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.

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

- Outline of cave walls
- Unsurveyed outline
- Outline of a lower level (PLAN) or of a projected passage from in front (SECTION)
- Outline of a higher level (PLAN) or of a projected passage from behind (SECTION)
- Passages cross at different levels (dotted one is below)
- Pit, or vertical change in floor level, hatching on lower side.
- Floor slot & canyon, (narrow to broad).
- Aven, or vertical change in roof level, dots on lower side.
- Roof slot & canyon, (narrow to broad).
- Shaft connects two levels, or one level with surface entrance (combination of pit and aven symbols)
- Vertical (shaft) entrance.
- Horizontal (cave) Entrance
- Direction of downward slope of floor
- Height from floor to roof (metres)
- Depth of water (metres)
- Combined roof height over water depth
- Line of cross section, tics point in direction of view
- Intermittent water course
- Perennial stream with direction arrow
- Standing water (pool or lake)
- Water without free surface to air (sump).
- Rockpile, large boulders
- Gravel, cobbles
- Sand
- Silt, clay, mud, earth
- Vegetation debris
- Roots, vertical for hanging, horizontal if on floor
- Guano
- Flowstone
- Stalactites
- Stalagmites
- Stalagmite
- Column (speleothem, not bedrock), use the right-hand symbol for large ones, and draw to scale.
- Crystals
- Helictites
- Momicritic
- Current scallops (pointed in direction of flow)
- Paleocurrent direction (deduced)
- Air flow direction. With date & time.
- Surface features
- Degraded Doline (subsidence or solution)
- Cliffy Doline (collapse doline)
- Cliff line

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
Cave Mapping - Sketching the detail
Some features that deserve sketching

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, cuspy 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.

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Normally a slot like this would suggest solution at an old water-table...

... but in this case the limestone is flat-lying, so perhaps this is solution of a soluble bed?

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.

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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.

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Show the nature of the wall and floor material; both on the plan and in section. Is it solid bedrock? Breakdown? Speleothem? Sediment? etc...

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Scallop and other features can show the direction of water flow in the past. The asymmetry of the scallop shows the direction of flow. The size is inversely proportional to flow rate.
Cave Mapping - Sketching the detail
Hints and Tips

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.

The drawings are... 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.

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

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

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

Note systematic labeling of sections and profiles.

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

Note the use of small arrows, or ‘tics’ to indicate the direction of view.

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

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

Special symbols - this map accompanied a report on the sediments

List of symbols used

A commented example of a well-drawn cave map


www.hinko.org
A commented example of a well drawn cave map

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

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

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

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 that this copy is still at the original scale?