Cave Mapping - Sketching the detail

A guide to producing a useful cave map

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SURVEYING and SKETCHING

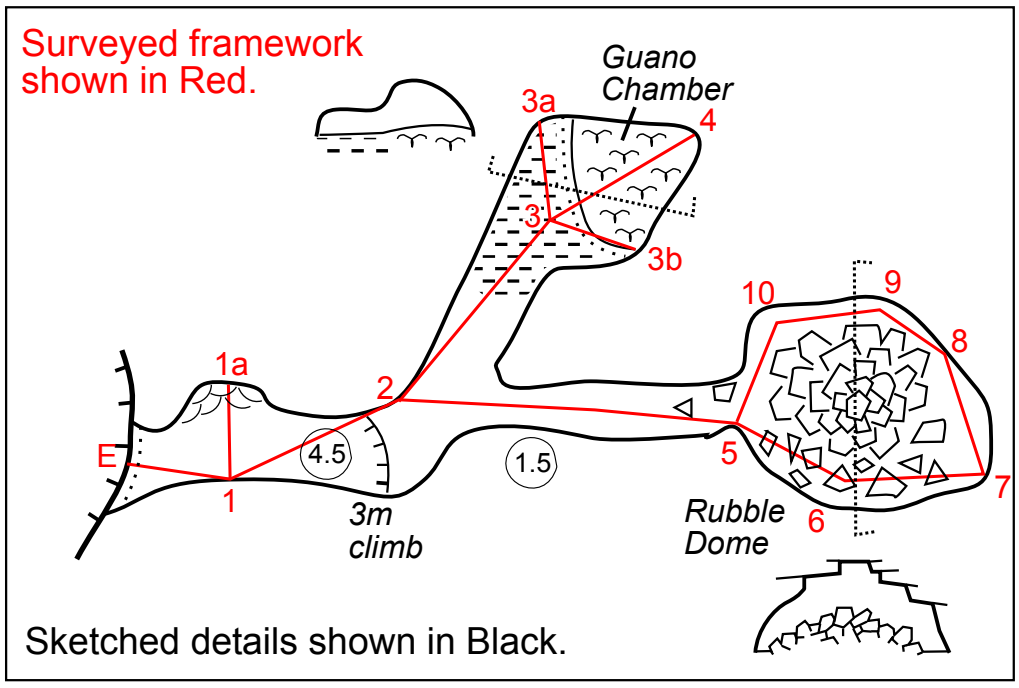
Surveying and Sketching are two distinct and complimentary operations.

Surveying involves measuring a control framework through the cave using tape and compass.

Sketching involves drawing the walls and other detail to scale, using the surveyed framework as control.

When the two processes are combined, they produce a Map. Unfortunately many cave mappers tend to concentrate on one to the detriment of the other and so produce a sub-standard map.

This set of posters concentrates on the sketching side of the mapping operation.



WHAT are the AIMS of the Cave MAP?

Unless your map has a special purpose you should try to cater for **most** of the following:

Description: What does the cave look like?

Navigation: How to get through it, pitch details, etc.

Scientific: Indicate features of interest.

Engineering: Possible connections, relationship to surface features, hydrology...

Artistic: Show off your drafting abilities!

COMPONENTS of a CAVE MAP

As well as the actual map (the **Plan** view) there should be **cross-sections** to show the shape of passages and a side view (**long-profile** or **projection**) to give an idea as to the different levels of the cave and how these connect.

