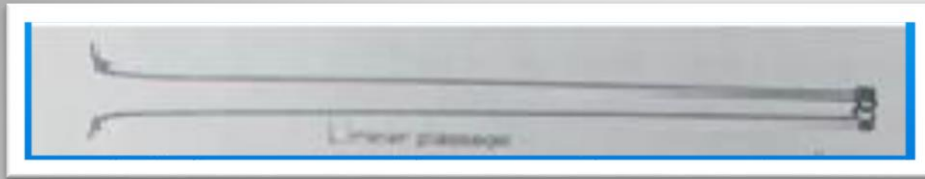
- Maze Passages

- Network Maze Passages

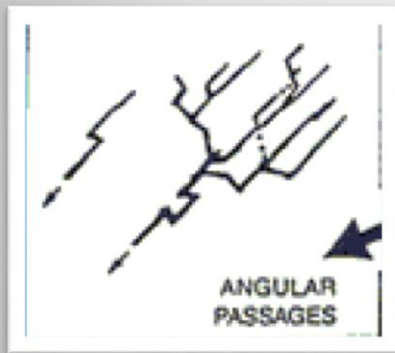
- Anastomotic Maze Passages

- Spongework Maze Passages

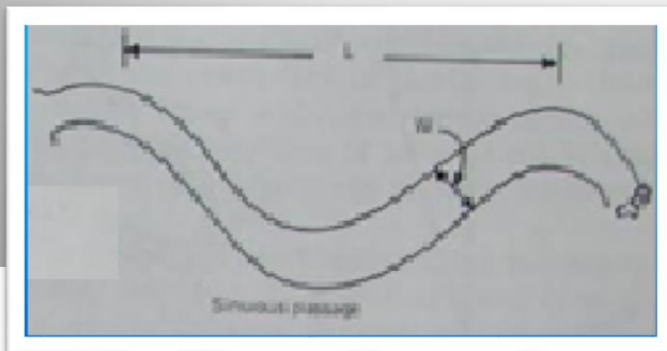
گذرگاه های خطی



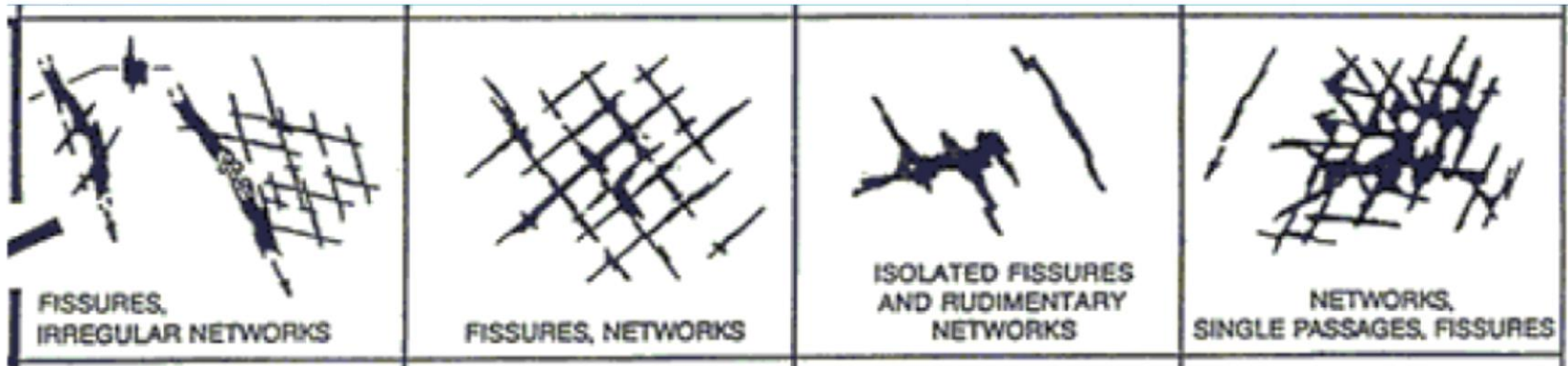
گذرگاه های زاویه ای



گذرگاه های سینوسی

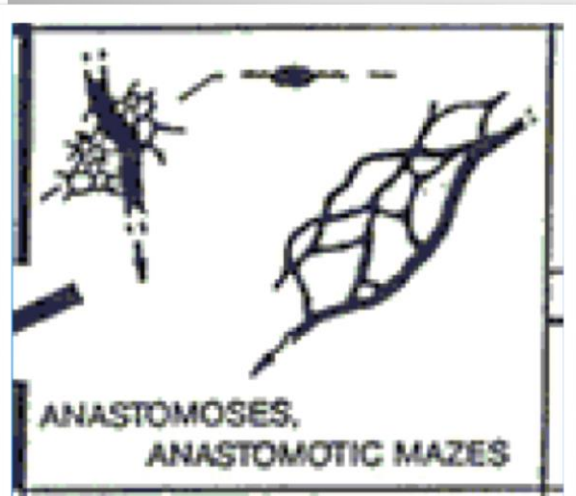


- Passages:
 - Single conduit passages
 - Linear Passages
 - Angulate Passages
 - Sinous Passages
 - **Maze Passages**
 - **Network Maze Passages**
 - **Anastomotic Maze Passages**
 - **Spongework Maze Passages**

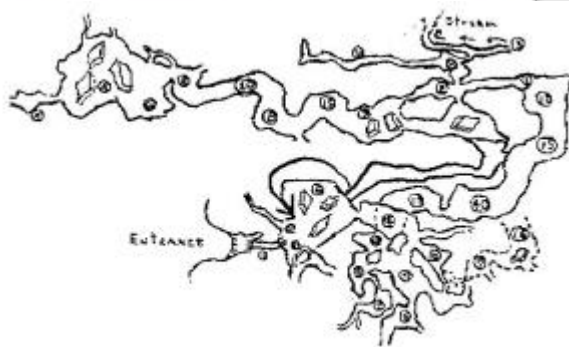


گذرگاه های شبکه ای

گذرگاه های مارپیچی



گذرگاه های مارپیچی بهم پیوسته



Passage Cross Section

- **Flow Regims:**

- **Hydraulic control**

- Elliptical tubes: Full pipe
 - Rectangular Passage
 - Canyons: Free surface

- **Structural Control**

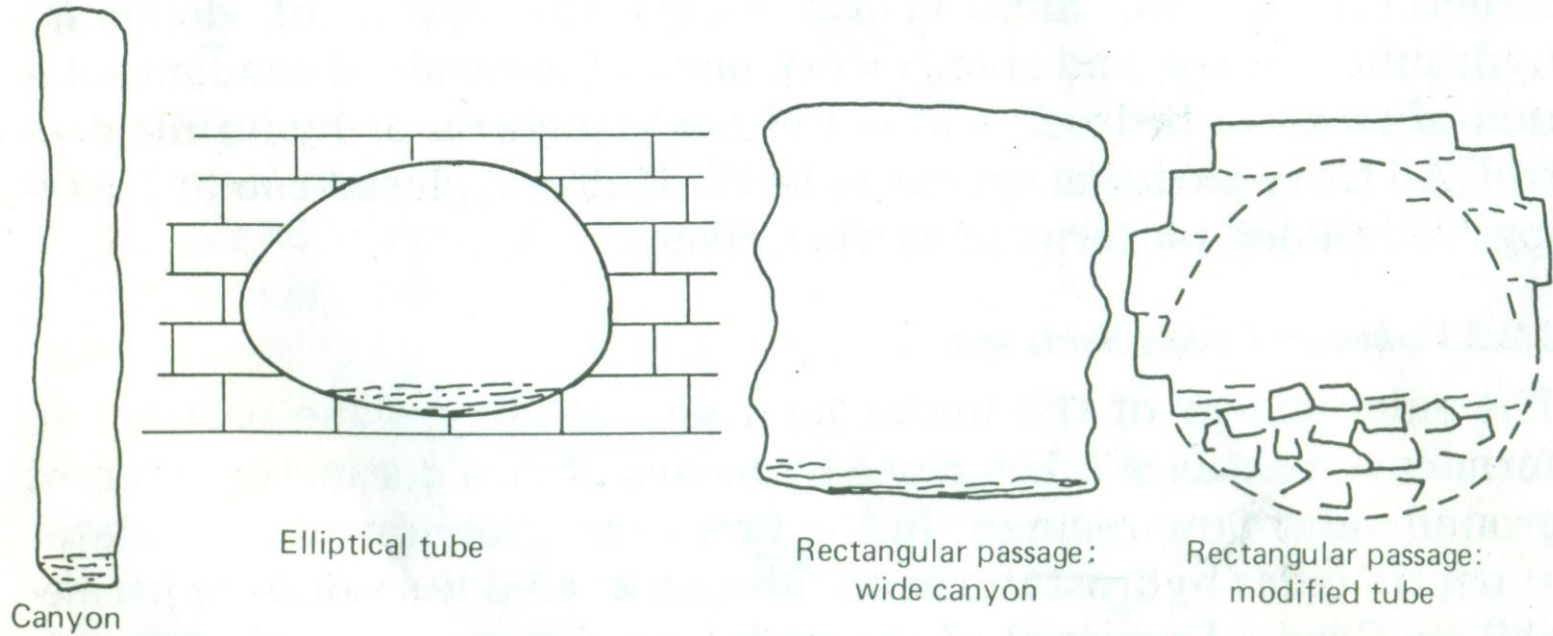


Figure 3.5 Cross sections of passages with shapes controlled by the hydraulics of flowing water.

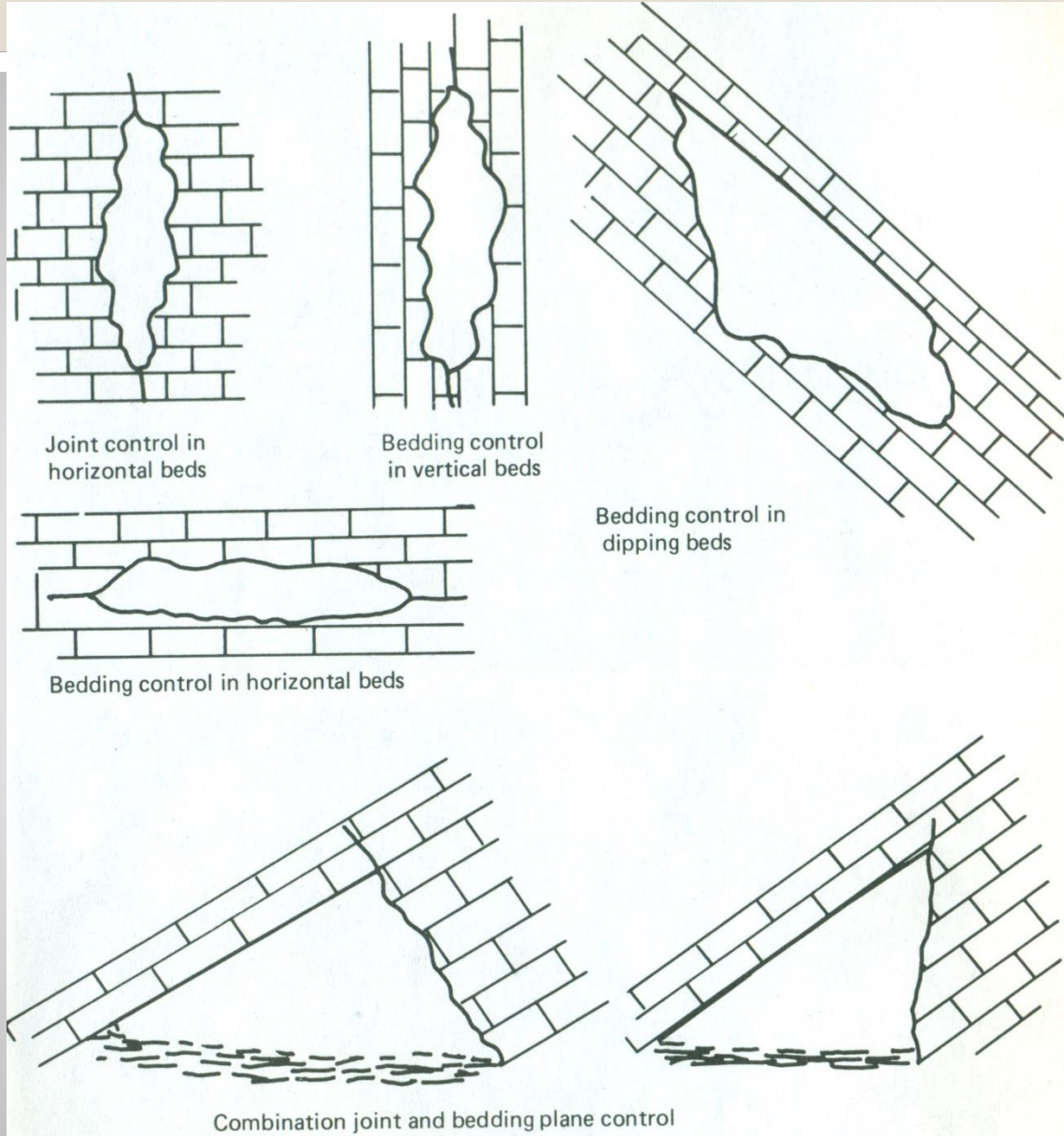


Figure 3.6 Cross sections of passages resulting from structural control of limestone dissolution.

Cave Patterns

- Single conduit caves
- Branchwork caves
- Tight maze caves
- Loose maze caves
- Three-dimensional mazes (Tiered Cave)
- High Gradient Caves

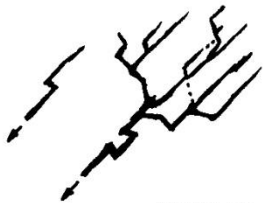

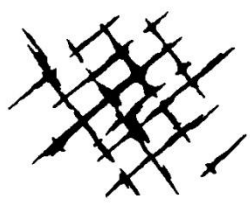
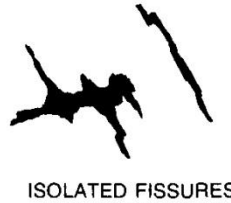



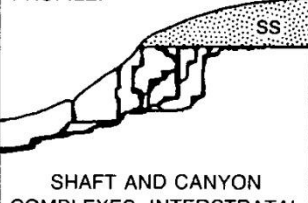


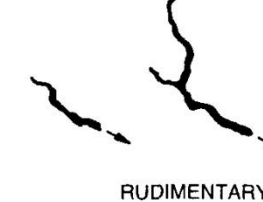

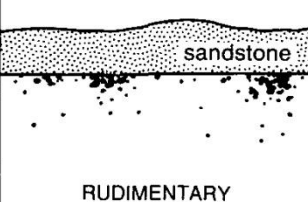


		TYPE OF RECHARGE				
		VIA KARST DEPRESSIONS		DIFFUSE		HYPOGENIC
		SINKHOLES (LIMITED DISCHARGE FLUCTUATION)	SINKING STREAMS (GREAT DISCHARGE FLUCTUATION)	THROUGH SANDSTONE	INTO POROUS SOLUBLE ROCK	DISSOLUTION BY ACIDS OF DEEP-SEATED SOURCE OR BY COOLING OF THERMAL WATER
		BRANCHWORKS (USUALLY SEVERAL LEVELS) & SINGLE PASSAGES	SINGLE PASSAGES AND CRUDE BRANCHWORKS, USUALLY WITH THE FOLLOWING FEATURES SUPERIMPOSED:	MOST CAVES ENLARGED FURTHER BY RECHARGE FROM OTHER SOURCES	MOST CAVES FORMED BY MIXING AT DEPTH	
DOMINANT TYPE OF POROSITY	FRACTURES	 ANGULAR PASSAGES	 FISSURES, IRREGULAR NETWORKS	 FISSURES, NETWORKS	 ISOLATED FISSURES AND RUDIMENTARY NETWORKS	 NETWORKS, SINGLE PASSAGES, FISSURES
	BEDDING PARTINGS	 CURVILINEAR PASSAGES	 ANASTOMOSES, ANASTOMOTIC MAZES	PROFILE:  SHAFT AND CANYON COMPLEXES, INTERSTRATAL SOLUTION	 SPONGEWORK	 RAMIFORM CAVES, RARE SINGLE-PASSAGE AND ANASTOMOTIC CAVES
	INTERGRANULAR	 RUDIMENTARY BRANCHWORKS	 SPONGEWORK	PROFILE:  RUDIMENTARY SPONGEWORK	 SPONGEWORK	 RAMIFORM & SPONGEWORK CAVES

Figure 25. Summary of cave patterns and their relationship to types of recharge and porosity. Maps are plan views unless otherwise noted and are generalized to represent typical caves in each category. Many exhibit rudimentary forms, multiple stages of development, or combinations of more than one type. Individual passages differ in specific layout according to the local physical setting.

