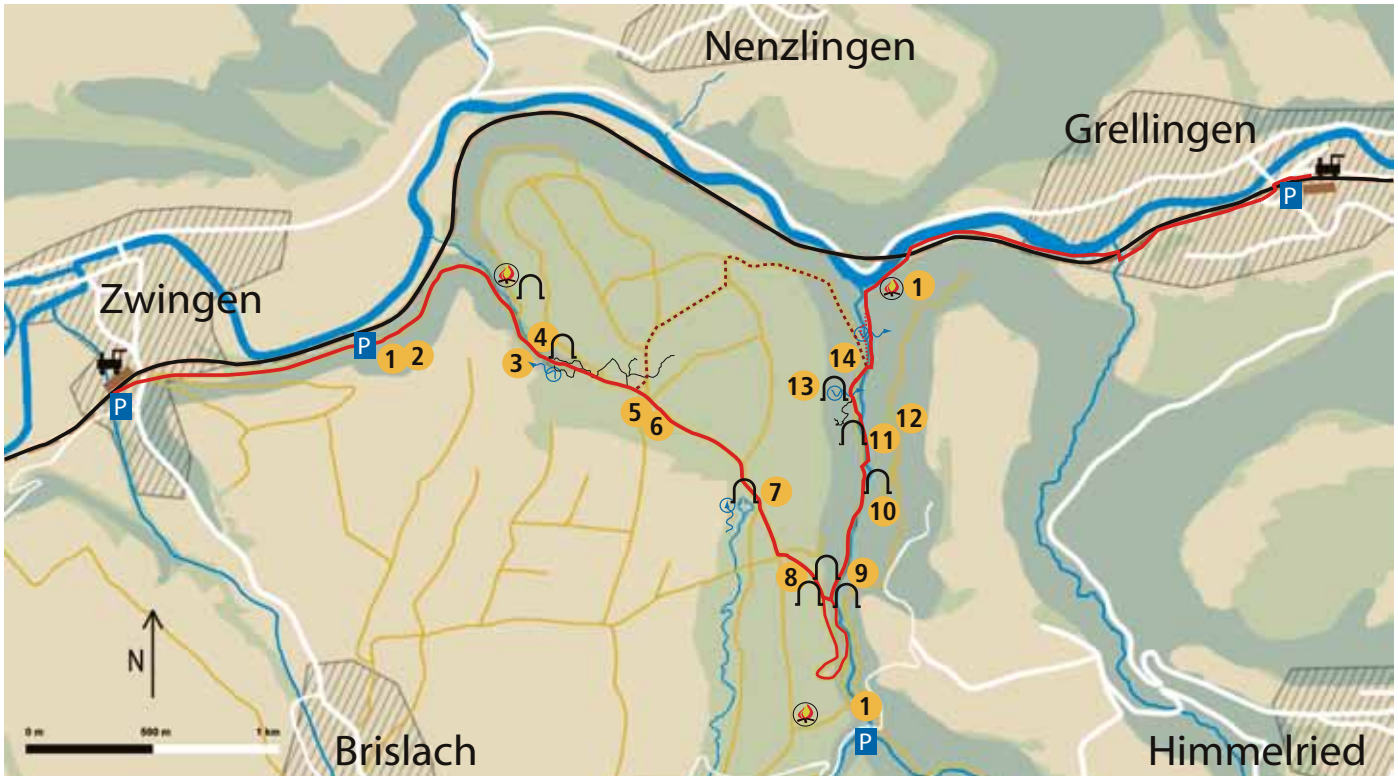
1 Educational Karst Trail

Kaltbrunnental-Brislachallmet

Water - Caves - Springs
One of the least known cave locations in Switzerland, the wooded landscape of Brislachallmet and the deep canyon of the Kaltbrunnental to the south-east of Zwingen, offers an opportunity to observe the various karst features in a relatively small area.
During the walk you can discover the unique powers of water on a variety of rock formations, caves and springs. You will learn

about the significance of the limestone and the interaction of water, caves and springs.