The Map should include

Walls: Generally drawn in a heavy line

Cross-sections & Long-profiles

Topographic details: floor and roof steps and slopes

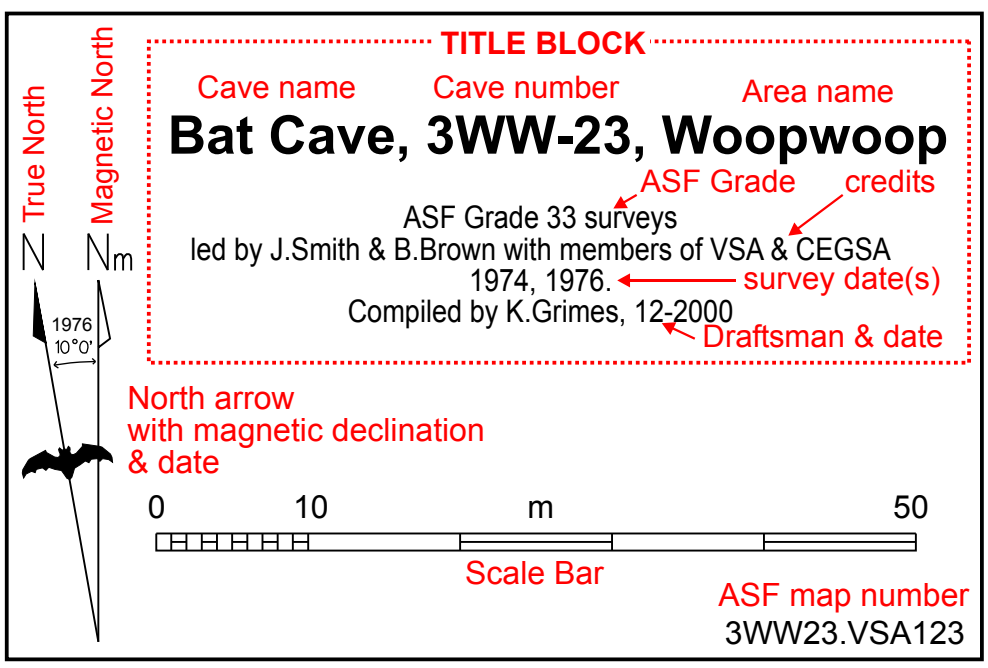
Contents: Water, pretties, sediments, biology, etc.

Surface features: at the entrance and elsewhere, dolines, streams, property boundaries.

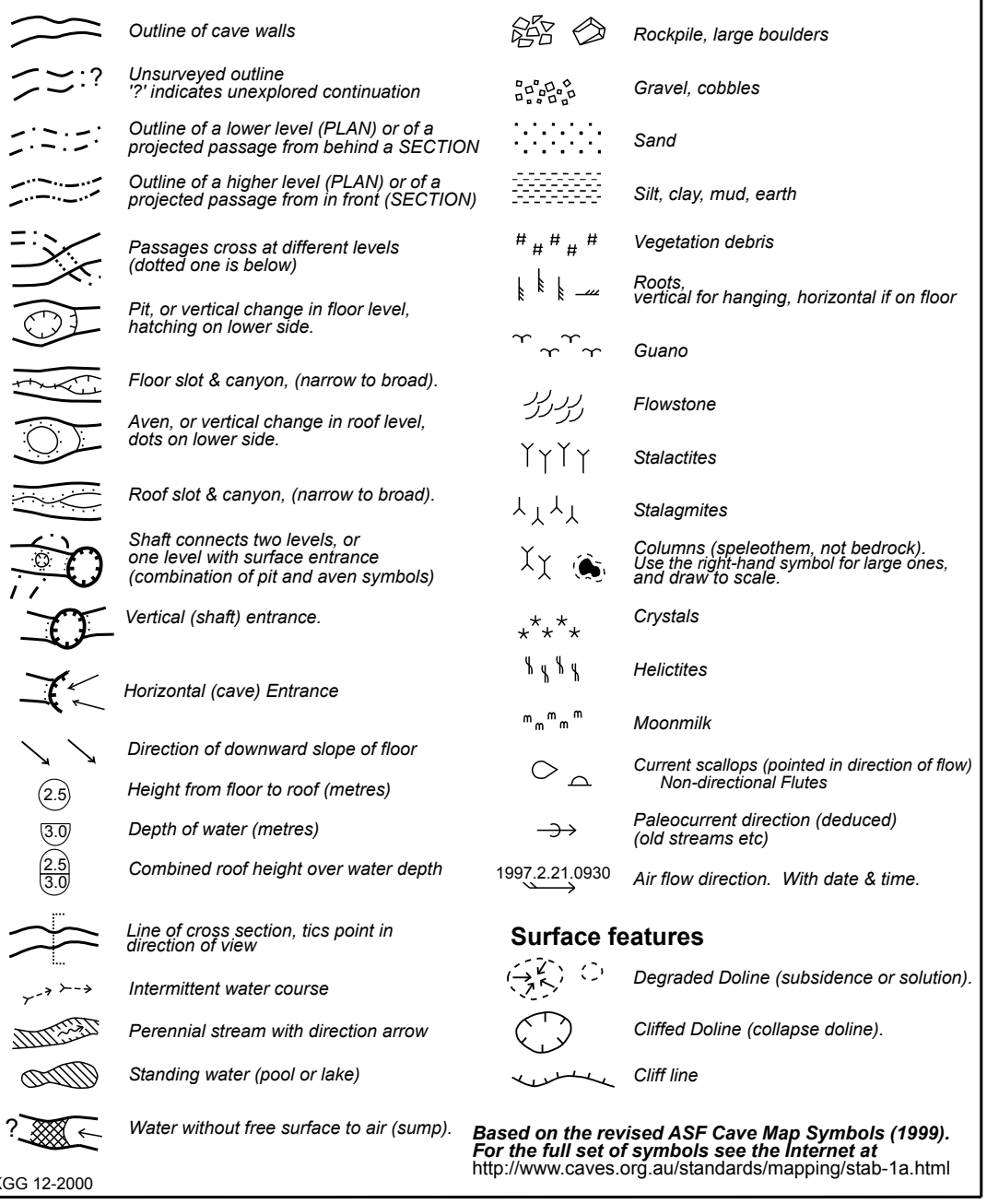
Navigational and rigging: comments, marked trails, etc.