Single conduit caves

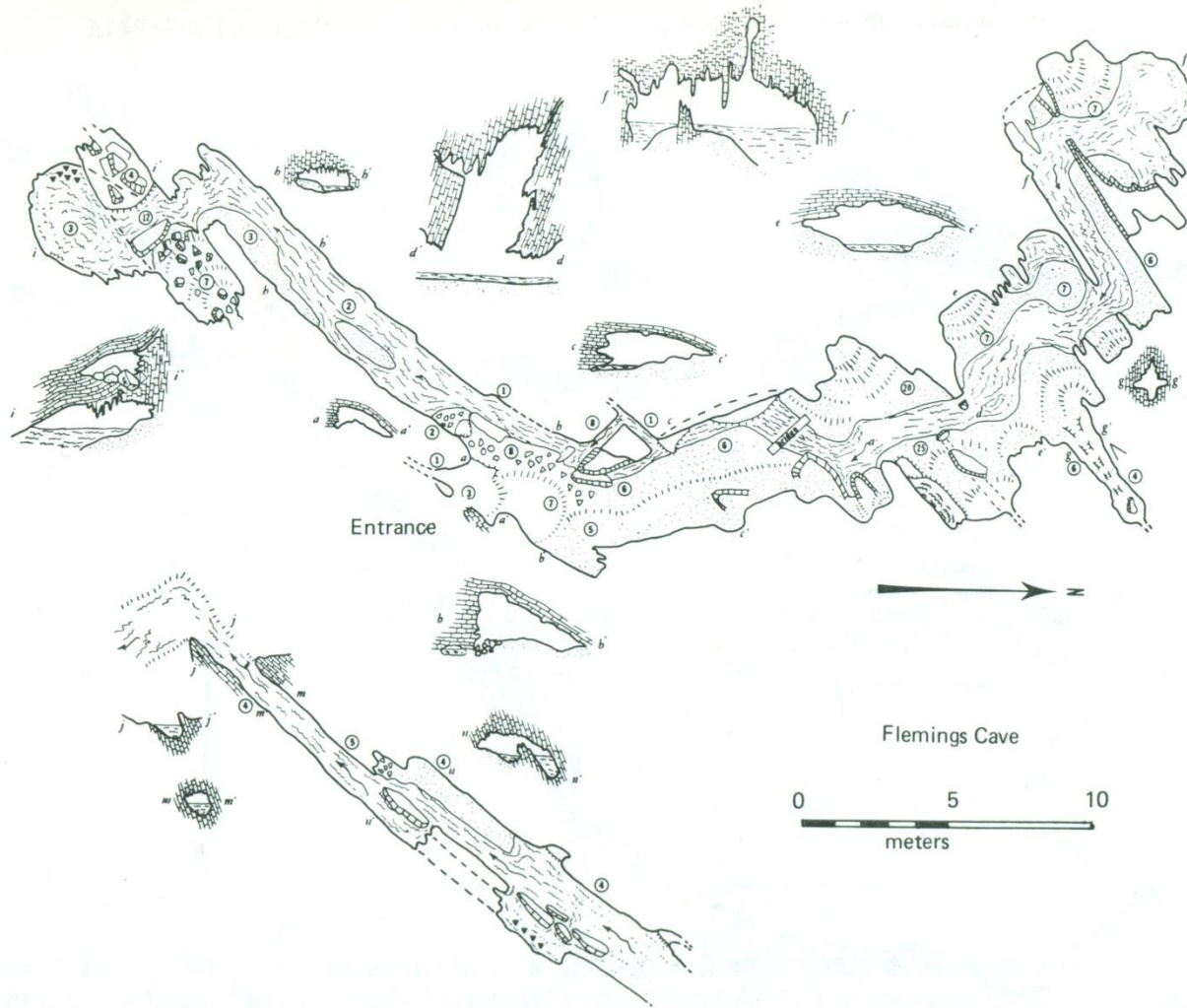


Figure 3.9 Fleming Cave, an example of an angulate cave in nearly vertical limestone. Fleming Cave is formed in Helderberg limestone in Huntingdon County, Pennsylvania. [Map prepared by B. L. Smeltzer.]

Single conduit caves

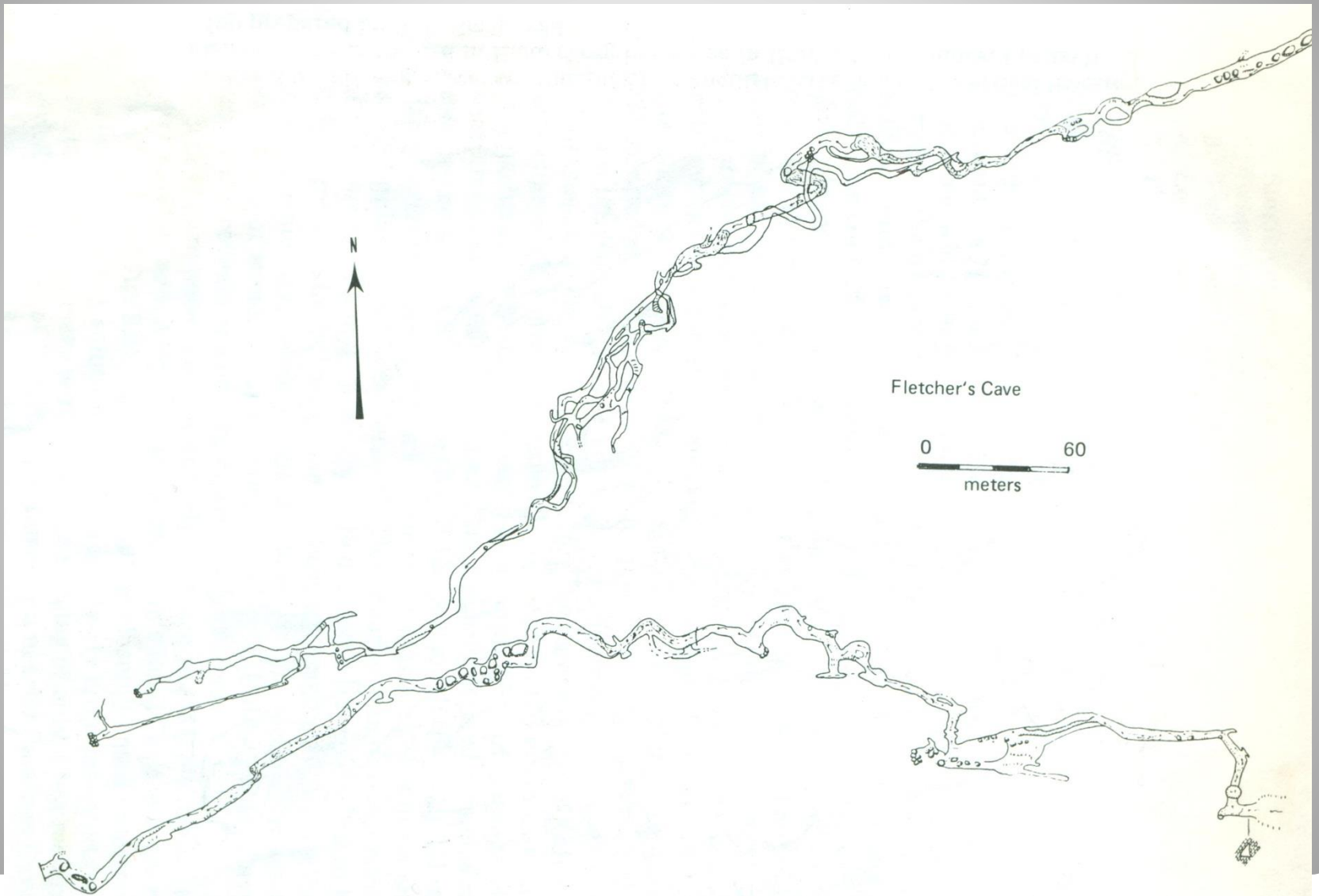


Figure 3.10 Fletcher Cave, an example of a sinuous, single-conduit cave. Fletcher Cave is formed in the Mississippian Greenbrier limestone in Monroe County, West Virginia. [Map adapted from Hempel (1975).]

Branchwork caves



Plan view of a
branchwork cave

Branchwork caves

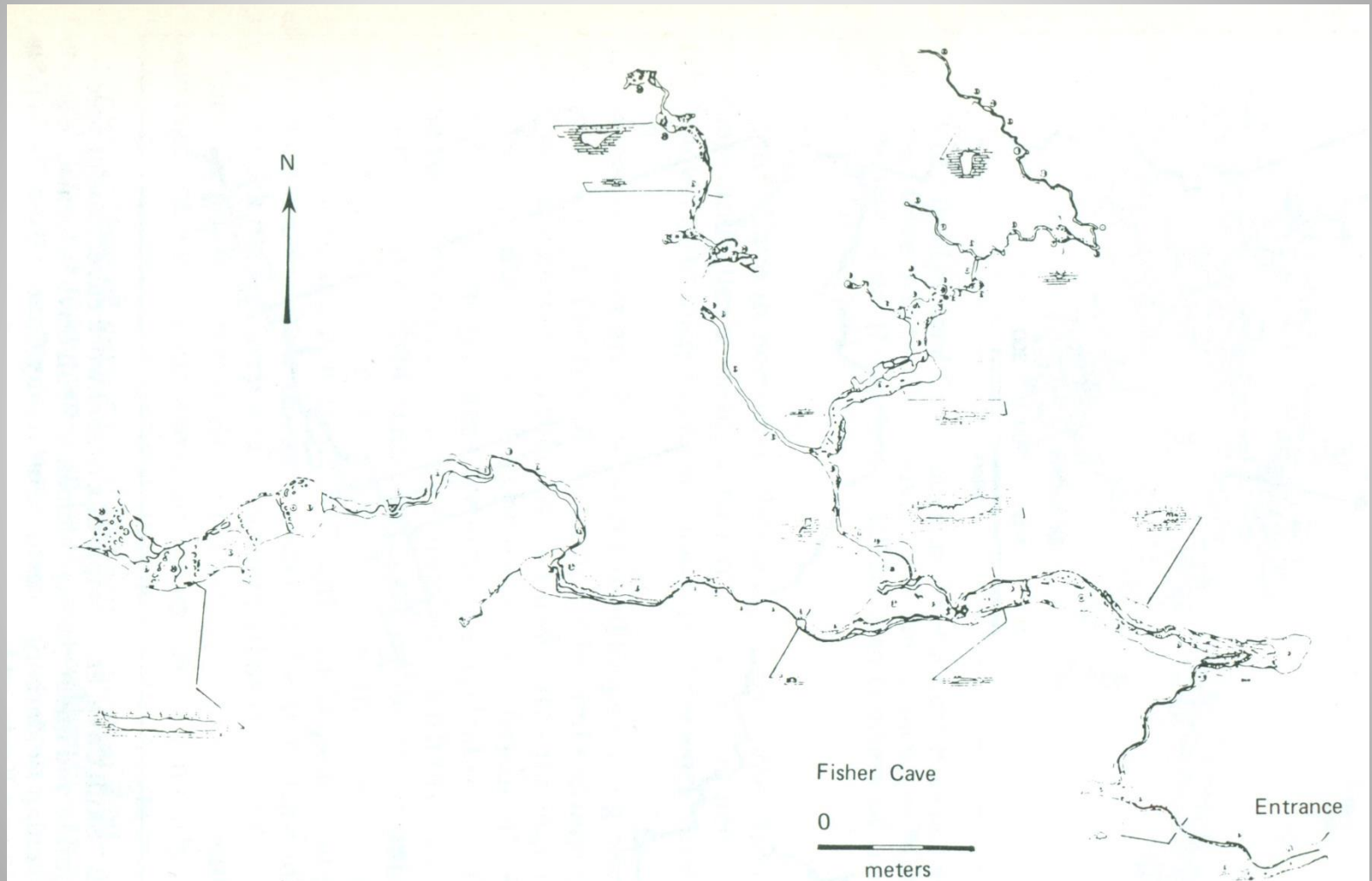


Figure 3.11 Fisher Cave, an example of a branchwork cave made of sinuous elliptical tubes. Fisher Cave is formed in the nearly horizontal Ordovician Gasconade dolomite in Franklin County, Missouri. [Map courtesy of the Missouri Speleological Survey.]

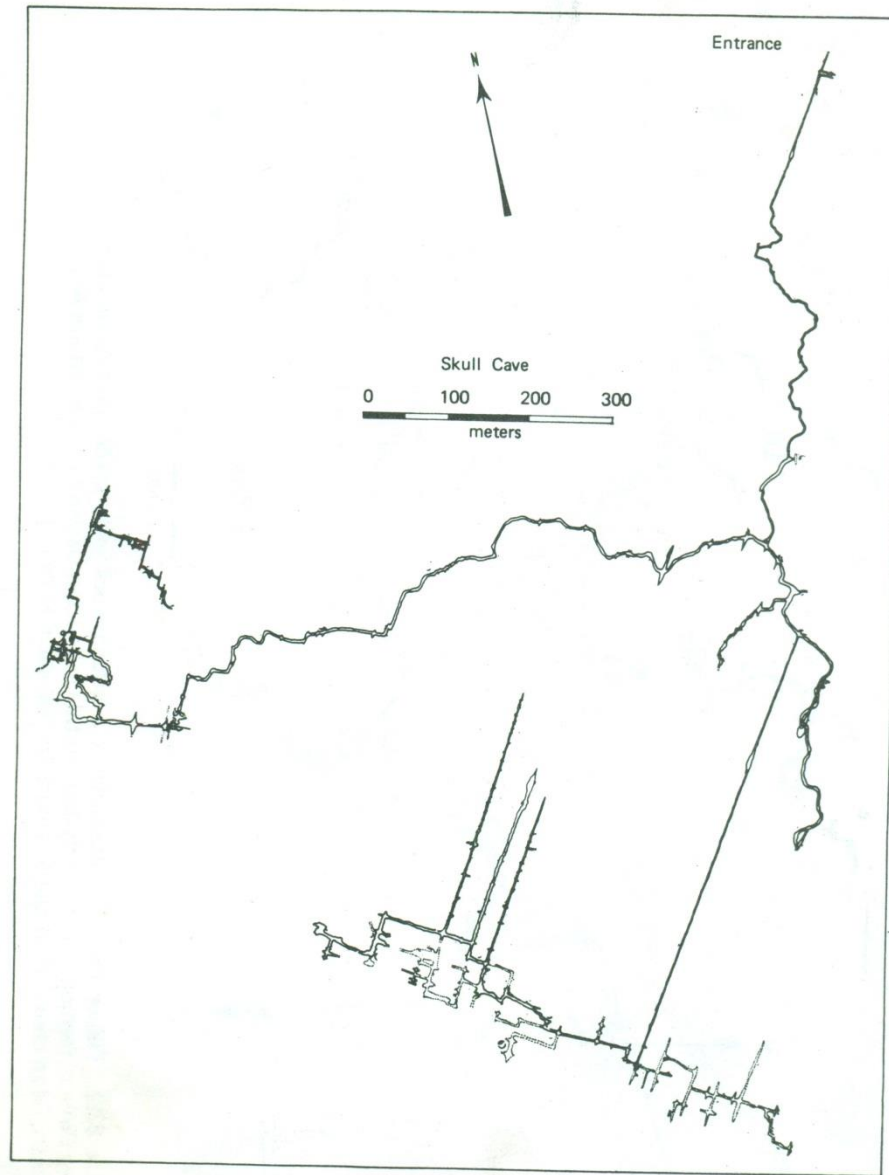


Figure 3.12 Skull Cave, an example of a branchwork cave made of predominantly angulate and linear passage elements. Skull Cave is formed in gently dipping Devonian Helderberg limestone, in Albany County, New York. [Map courtesy of Ernst Kastning.]