The caves in Kaltbrunnental were important places of settlement for our ancestors during the last ice age. Therefore, they are some of the most important prehistoric archaeological sites in Switzerland.
This is illustrated on several of the information panels along the route. The panels provide an insight into the world of speleology, cave exploration and cave research.
The path leads from Zwingen over the wooded Brislachallmet to Kaltbrunnental, follows it downstream and carries on via Chessiloch to Grellingen or via the usual footpath back to Zwingen.



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Karst
Karst is the name of an area around Trieste. It is used as a general term to describe all limestone formations with subterranean drainage systems and areas of dissolved bedrock, such as caves etc.

CAUTION:
Caves are naturally occurring hollow spaces that are subject to the laws of nature.Before entering any cave, one must be observant of weather conditions and forecasts, and consider possible dangers such as thunderstorms, flooding, clear ice, etc.
If you do not know the cave and have no caving experience, you should not attempt a visit.

Tips and Tricks
The Karst Trail follows marked footpaths over a length of approx. 9.5 km (6 miles).
Walking it takes around 2.5 to 3 hours.
It is helpful to carry a hand-held torch if you want to get a better view of the cave entrances.
Substantial footwear and robust clothing offer some protection when coming in contact with the sometimes damp and muddy terrain of this fascinating world, so it can be fully enjoyed. Be careful of plants and animals. Do not leave any rubbish behind. Refrain from producing graffiti or ‚carvings'.

2 Research history of SSS BS

The history of exploration in Brislachallmet-Kaltbrunnental

Some of the caves in Kaltbrunnental have been known since prehistoric times. Archaeological digs in these caves have produced a variety of finds. But the spelaeological exploration of the caves in this region started only in November 1969. A tip from people in Zwingen led to the exploration of Bättlerloch. By Easter 1971, a total length of 800m of explored cave passage was discovered.
Since then the extended area around Bättlerloch has attracted attention. Some small caves were explored and surveyed, including Höhle im Schäll and Bättlerkuchi in 1972.
There was a desire to prove the hydrological connection between the Schällbach sinkhole and the stream in Bättlerloch.
In June 1972 a dye-test was carried out. Surprisingly, the Schällbach emerged not in Bättlerloch, but in Kaltbrunnental. This confirmed the so far disbelieved result of a dye-test in 1923. With this knowledge, attention was directed to a temporary spring, the Versturzquelle in Kaltbrunnental. Access to the entrance siphon was forced in July 1973. By means of pumping out and diving, three siphons were overcome, and the course of the underground Schällbach was reached.
At the end of a very active period of exploration the path led back to the enigmatic Schällbachponor. In September 1973 it became possible to enter the cave through a very narrow gully (belly crawl), behind which the largest cave chamber of the region was discovered.
Apart from a few visits to Bättlerloch nothing much happened for several years. Returning to Bättlerloch in 1988, diving passes resulted in the discovery of new sections of corridor, showing the cave to be a full kilometre long.
A new start was made in 1999 in Schällbachponor. By opening a small passage a second large cavity was found, into which Schällbach descended in the form of a waterfall. Again a siphon made it difficult to progress towards the Versturzquelle. The future will perhaps reveal what might be found behind this obstacle.
The establishment of this Karst Trail is the latest project in an endeavour to introduce a wider public to the world of caves and karst.

Realisation: The Society Karstlehrpfad Kaltbrunnental-Brislachallmet

We wish to thank all those who have made this trail possible, supported and financed it. Special thanks are due to

Gemeinde Zwingen, Gemeinde Brislach, Gemeinde Himmelried

Belly crawl	A narrow section that can only be passed by crawling
Siphon	Entirely water-filled passage
Ponor	In limestone areas any site where water disappears underground

The SSS

The Swiss Spelaeological Society (SSS) is a society of friends of the subterranean world. It promotes cave exploration in the scientific and sporting sense and encourages the study of karst. It aims to widen the knowledge about the caves in Switzerland and promotes for their conservation.
It is comprised of 42 sections with a total of around 1100 members and includes the Swiss Institute for Spelaeology and Karst research (SISKA)
SSS organises training courses, co-ordinates expeditions here and abroad, produces documentation and inventories, participates in scientific projects, establishes guidance for safety and the protection of caves, maintains the rescue organisation Speleo Secours Suisse and organises national and international conferences on a regular basis.
www.speleo.ch