Special features: stairs, paths, excavations, etc.

Other essential items are shown in the box below.



COMMON SYMBOLS USED IN CAVE MAPS



Based on the revised ASF Cave Map Symbols (1999). For the full set of symbols see the Internet at
http://www.caves.org.au/standards/mapping/stab-1a.html

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Some features that deserve sketching

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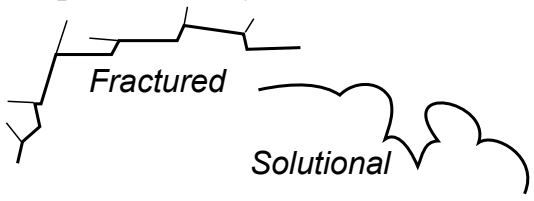
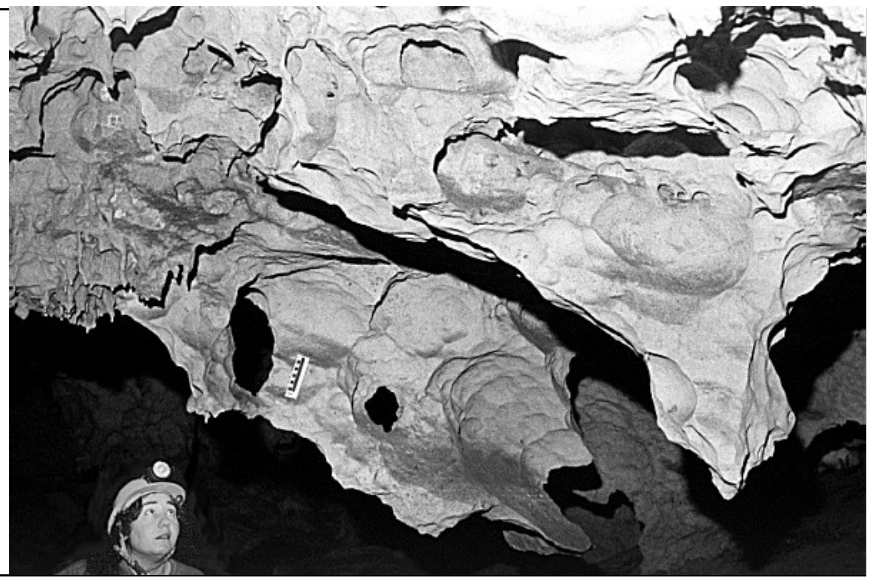
When drawing walls, show the true shape - all its bends, alcoves and bulges. Straight wall sections are rare and significant when we do see them.