Tight maze caves

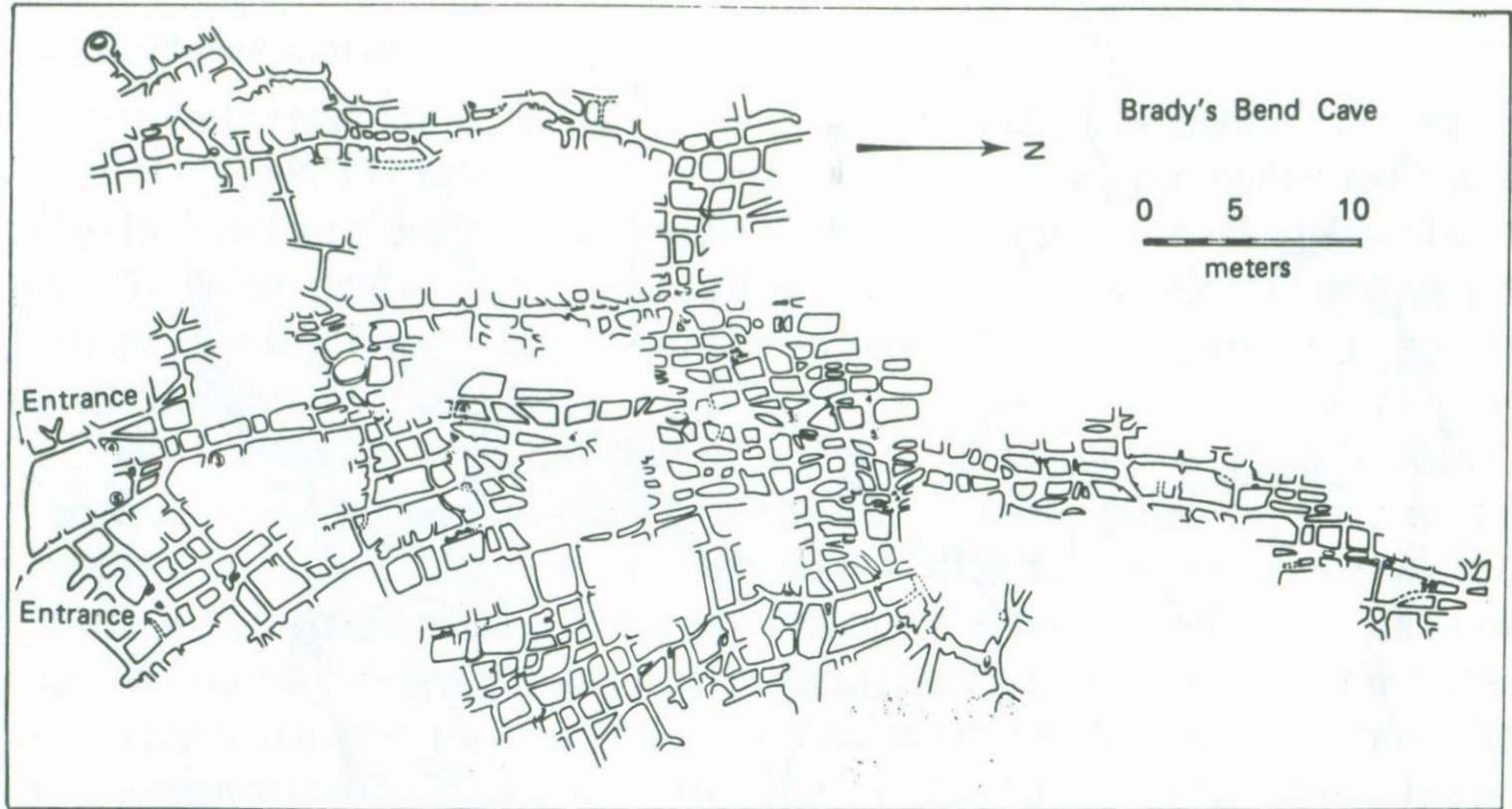


Figure 3.13 Bradys Bend Cave, an example of a tight network maze cave. Bradys Bend Cave is in the Pennsylvanian Vanport limestone in Armstrong County, Pennsylvania. [From White, 1976a. Map courtesy of the Pennsylvania Geological Survey.]

Loose maze caves

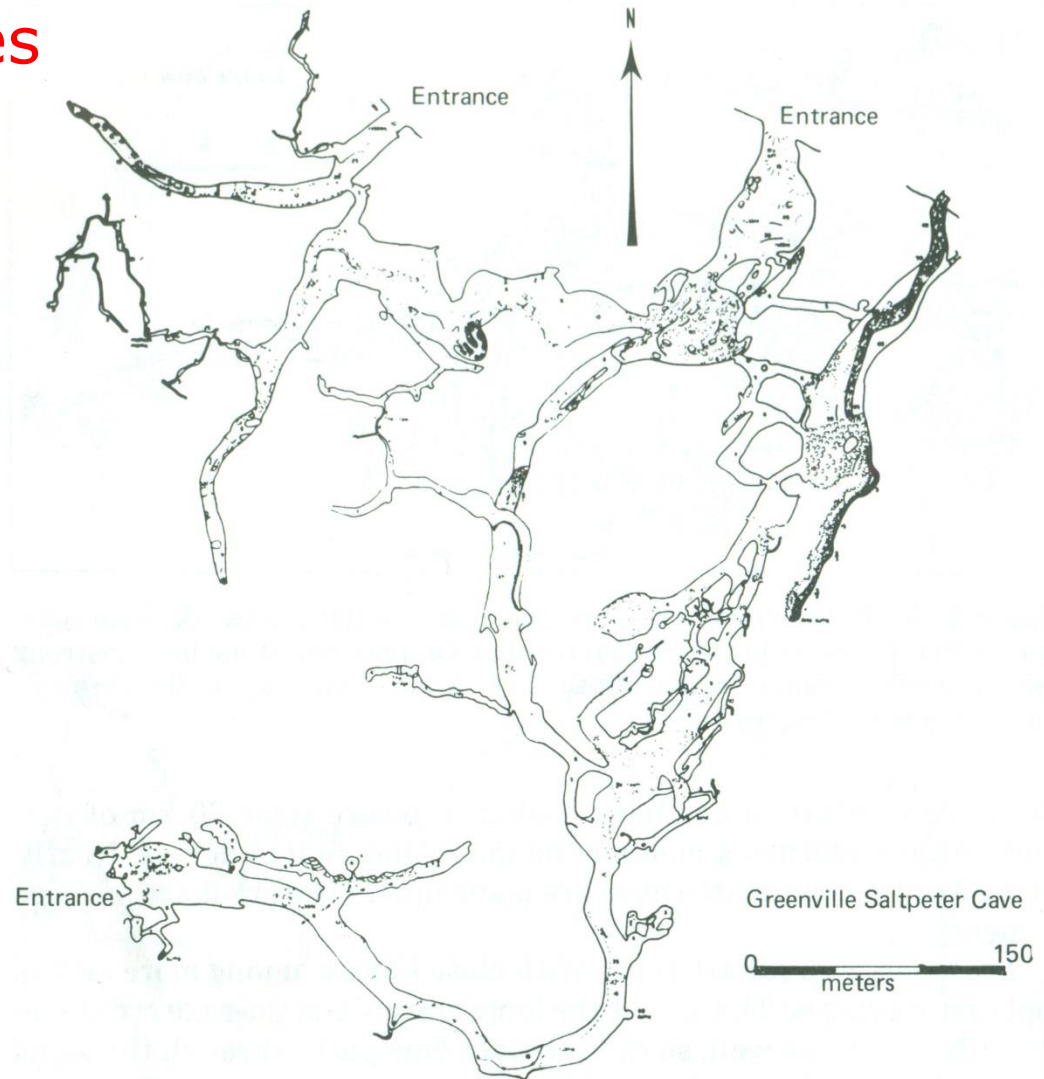


Figure 3.14 Greenville Saltpetre Cave, an example of a loose maze cave. Most cave development is along bedding planes, and most of the passages are elliptical tubes. Greenville Saltpetre Cave is formed in the Mississippian Greenbrier limestone in Monroe County, West Virginia. [From Hempel (1975).]

High Gradient Caves

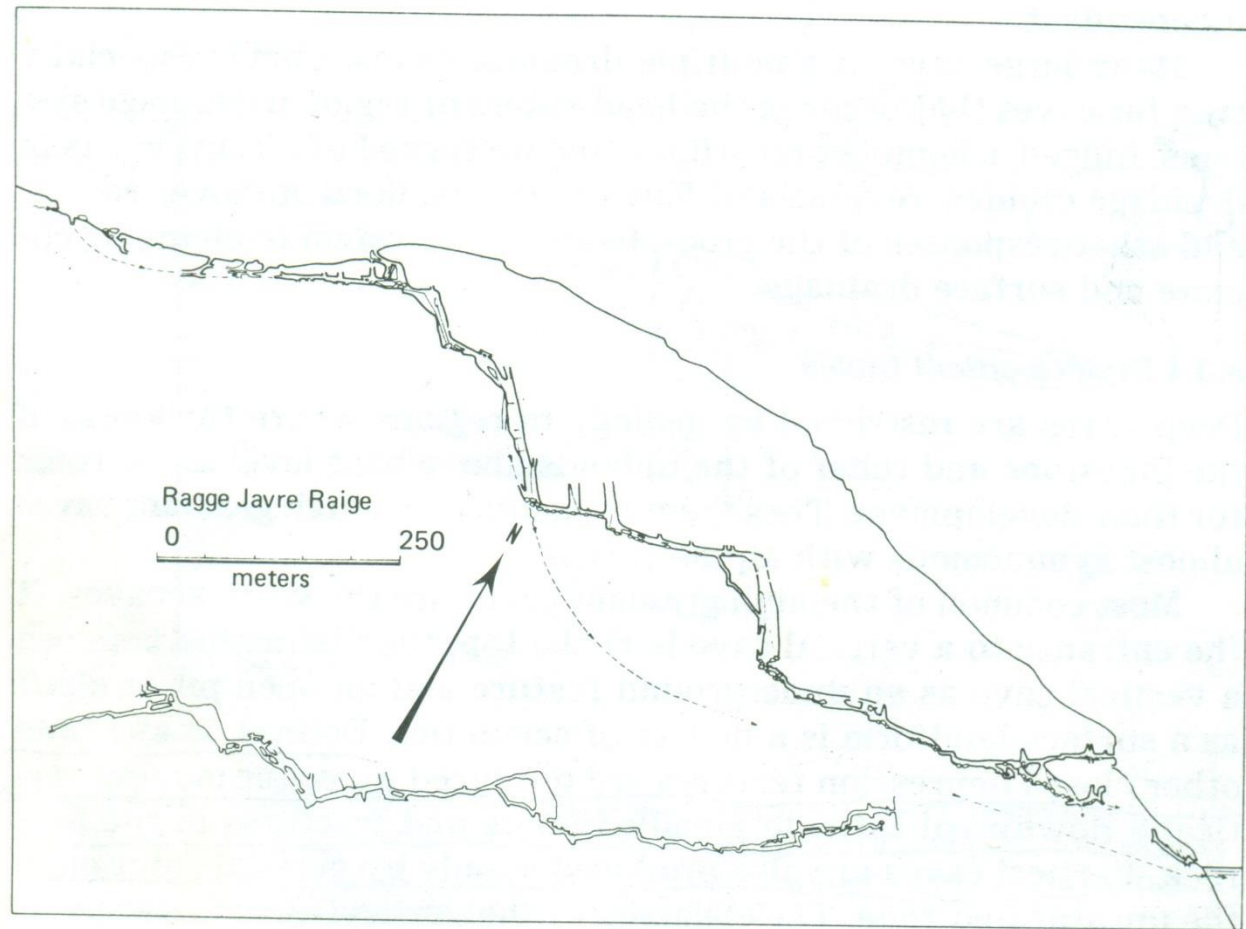


Figure 3.16 Profile of Ragge Javre Raige Cave in Norway, showing relation of stair-step profile of the cave to the slope of the land surface. [Adapted from Courbon (1972).]

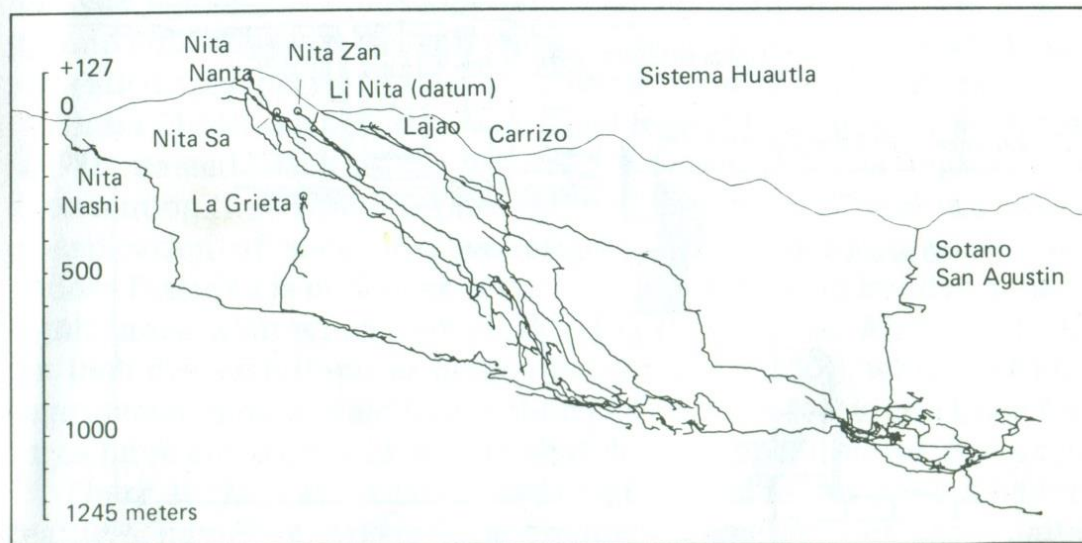
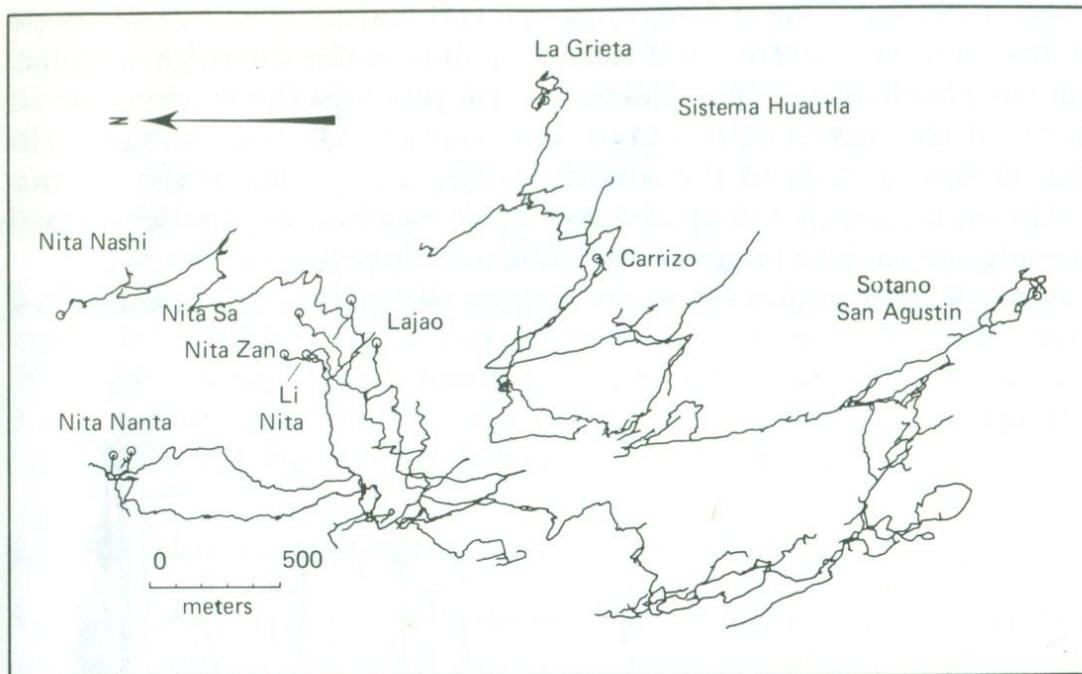


Figure 3.17 Plan and profile of the Sistema Huautla, Oxaca, Mexico. The names on the map are those of the various entrances to the system. [Courtesy of the Association for Mexican Cave Studies.]