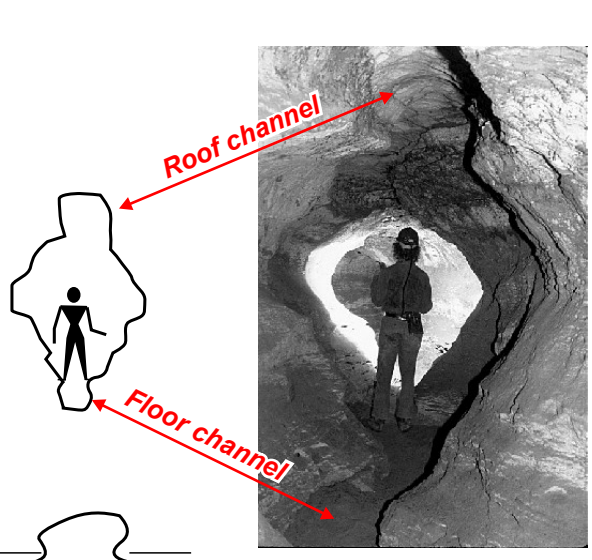
Distinguish between angular fractured surfaces and solutional surfaces - which can be smooth, cuspate or honey-combed ...



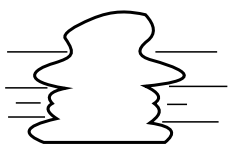


Keyhole passages, and other systematic enlargements and reductions of passage width are useful clues to prior water flow and levels.

Narrow areas suggest rapid incision, while wide areas suggest a stable water level.



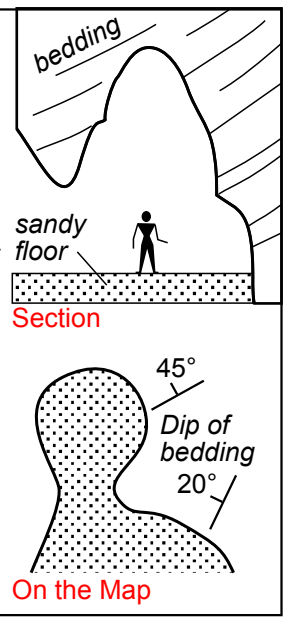
However in flat-bedded limestone variations in solubility of beds may also play a role.

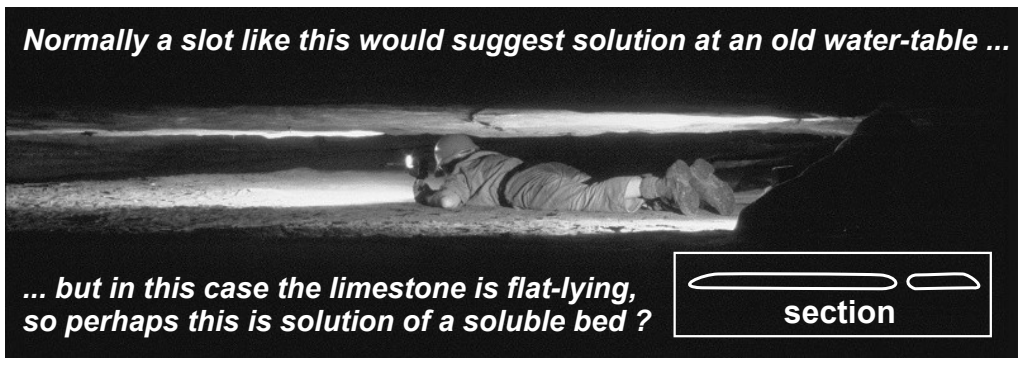


Bedding is not usually as obvious as in this photo, and may be hard to pick from jointing.

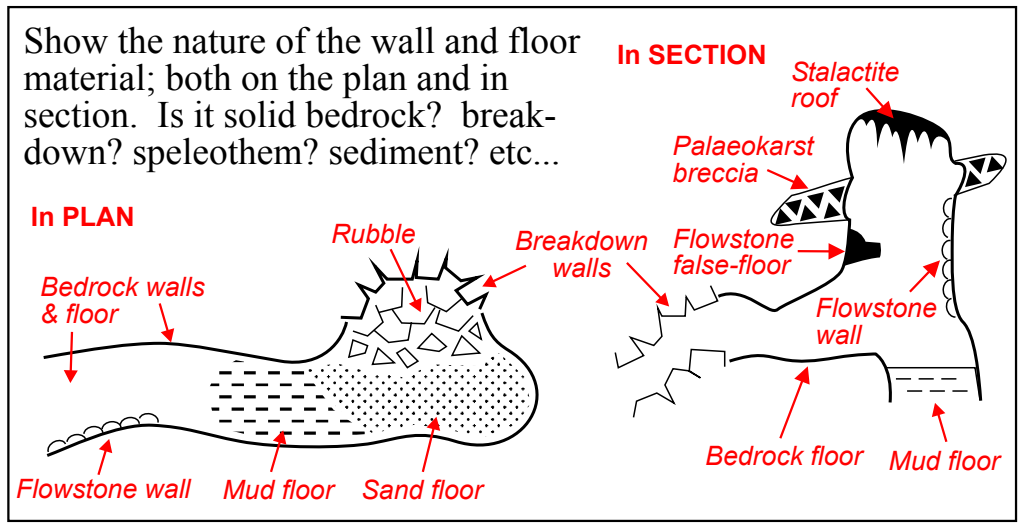
However, you should try to show any planar structures in the rock as these commonly influence cave development.

In section show the apparent dip in the plane of view. On the map use a dip symbol.





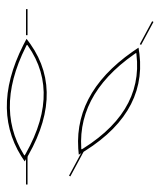
Show the nature of the wall and floor material; both on the plan and in section. Is it solid bedrock? break-down? speleothem? sediment? etc...



The classic key-hole section indicates incision into the floor by a stream.

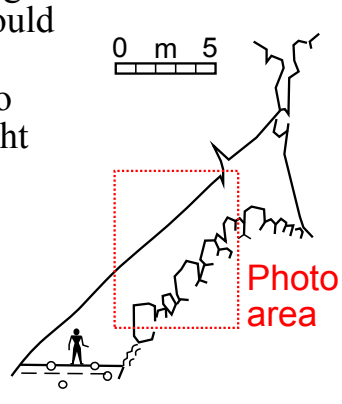
Bell-holes in the roof are interesting features that are worth noting (as a roof step in the Plan, or shown on the section)

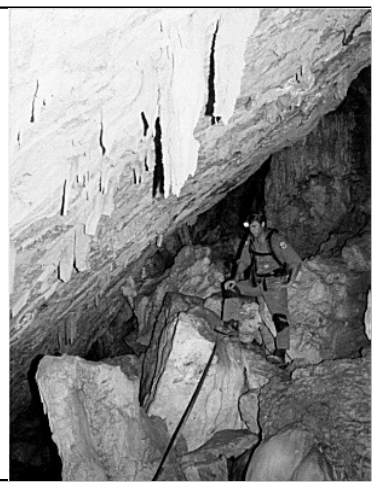
Vertical or inclined fissures may indicate joint-control of cave development.

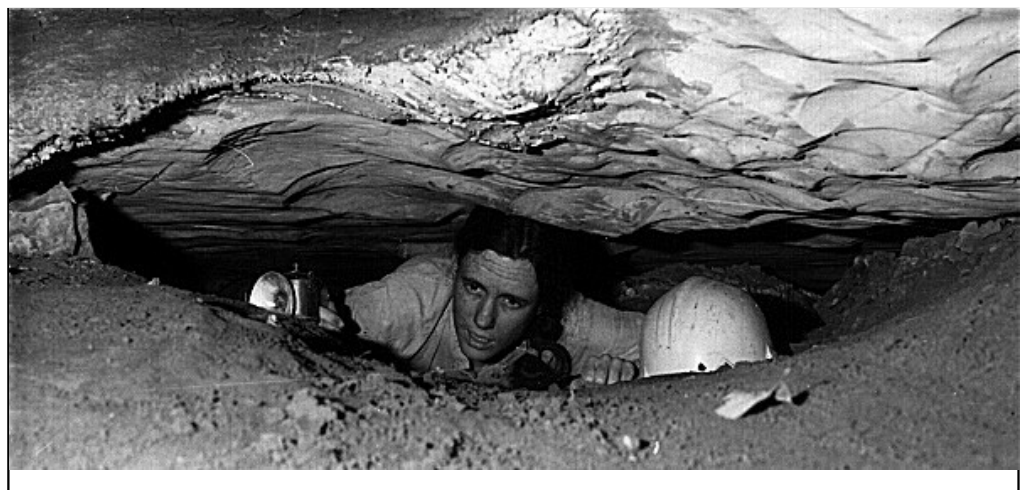


The planar hanging wall in this chamber could be a fault.