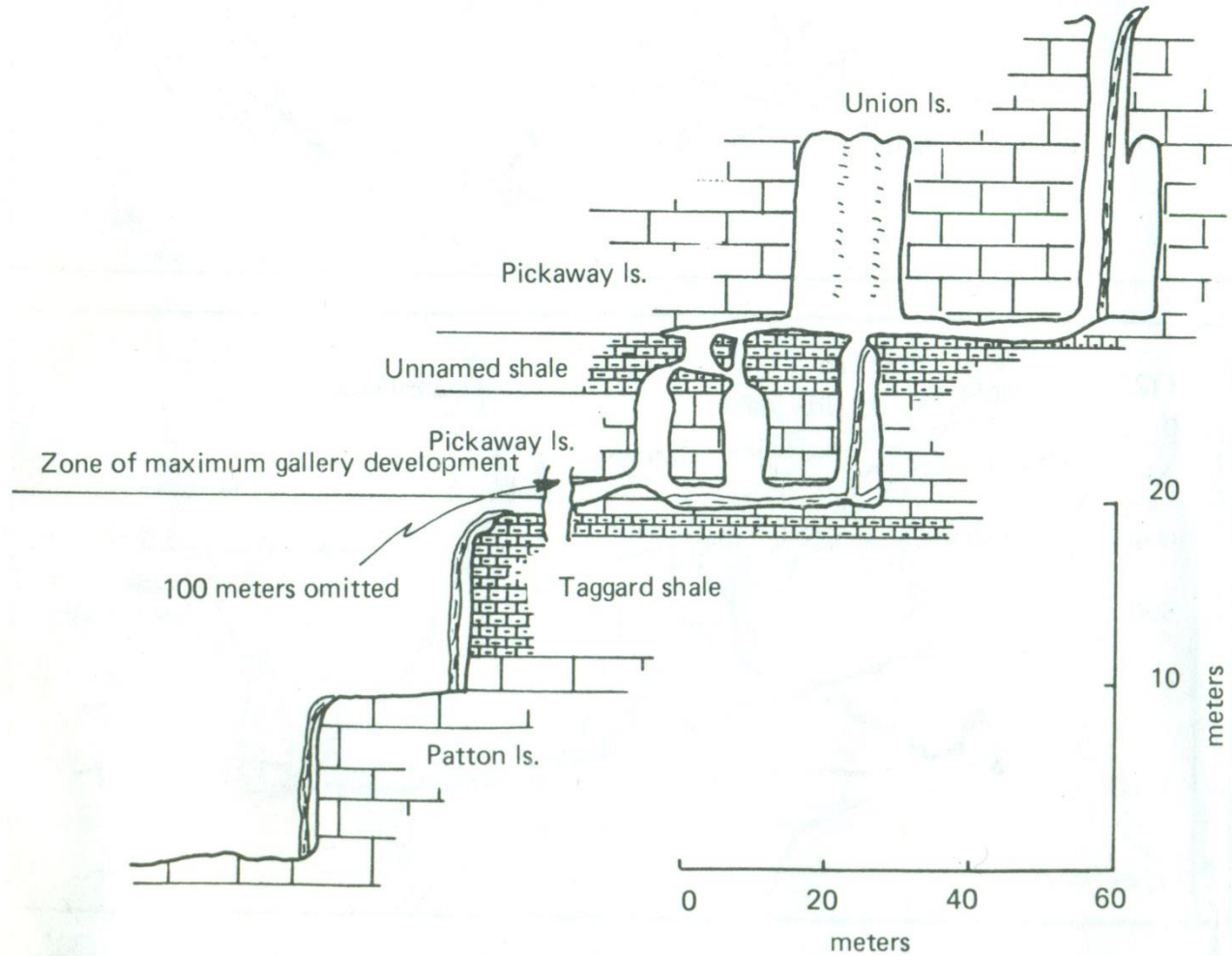


Figure 3.18 Profile of the Swago Pit section of the Swago-Carpenters Cave System, Pocohantas County, West Virginia, showing stair-step profile.

Solutional Sculpturing:

1. Channel Features

2. Hydraulic Features

3. Etched Features

***4. Residual Features
(Peteromorphs)***

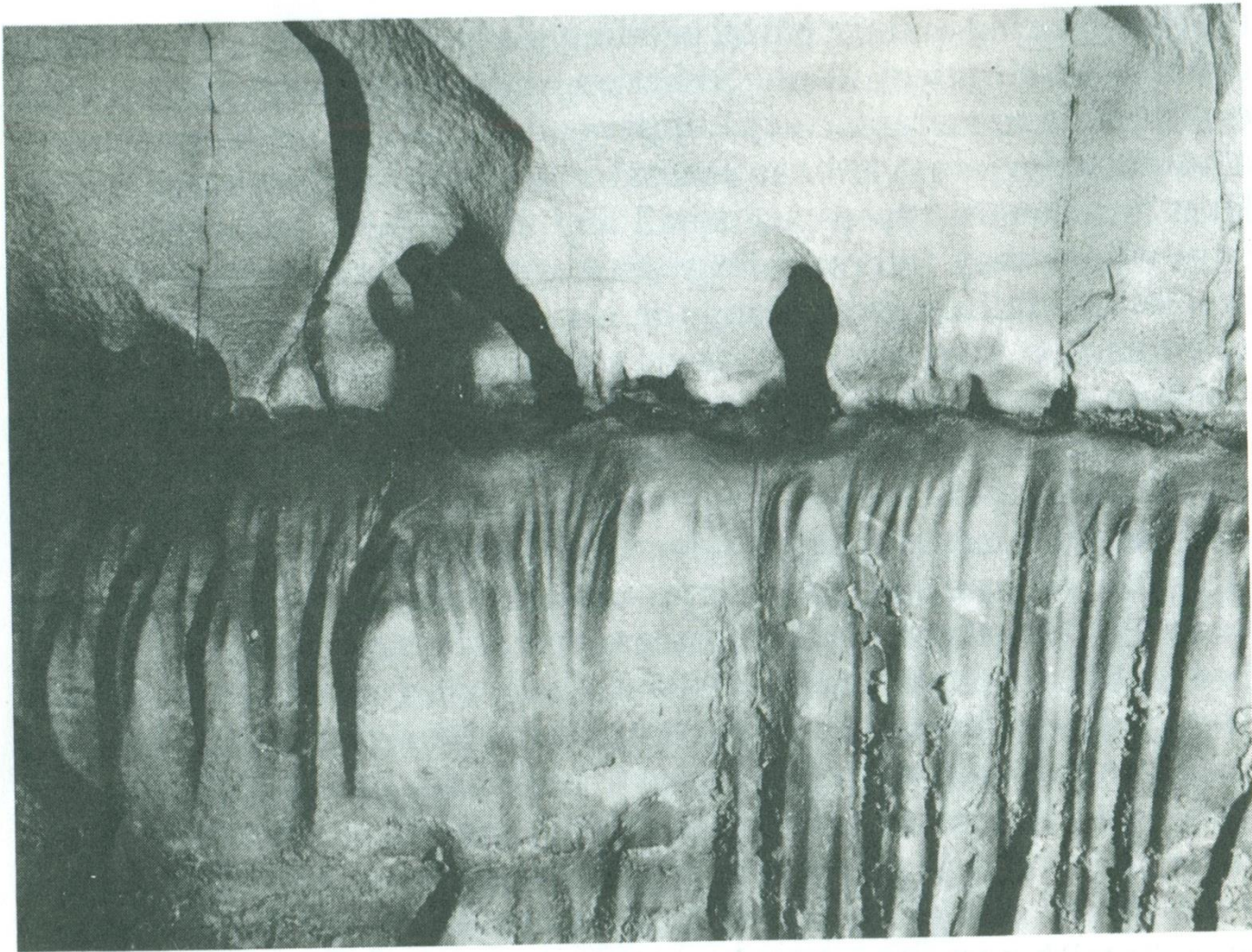


Figure 3.19 Vertical rills in relation to small anastomosis channels. The photograph was taken in Fossil Avenue in the New Discovery section of Mammoth Cave, Kentucky.



Figure 3.20 Pendants resulting from exposure of closely spaced anastomosis channels by breakdown along the bedding planes containing the channels. Rickwood Caverns, Blount County, Alabama. [Courtesy of Barry F. Beck.]

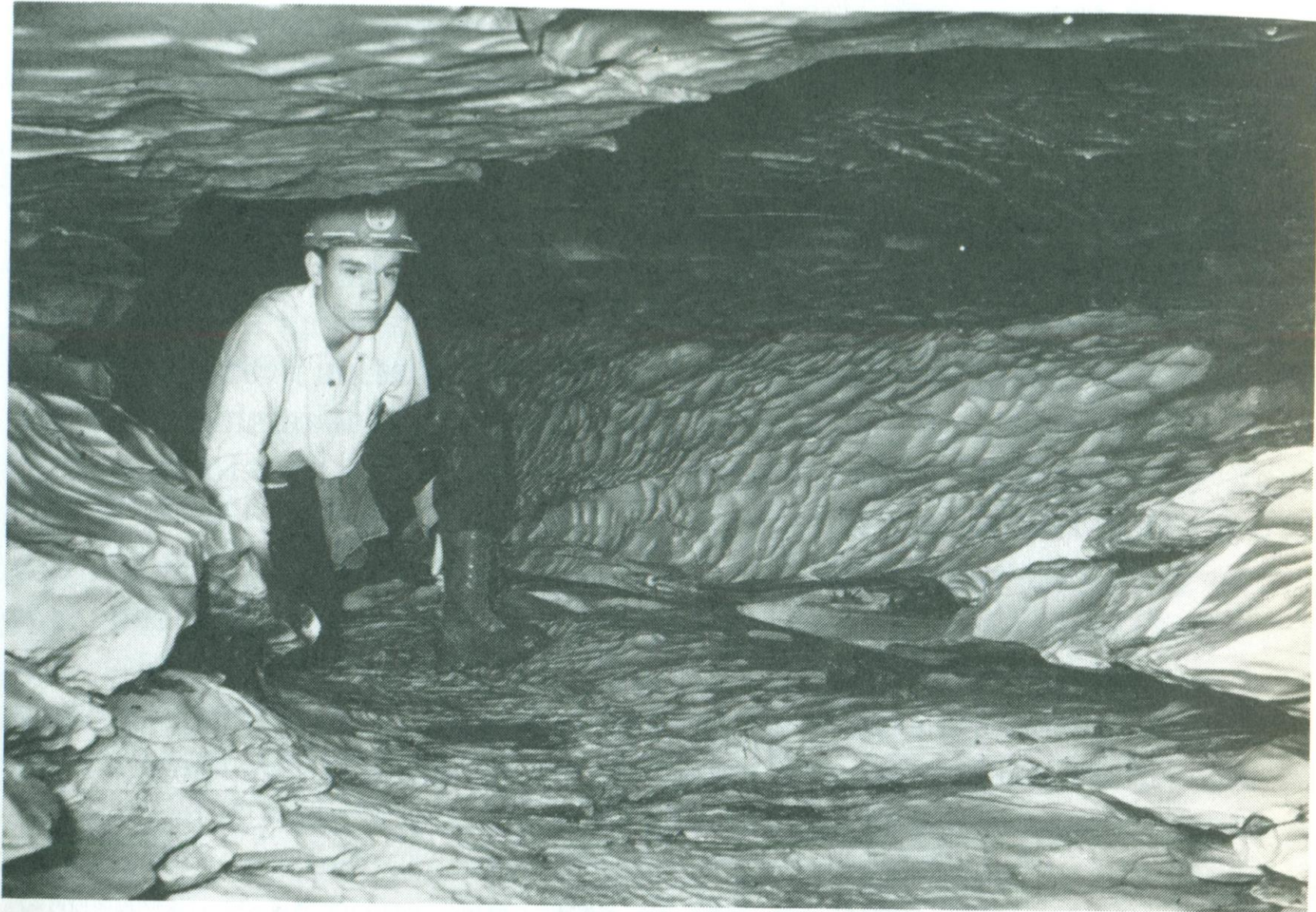


Figure 3.22 Small scallops on walls, floor, and ceiling of a well-scoured flood overflow passage in Horn Hollow Cave, in Carter Cave State Park, Kentucky.

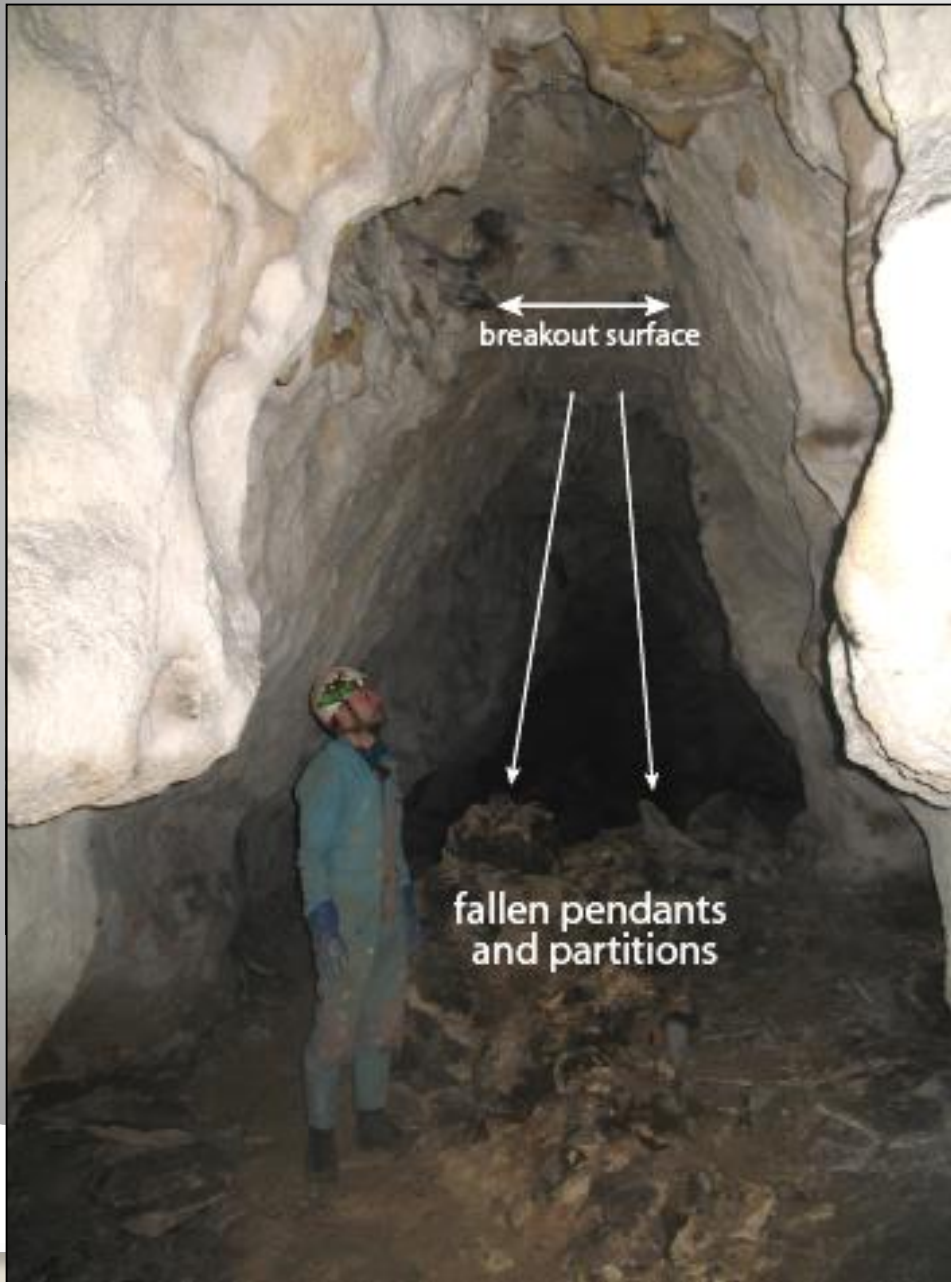
Tavrskaya Cave: Meso-forms: Feeders & rising wall channels