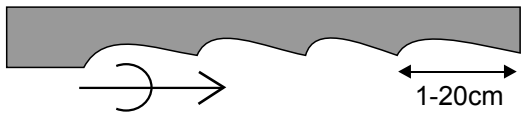
So I was careful to show it as a straight line.







Scallops and other features can show the direction of water flow in the past.



Map symbol

The asymmetry of the scallop shows the direction of flow.
The size is inversely proportional to flow rate.

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Hints and Tips

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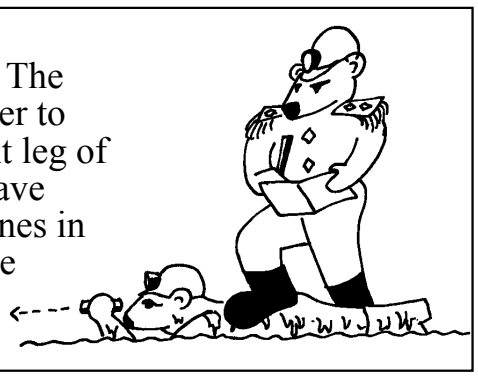
The Sketcher is Boss!

The sketcher should be in charge. The surveyors must wait for the sketcher to finish before moving on to the next leg of the survey. The sketcher should have them measure additional control lines in chambers etc to give control for the sketching.



Carry the following...

A spare pencil (or two) and some way to sharpen them. I prefer soft 2B leads, but some people like harder ones. Ball-points don't like damp paper.

A spare protractor-ruler.

A small 3 m metal tape for quick measurements of roof height, passage width etc.

Gloves etc to keep your hands clean

Some way of keeping the book clean.

Your Notes & Sketches:

Some people prefer loose sheets of graph-paper on a clip-board, changing sheets whenever they get muddy.

Others prefer a bound notebook. If you go for books use many small ones rather than one big book, so if you drop one down a pit you will not loose several years notes!. A durable cover with replaceable inserts is best.

Either way be prepared for the mud - get waterproof or at least resistant paper. The *Rite-in-the-Rain* notebooks (rag paper) are good for normal caves. For very wet caves some sort of plastic sheet is better.

Sketch and note **everything** you intend putting on the final map. Do not rely on your memory!

Generally sketch the wall first, then detail, then sections. However in a large room it might be easier to sketch local detail first, then work your way out into the room (adding extra survey points as you go).

Don't forget the sections. Note their location on the plan, and the view direction.

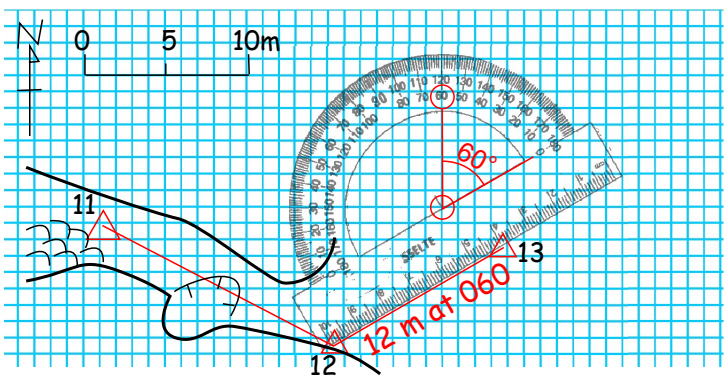
Don't forget the ceiling features.

Include written descriptions of anything of interest. Even if these do not go on the final map, they can be put in the accompanying report.

Sketch to scale in the cave.

Use a ruler and protractor to lay out the survey lines (with rough adjustments for inclined sights) and use those as a guide to sketching. Check that the result looks right - if not, has someone made a mistake in a reading?

Draw a scale-bar and north arrow on each page for reference.



Study other people's maps.

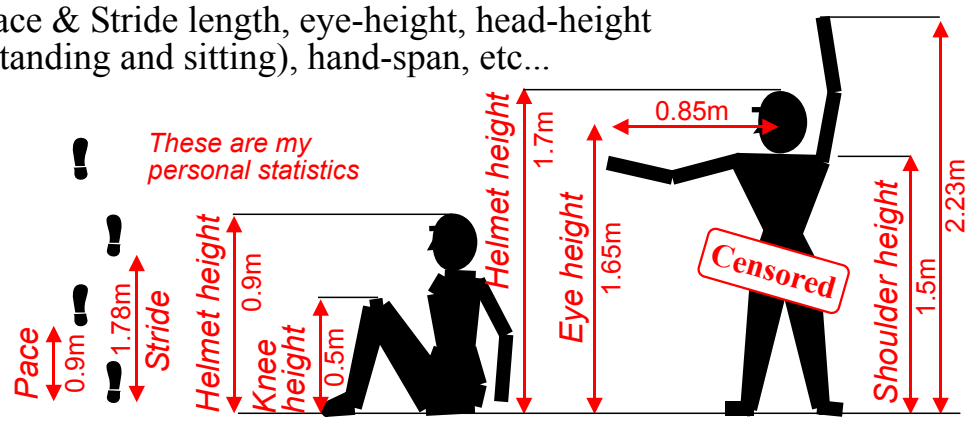
Especially of caves you know. Are they good or bad - and why? Note how they handled various problems. Copy their good points and avoid their bad ones.

At Junctions

If starting a new survey be sure to sketch enough detail at the junction to overlap with the previous sketches.

Calibrate your body.

Pace & Stride length, eye-height, head-height (standing and sitting), hand-span, etc...

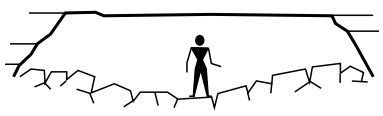


Practice estimating length & heights.

e.g. guess the tape distance before it is read out. Most people tend to exaggerate heights - allow for this.

Visual aids:

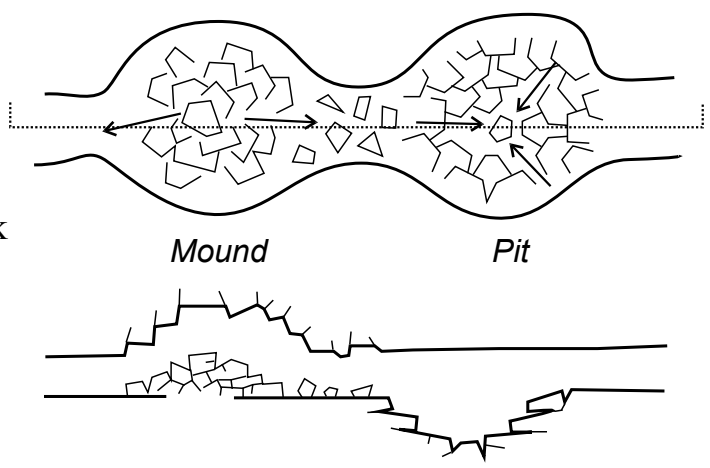
When sketching cross-sections, put someone with a light ahead of you. The shadow edge will assist your sketching. The broad beam of a carbide light is best! You can also use the height of the person as a guide to scale. A tape laid out on the ground is another aid.



Rubble

When sketching rubble, try to indicate the slope by use of overlapping block symbols.

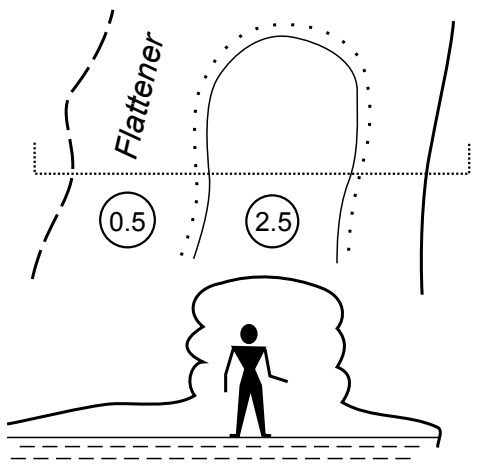
Slope arrows will also help.



Draw the outermost wall.

Where there is a closer 'visual' wall with narrow slots extending beyond it, use roof and floor steps for the near wall and the solid line for the far wall, A cross section may help the reader work out what is happening.