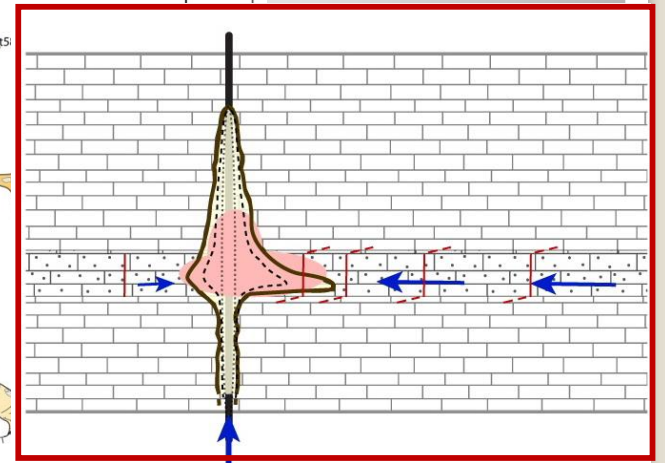
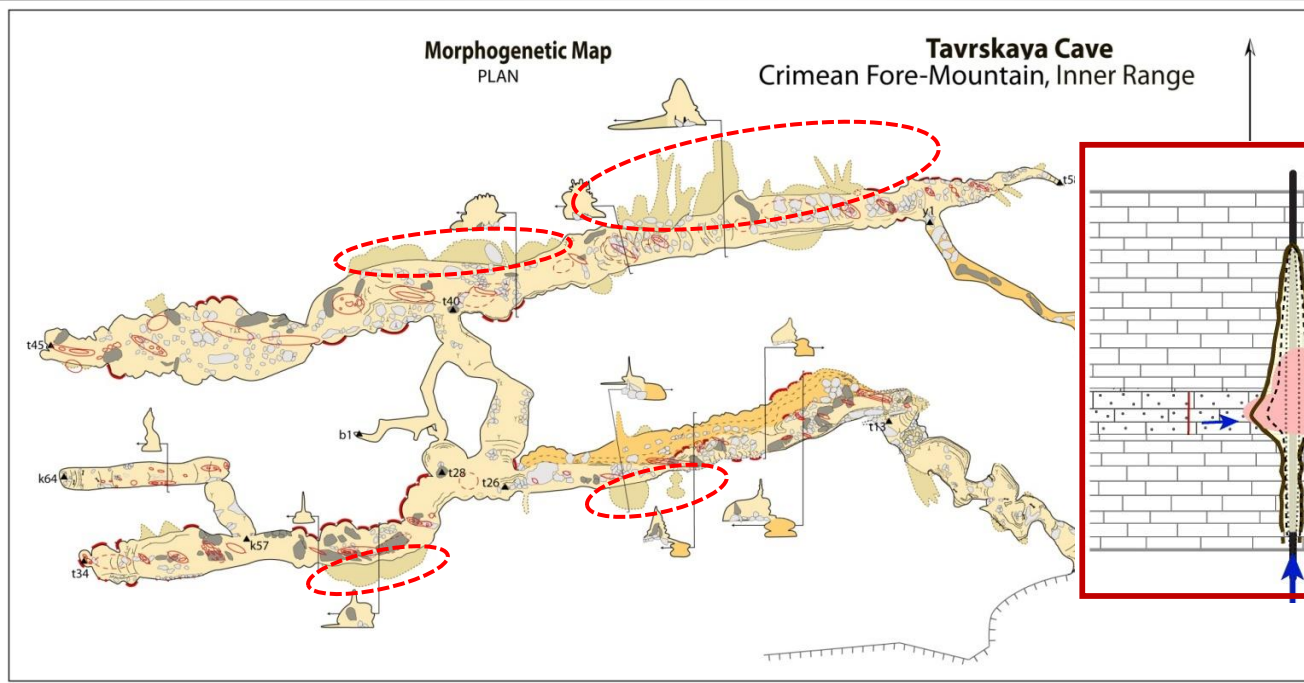
Tavrskaya Cave: Meso-forms: Cupolas & bell holes



Tavrskaya Cave: Meso-forms: Pendants & partitions



Tavrskaya Cave: Meso-forms: Side niches and conduits



رسوب شناسی غار
غار نهشته ها
کانی های تشکیل دهنده رسوبات ثانویه

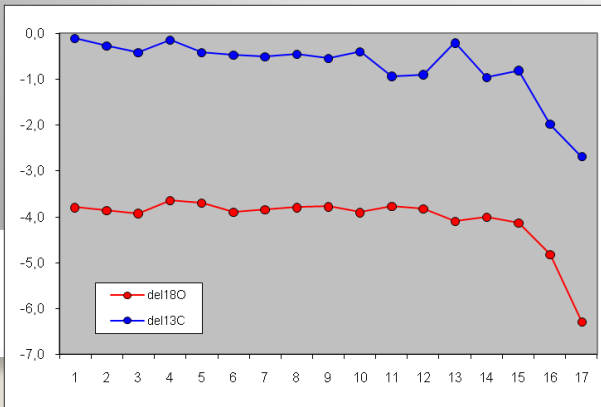
Tavrskaya Cave: Mineralogical evidence of hypogene speleogenesis



Phreatic calcite crust



Stibnite



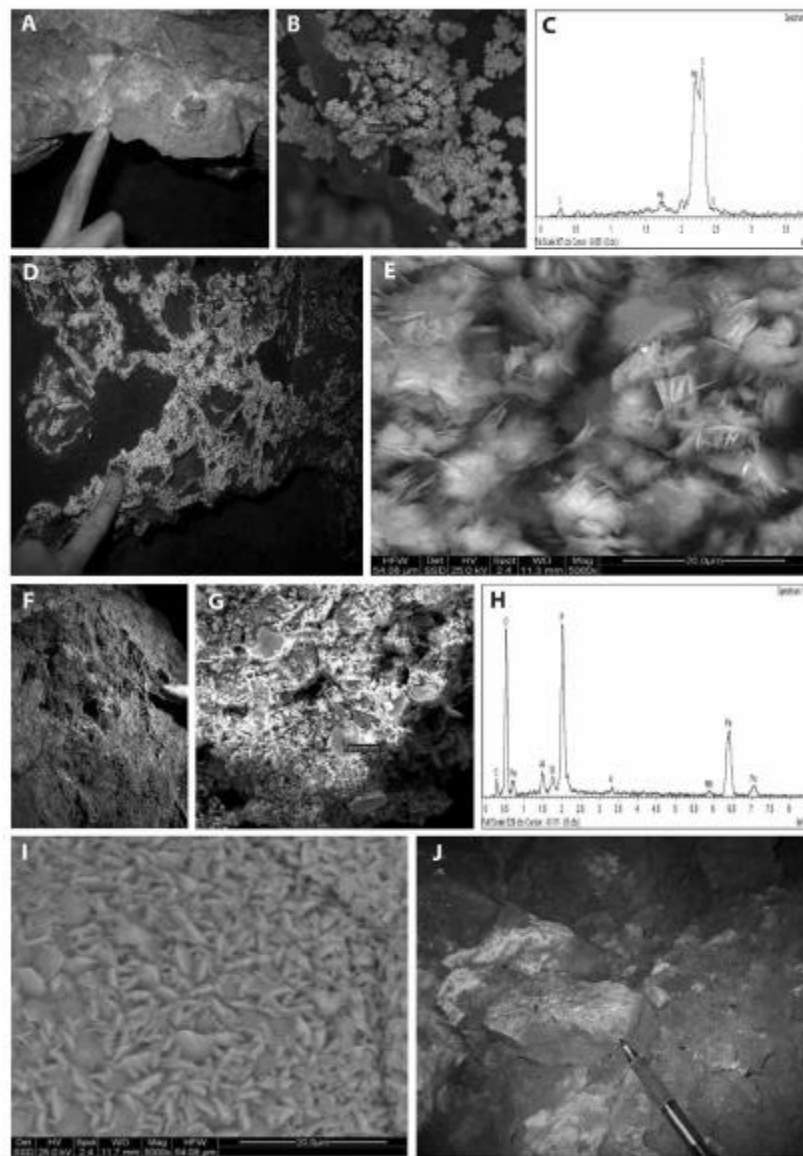


Figure 4. *In situ* pictures, electron microscope images and diffractograms of some minerals from Corona 'e Sa Craba Cave: A-B-C. Cinabar; D-E. Basaluminite; F-G-H. Spheniscidite; I. Lizardite; J. Alunite.

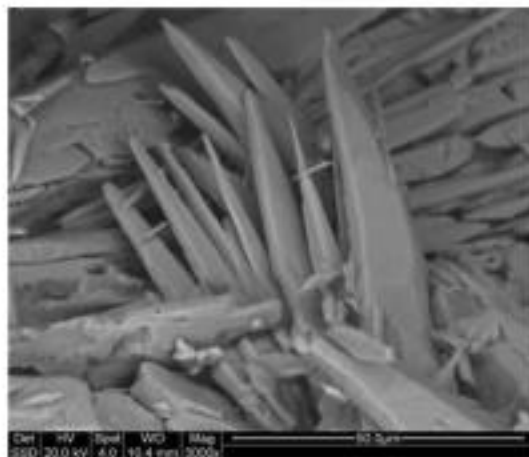


Figure 3B. A group of strontianite crystals.

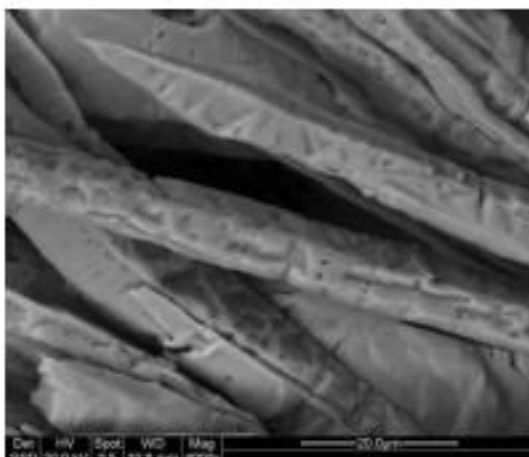


Figure 3D. The hopper-like surfaces of the strontianite crystals.

3. How and when may strontianite develop as a cave mineral?

The presence of the cation Sr^{2+} in waters circulating in the

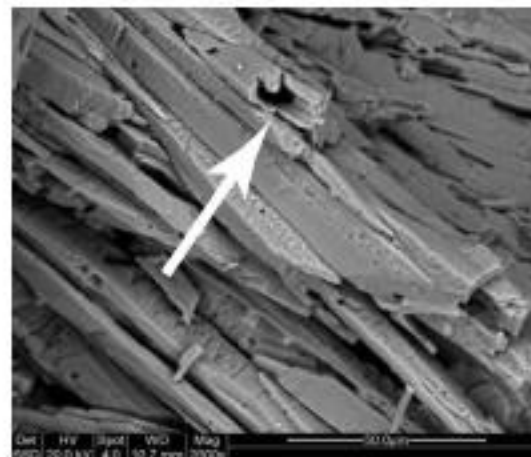
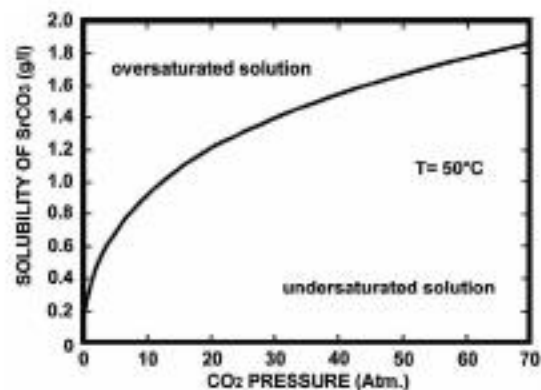


Figure 3C. A hollow crystal of strontianite.

is strongly related to the presence of CO_2 according to the well-known equation:



So in waters in contact with the atmosphere (with a partial pressure of CO_2 of around 350×10^{-6} atm), the solubility of strontianite reaches around 0.011 g L^{-1} , only about ten times less than that of celestine (0.13 g L^{-1}) (Fig. 4).



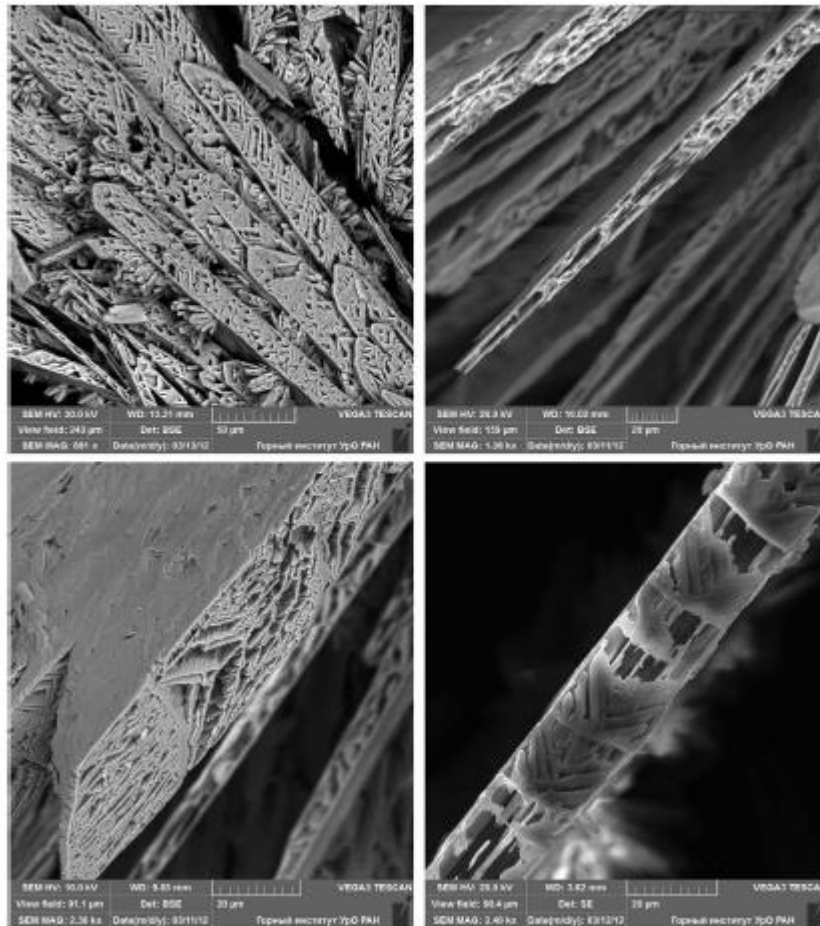
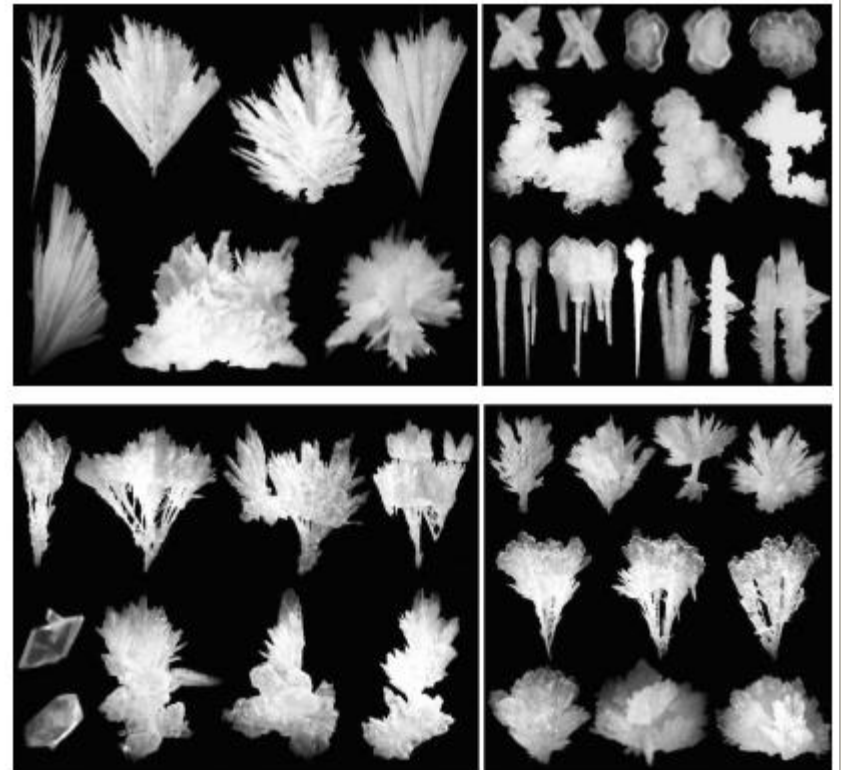


Figure 4. The internal skeleton structure of crystals caused by the presence of partitions oriented parallel to the faces.



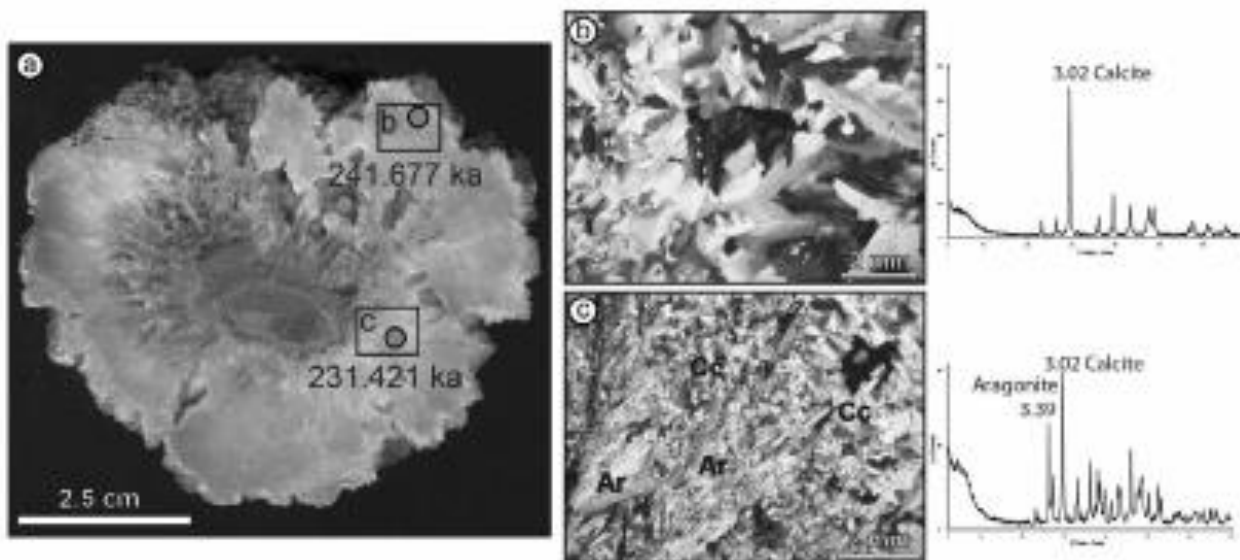
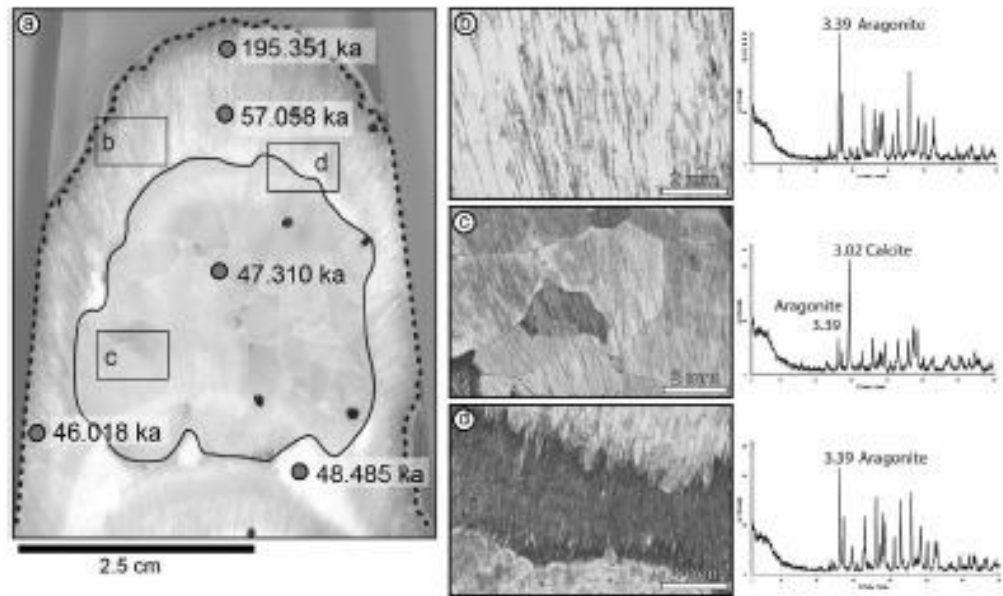


Figure 3 a) Polished hand sample. The dating points (grey) and the ages are indicated. b) Microphotography of the calcite crystals.

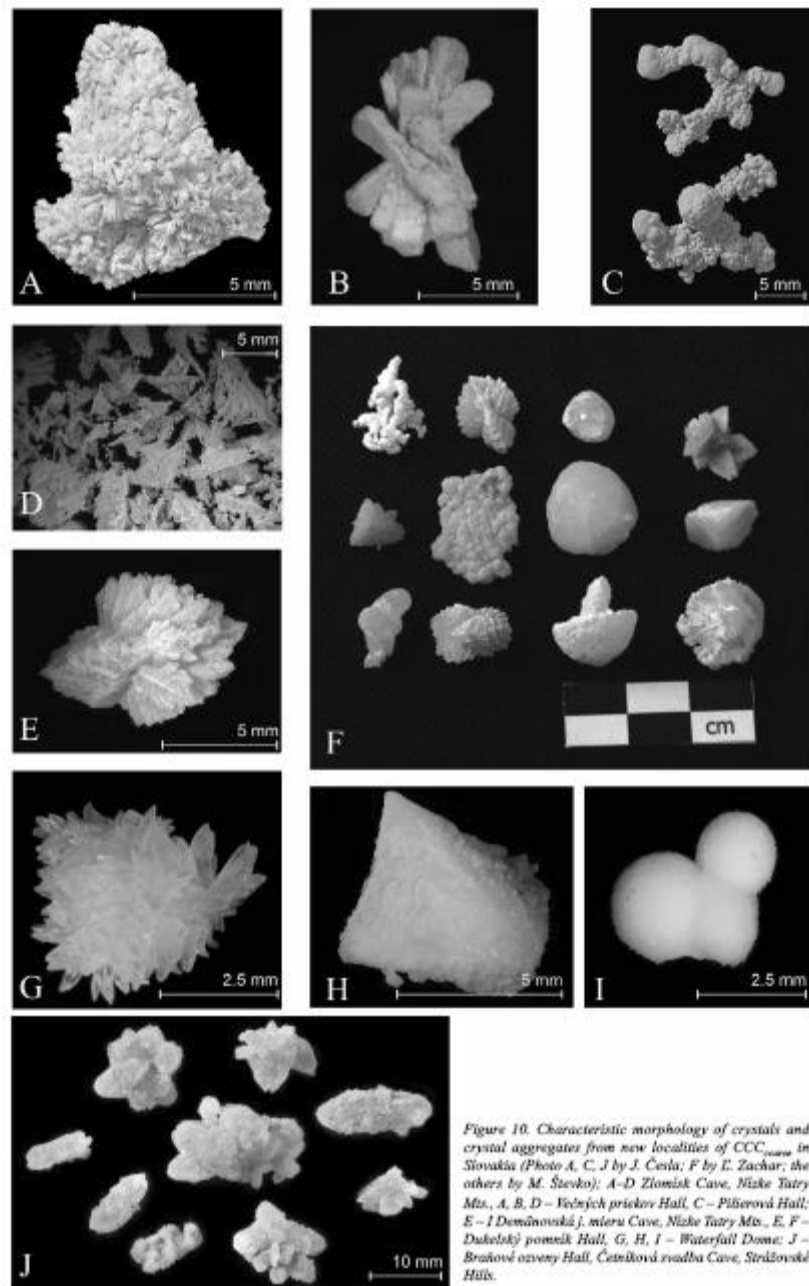


Figure 10. Characteristic morphology of crystals and crystal aggregates from new localities of CCC_{cave} in Slovakia (Photo A, C, J by J. Česla; F by E. Zachar; the others by M. Števo): A-D Zlomisk Cave, Nízke Tatry Mts., A, B, D – Večých priskov Hall, C – Plišerová Hall; E – Demänovská j. miera Cave, Nízke Tatry Mts., E, F – Dukelský pomník Hall, G, H, I – Waterfall Dome; J – Braňovské osveny Hall, Četníkova zvalba Cave, Strážovské Hory.

آب شناسی

بررسی منابع آب پیرامون غار
نمونه گیری از آب، انجام آنالیز های شیمیایی و
میکروبیولوژی و انجام تحلیلی های مربوطه
تهیه مدل هیدروژئولوژیکی

میکروپالئونتولوژی و پالئوکلیماتولوژی
انجام نمونه گیری ها ، تعیین سن و تحلیل های مربوطه

Field/Laboratory Work



JeG-stm-1



Replica of JeG-stm1



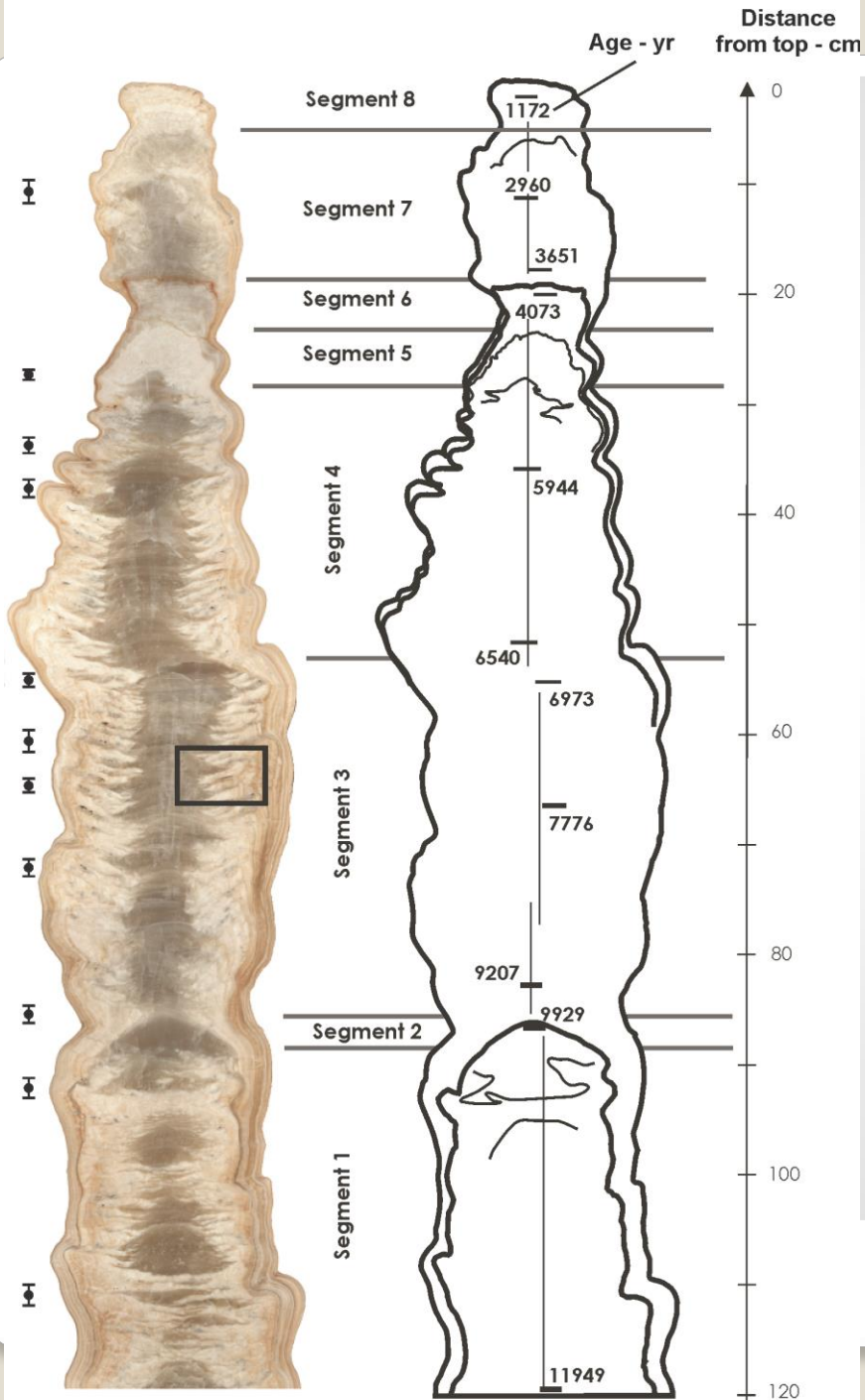
**Polishing the stalagmite
cut-face**

Petrography and Dating

- Regular deposition of dense calcite, dark grey to light yellow-beige
- Regular lamination (<0.2mm) generally visible at the sides of the speleothem – in the centre gray translucent dense calcite.
- Diameter: variable/ thickened in its middle part (max. 18cm)
- Shape: dish-stacks / candle-shape



wing-patterns: abundant fluid inclusions, and clear discontinuous layering



U/Th Dating

U-series dating results of JeG-stm-1 stalagmite (Jeita cave)

Sample number	^{238}U (ppb)	^{232}Th (ppt)	$^{230}\text{Th}/^{232}\text{Th}$ (atomic $\times 10^{-6}$)	$\delta^{234}\text{U}^{\text{a}}$ (measured)	$^{230}\text{Th}/^{238}\text{U}$ (activity)	^{230}Th age (yr) (uncorrected)	^{230}Th age (yr) ^b (corrected) ^b	$\delta^{234}\text{U}_{\text{Initial}}^{\text{c}}$ (corrected)
J1	158.9±0.3	265±7	1065±28	31.4±1.8	0.1074±0.0008	11996±98	11949±101	32.4±1.8
J2	158.5±0.3	160±7	1471±69	29.0±1.9	0.0897131±0.00081	9957±96	9929±97	29.8±2.0
J3	172.6±0.3	117±7	2033±131	29.2±1.8	0.0834±0.0007	9226±84	9207±85	30.0±1.9
J4	148.5±0.2	126±7	1387±79	30.2±1.8	0.0710±0.0007	7800±82	7776±83	30.9±1.9
J5	171.4±0.3	157±8	1150±60	25.2±1.8	0.0636687±0.00058	6999±67	6973±68	25.7±1.8
J6	146.7±0.3	82±8	1763±173	28.3±1.9	0.0599±0.0009	6556±105	6540±106	28.8±2.0
J7	183.1±0.3	168±7	981±43	23.3±1.7	0.0545±0.0005	5970±61	5944±63	23.7±1.8
J8	126.2±0.2	410±8	194±5	23.5±2.0	0.0383±0.0007	4165±73	4073±86	23.7±2.0
J9	114.6±0.2	352±8	185±5	23.9±1.9	0.0345±0.0006	3738±62	3651±76	24.2±1.9
J10	129.0±0.2	146±7	402±21	19.9±1.9	0.0276±0.0004	2992±47	2960±50	20.0±1.9
J11	177.9±0.3	1323±9	28±1	18.6±1.8	0.0128±0.0003	1384±37	1172±113	18.7±1.8

^{230}Th dating results. The error is 2σ .

$\lambda_{230} = 9.1577 \times 10^{-6} \text{ y}^{-1}$, $\lambda_{234} = 2.8263 \times 10^{-6} \text{ y}^{-1}$, $\lambda_{238} = 1.55125 \times 10^{-10} \text{ y}^{-1}$.