Hard-to-see far walls in slots should be dashed.



The Survey

Avoid long survey legs. If you do use them, lay the tape down and use it as a reference while sketching down the passage.

Sketch in the natural features used as survey stations (large boulders, stalagmites, ...

Learn how to triangulate to locate remote points, or estimate heights of large chambers.

On expeditions it is best to ***Survey In***. Coming out you may be too tired, or running late.

A commented example of a well-drawn cave map

Originally published in
The Sedimentary and morphological Development of the Borenore Caves
by R.M. Frank, in *Helictite* **11(2)**, pp 27-44, 1973.

A local grid was provided to help locate features described in the accompanying report.

Note systematic labeling of sections and profiles.

FIG 1

The North arrow is Magnetic.
But the local declination is not indicated.

Note the use of small arrows, or 'tics' to indicate the direction of view

Surface features and shallow caves

Surface hollow

Title
we would now also give the ASF cave number "2BN-25"

BORENORE TUNNEL CAVE

High-level cave. Would an offset have helped?

A useful symbol where it is not obvious that pillars exist.

List of symbols used

- Upper level passage
- Cliff face
- Vertical drop
- Surface feature (doline)
- Stream course in cave
- Stalagmite
- Recent river sediments
- Limestone Pillar
- Breakdown
- Flowstone
- Limestone wall determinable
- Limestone wall not determinable
- Cave earth undifferentiated
- Ancient river sediments
- Soil (see profile)

Special symbols - this map accompanied a report on the sediments

The main profile T-P1 has been picked out in green for easy reference

text should never be smaller than this

0 10 20 30 METRES

Scale bar

SURVEYED BY R.FRANK AND P. DANIEL, 1968
CRG GRADE 6sD
MINERS DIAL AND STEEL TAPE

Credits and survey grade etc. Should also indicate Club, or affiliation of author.

Add an ASF map number

General Notes:

** This is a good example of the combined use of Plan, Profile and Sections to produce a useful picture of the cave form in all three dimensions.*

** At this scale (1:1000) it is not possible to show much of the floor or roof detail.*

** Showing the surface features and high-level caves is useful - but care is needed to avoid confusing the view of the main cave map.*

Note that T-P1 is a "developed profile", that has been unfolded to show the shape of the main stream passage.

He is trying to show a section of cave that lies in front of the main profile - with mixed success!

This section is essential to show that a bridge is involved.

The surface features have also been sketched and included in the profile

FIG 2

BORENORE TUNNEL CAVE
PROFILES AND SECTIONS

T-P1 T-P2 T-P3 T-P4

0 10 20 30 METRES

These three profiles would have been better placed together with lines indicating where they cross each other.

A commented example of a well drawn cave map

Map by Peter Campbell & Prue Kirby.
From *The Caves of Jenolan, 2:* 1976

J 79 Maiden Cave

PLAN

this is all one section, but not obviously so!

add a 1.7m 'caver' to help indicate scale

passage through breakdown

Upper level shown as an offset map

The developed long profile has been added in green for your reference

Change of survey grade (is not really necessary)

Roof step (see profile)

ASF Map Number

Higher level walls, (see offset above)

Lowest level walls

General Notes:
At 1:200 scale one can show extensive floor detail.
Note the use of offset maps of the different levels to avoid the confusion of overlapping detail.
This is from a book - so the lack of north arrow, survey credits, etc is partly forgivable as these were placed in an appendix. But it would have been better to put them on the individual maps.

No Scale Bar ! So, how can you tell whether this copy is still at the original scale?

1:200

2J79.SUS2

J 79 Maiden Cave

How to show a passage through breakdown rubble

Note how speleothems are drawn in section

profiles behind and in front of main one use different dot-dash patterns and are drawn elsewhere as offsets.

No Scale Bar ! So, how can you tell that this copy is still at the original scale?

ASF Map Number

DEVELOPED LONG SECTION

1:200

2J79.SUS2

General Notes:
** These are the long profiles that go with the map above. They are an essential step in showing the three-diminsional form of the cave and its different levels.*
** Note, the profiles are "developed" ones which follows a zig-zag path (shown in green) that has been unfolded in the plot.*