Corrected ^{230}Th ages assume the initial $^{230}\text{Th}/^{232}\text{Th}$ atomic ratio of $4.4 \pm 2.2 \times 10^{-6}$. Those are the values for a material at secular equilibrium, with the bulk earth

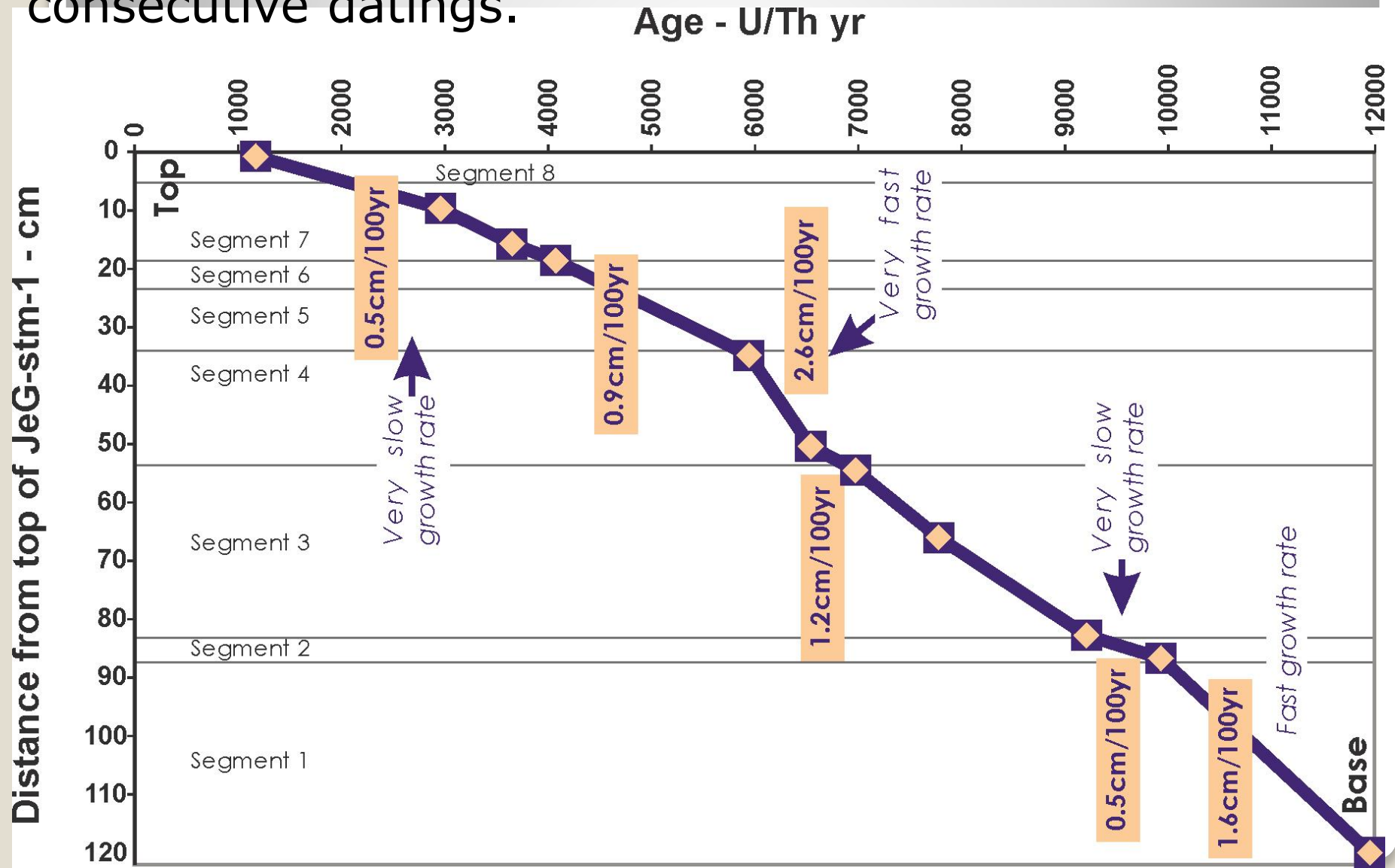
$^{232}\text{Th}/^{238}\text{U}$ value of 3.8. The errors are arbitrarily assumed to be 50%.

^a $^{234}\text{U} = ([^{234}\text{U}/^{238}\text{U}]_{\text{activity}} - 1) \times 1000$.

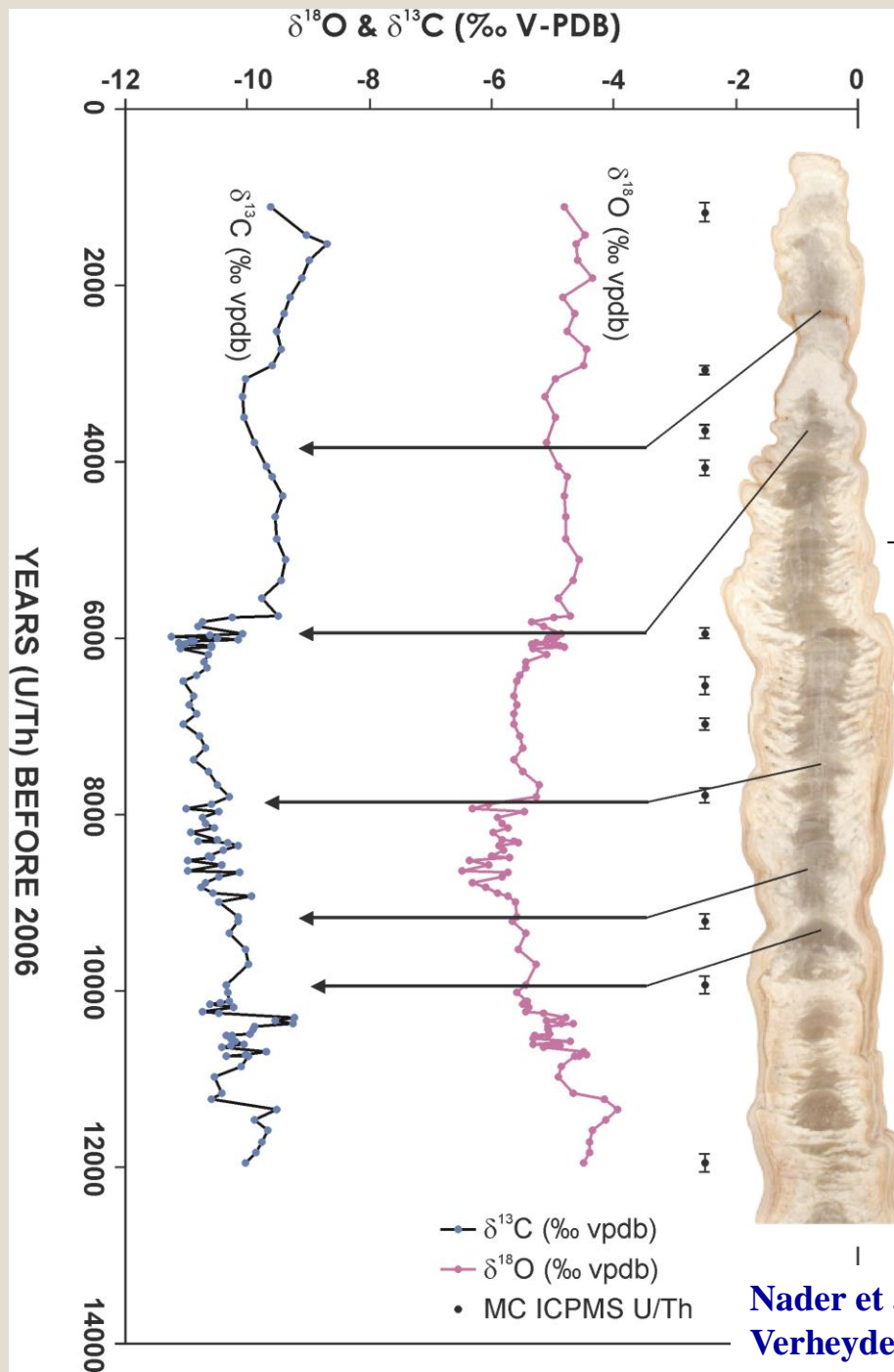
^b Ages are relative to 2006 (or year before 2006).

^c $\delta^{234}\text{U}_{\text{initial}}$ was calculated based on ^{230}Th age (T), i.e., $\delta^{234}\text{U}_{\text{initial}} = \delta^{234}\text{U}_{\text{measured}} \times e^{1234 \times T}$.

Growth rate of JeG-Stm-1 with respect to distance (in cm) from top - assuming linear growth rates between consecutive datings.



Oxygen and Carbon Stable Isotope Analyses



5 Ka represents the time when the major Phoenician Cities were built. (cutting of Cedar trees, ...)

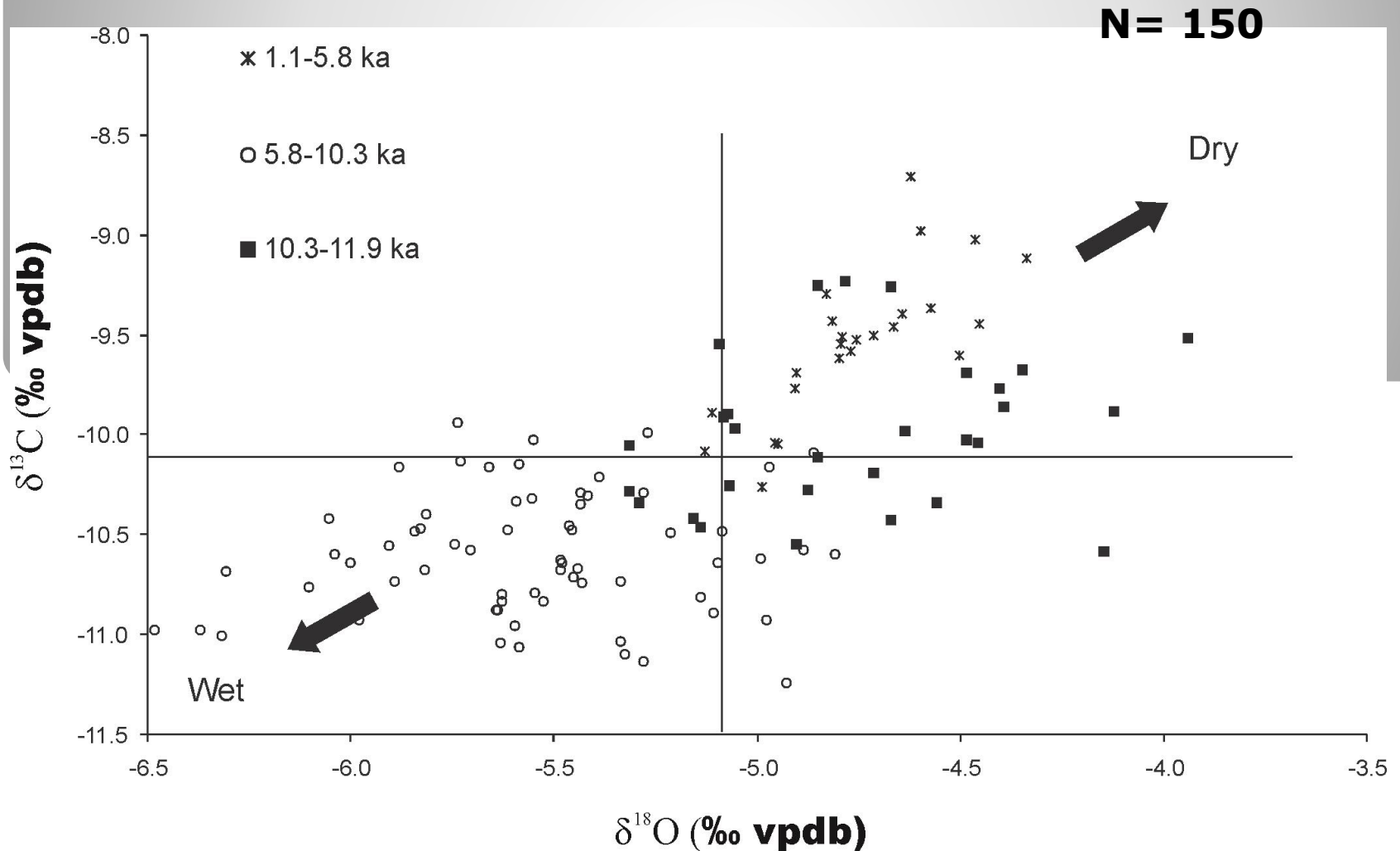
THREE main intervals:
Top: 1.1 – 5.8 ka
Middle: 5.8 – 10.3 ka
Base: 10.3 – 11.9 ka

End of Last Ice Age

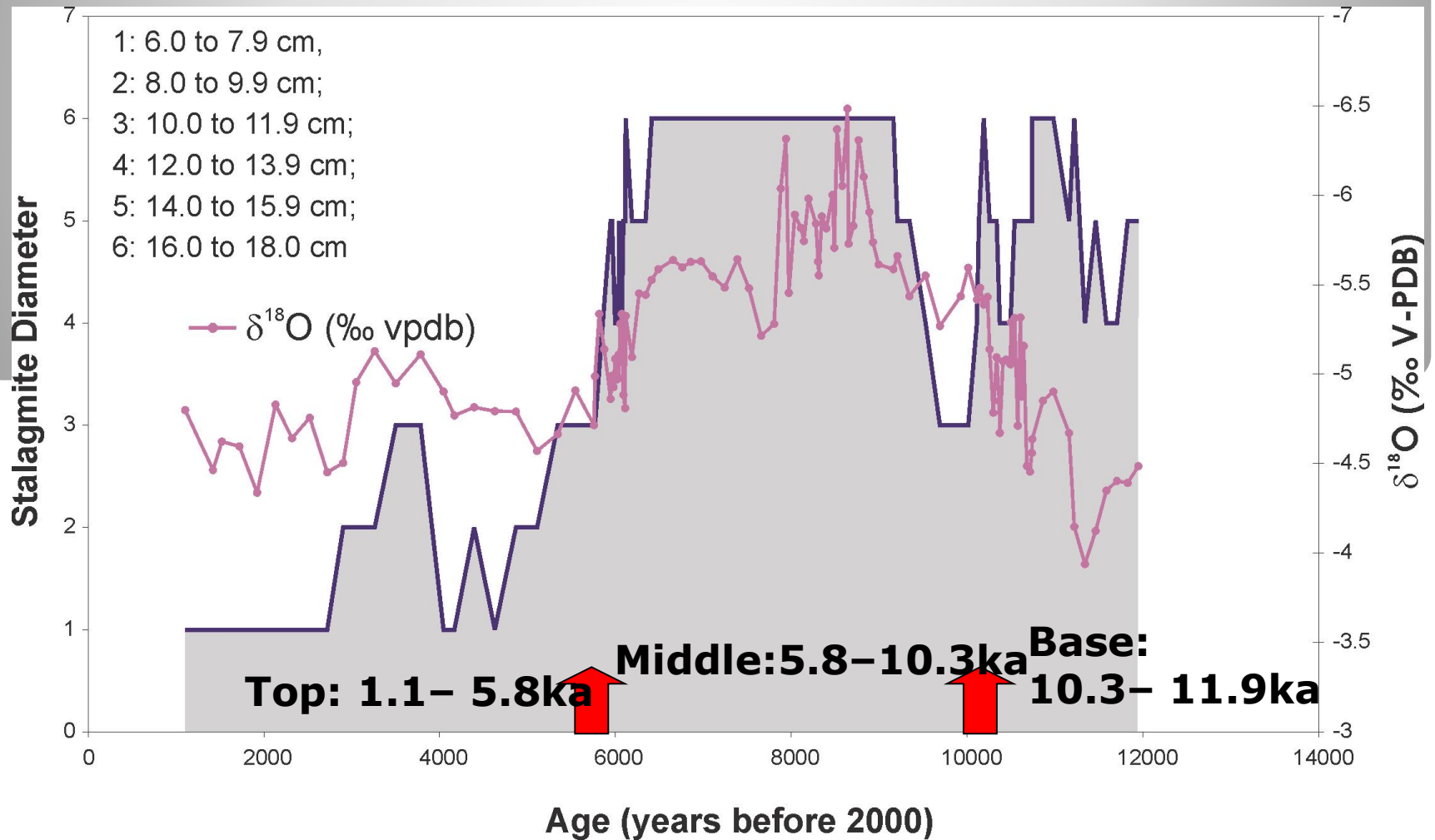
Nader et al. (2007) -LJS

Verheyden et al. (2008) - Quaternary Res.

Oxygen and Carbon Stable Isotope Analyses



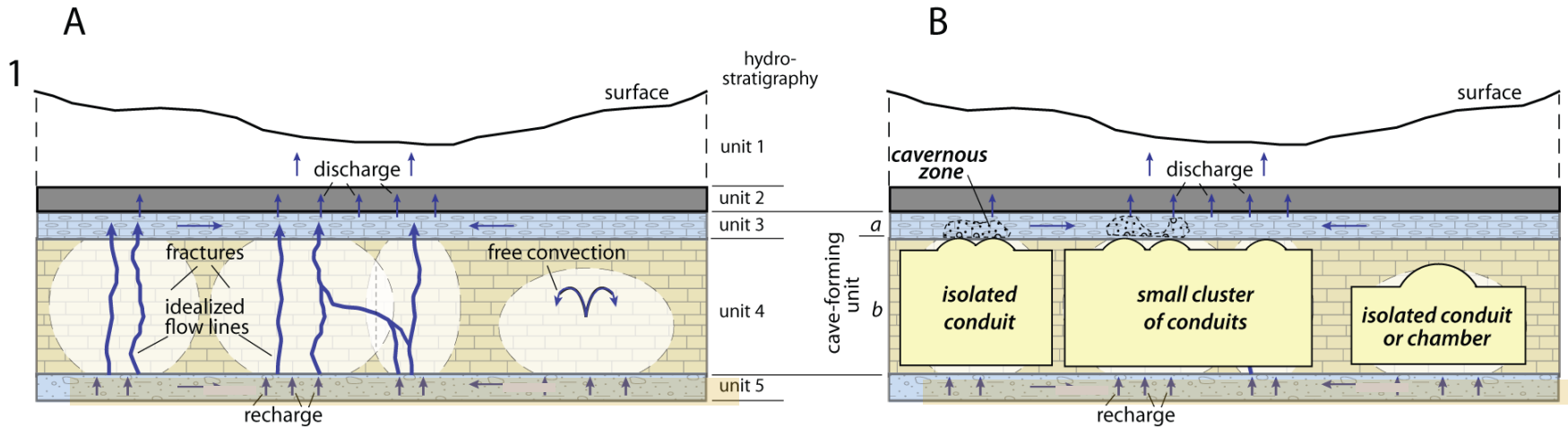
JeG-Stm-1 diameter (in classes of cm) with respect to age (U/Th) – the corresponding oxygen isotope values are also included.



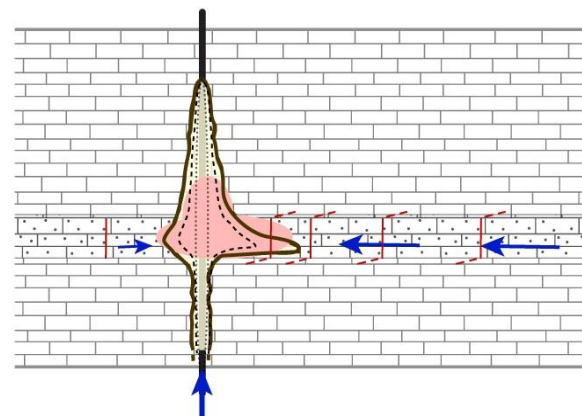
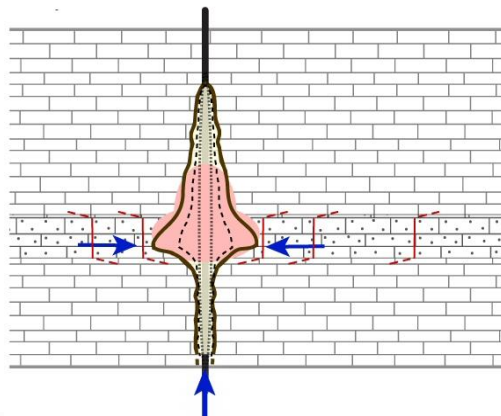
ژنز یا نحوه تشکیل غار

Hypogenic origin of the Odessa caves

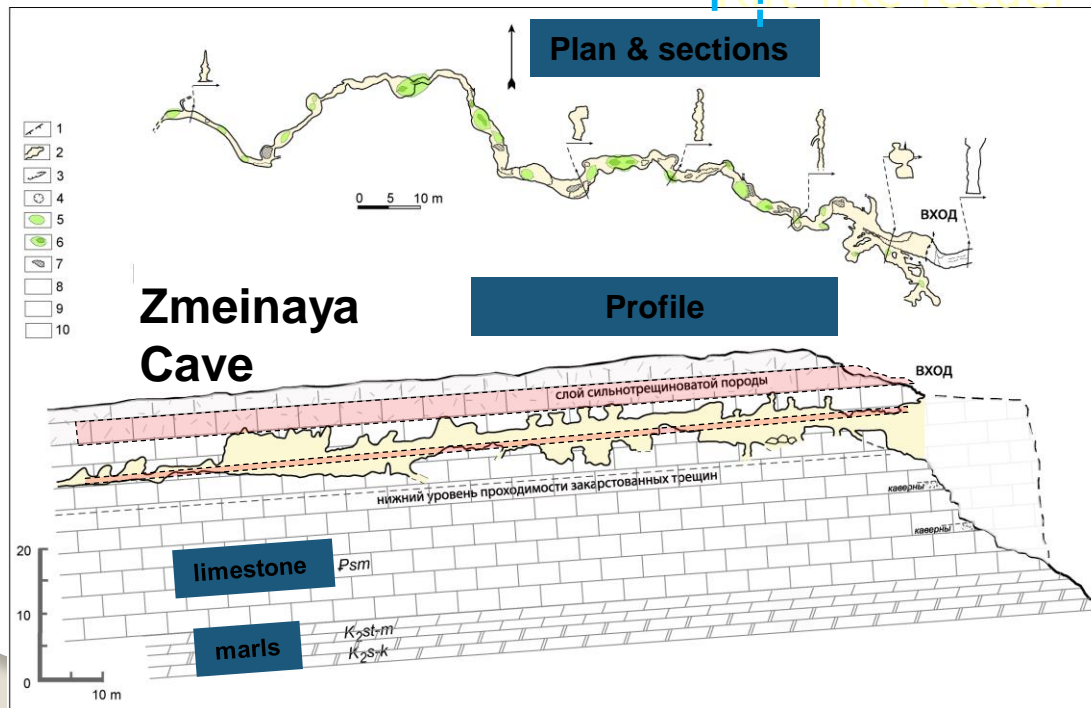
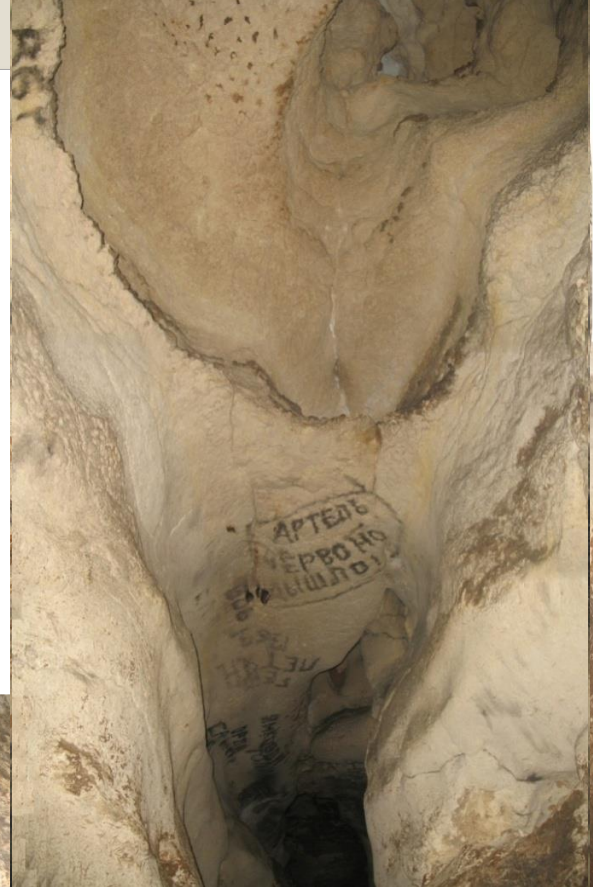
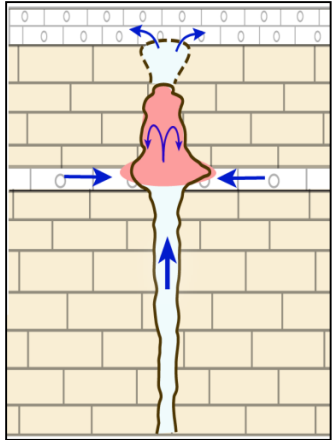
General model

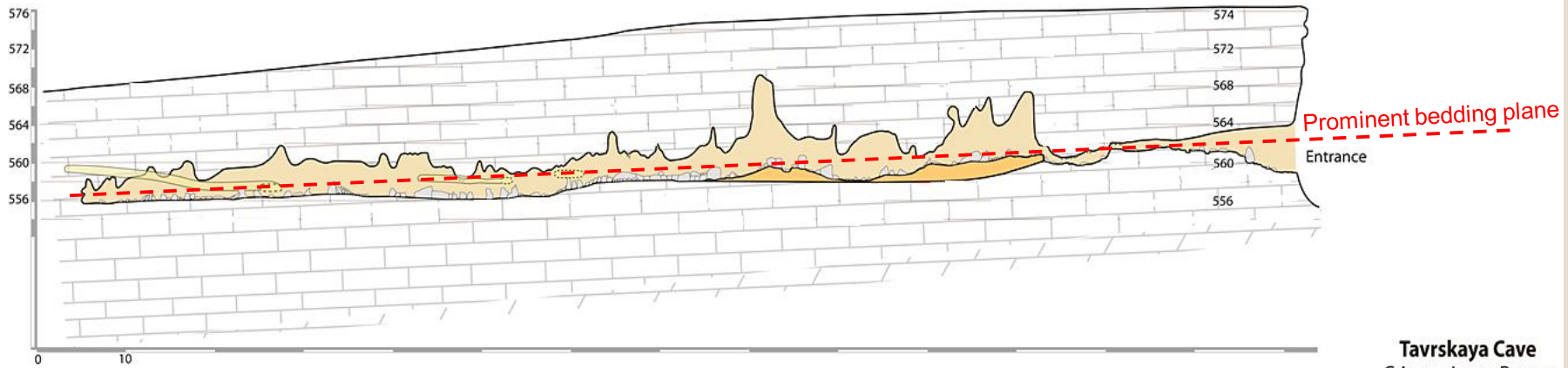


Interaction of upwelling flow along transverse fractures (deep flow system) with lateral flow along certain high-permeability beds and bedding planes

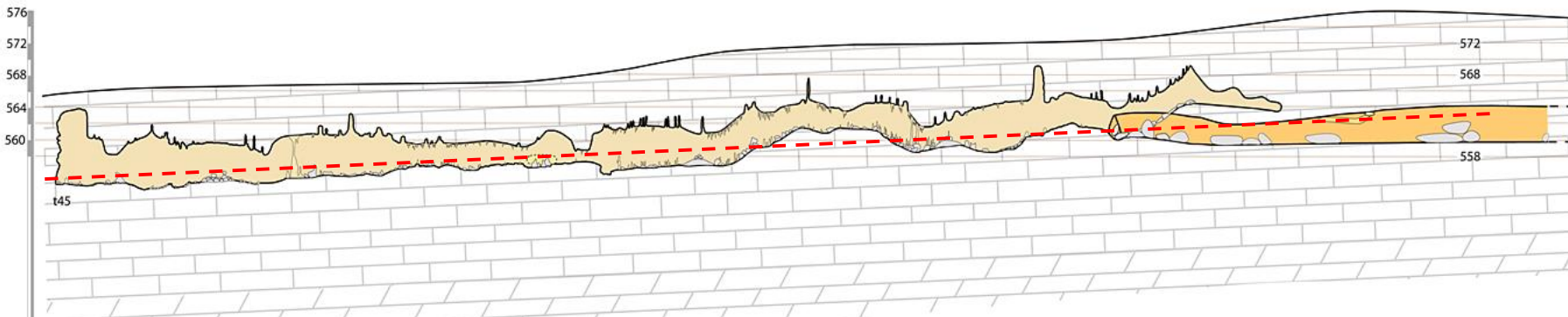


Inner Range of the Crimean fore-mountains: Zmeinaya Cave

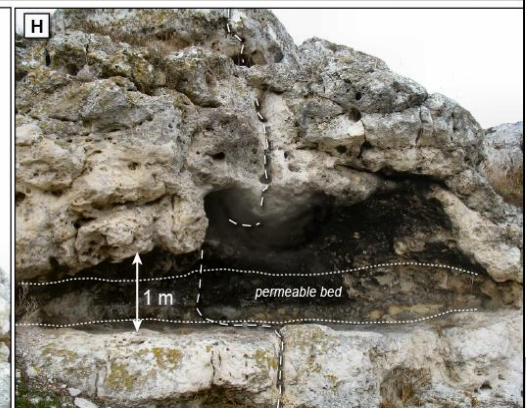
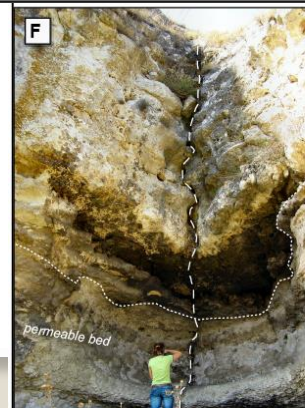
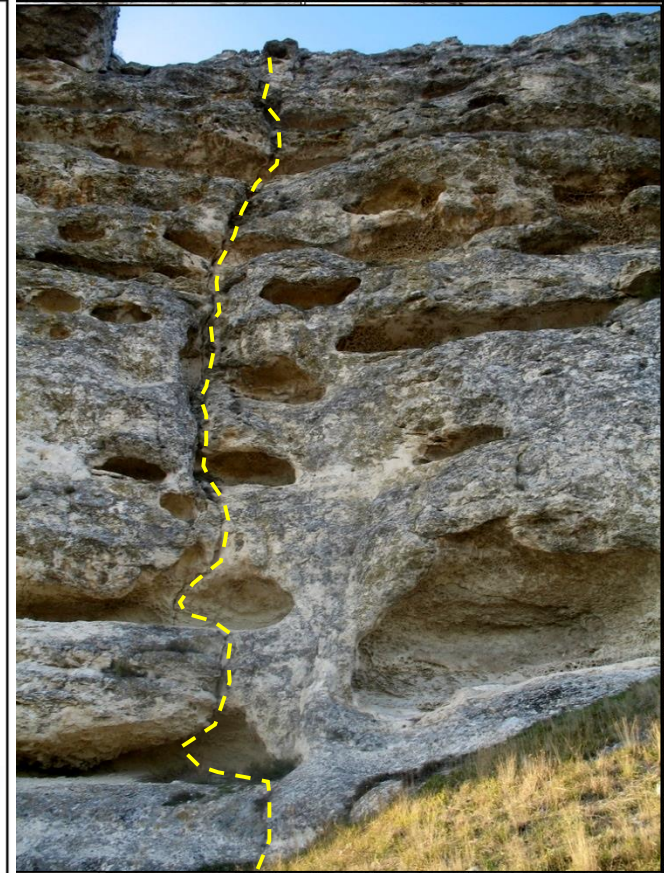
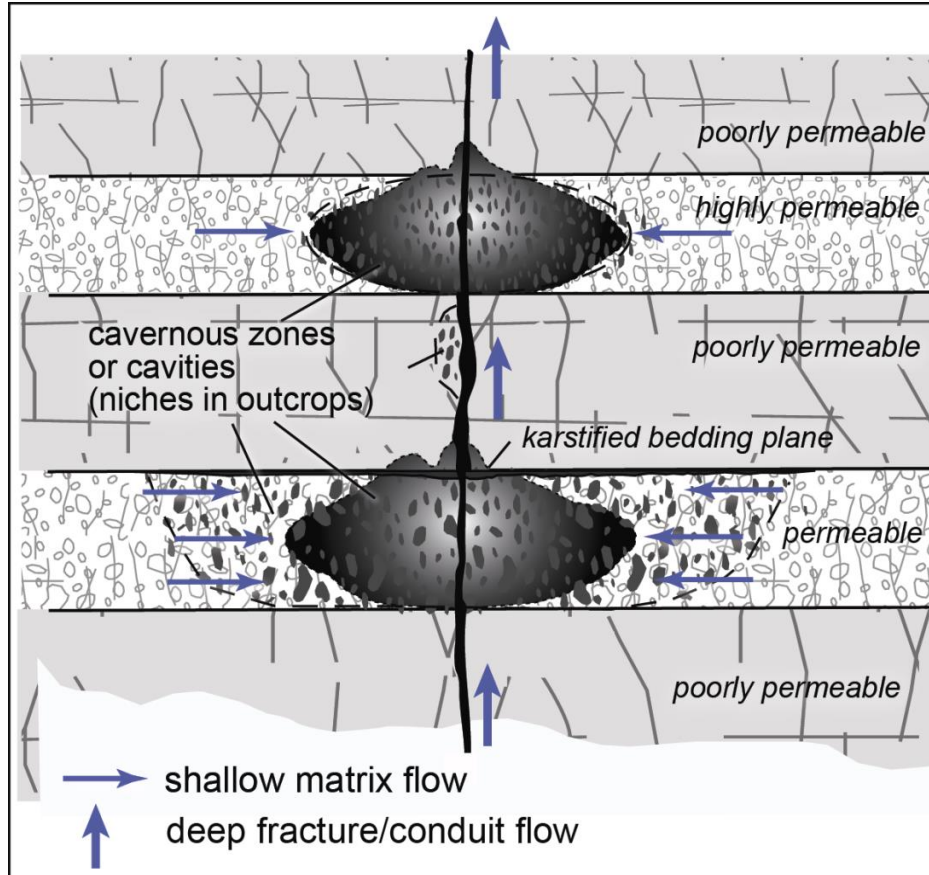




Tavrskaya Cave
 Crimea, Inner Range
 PROFILE



Cavernous fringe of fracture conduits, vuggy zones, isolated caverns



سنجش از راه دور، **RS , GIS**

اندازه گیری و ثبت دما و رطوبت و باد در غار جهت تحلیلی های آتی