SISKA / ISSKA

The Swiss Institute for Spelaeology and Karst Studies is a public foundation initiated by SSS.
SISKA collaborates with national and international academic institutions to promote a sustainable management of alpine karst areas. It supports authorities and environmental conservation organization in the field of caves and karst.
www.isska.ch

Sektion Basel

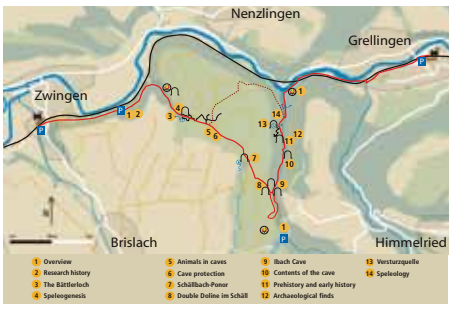
SSS Basel

The Basel section of SSS has around 110 members. Meetings are held on a regular basis, where information is exchanged, research projects are discussed, and cave tours, camps and lectures are planned. The main areas of research are Laufental and the Bernese Oberland. The society organises introductory courses in techniques and other disciplines of cave exploration for its members. News of its activities are published in its magazine «Höhlenwurm» and its annual report.

3 The Bättlerloch

Bättlerloch holds the record as the longest explored cave in Basel-land. Despite its impressive length the difference in altitude within it is only 8m at its maximum.

Bättlerloch is accessed by two narrow, low entrances. One leads through the Höhlenbach spring; the other takes us to the roomy main passage (East Corridor) via Tartaros. Tartaros is a narrow, sometimes barely passable, thoroughly wet corridor. Upon arrival at the main passage the cave is easily passable upstream over several 100m, but the last 180m of the main corridor remain inaccessible due to a siphon that is not diveable. The South Corridor and the Sauschluf, a muddy only crawlable section, are the only significant branches leading off the main corridor. Both are very narrow. Sauschluf is especially nasty to go through because of its clay-filled basins. The cave stream water supply is still an enigma. The stream reacts rapidly to thunderstorms, the waterlevel rises greatly in an instant.



In the narrow Tartaros. The entrance to Bättlerloch is characterised by very narrow, wet cleft passages

CAUTION
Please do not enter this cave! Floods, rockfall, hypothermia and falling can endanger your life.

Detail ground-plan of the "Znünihalle"

Detail Profile of the "Znünihalle"

In the West corridor we see evidence of the way clefts have influenced the zig-zag course of the cave stream.

The narrow bedding plane passage of Tartaros joins the roomy East Corridor. It too is an interface passage but in the course of time the water has produced a corridor of considerable dimensions.

Plan

The massive Speleothem plug in Bättlerloch. The presence of the stream has prevented the formation of a column.

Detail
Profile of the entrance area

Ground plan	Map projection of a cave (vertical seen from above)
Cleft	A break produced by movement within the rock
„Schluf"	A section that can only be passed by crawling (belly crawl)
Profile	Drawing of a sidewise cross-section of a cave
Flowstone	Term used to describe minerals deposited by water. They consist mostly of carbonates, e.g. calcite
Speleotem	Deposit drip-stones such as stalagmites and stalactites, floor coverings and coatings on clay etc.
Siphon	Entirely water-filled passage
Tartaros	From the Greek legend: the darkest place in the underworld, where sinners endure their punishment eternity
Diving pass	Passing of an underground lake or siphon with the help of diving equipment

4 Speleogenesis

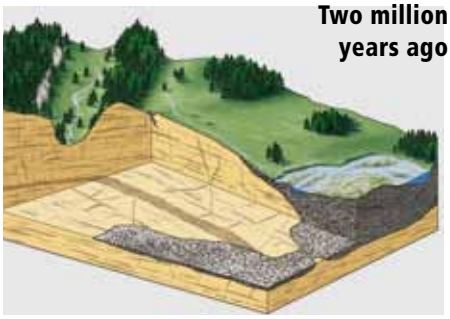
Two million years of karst history

If we humans wanted to observe the creation of a cave, we would have to be immortal. Water, starting from a hairline crack in the rock, takes tens of thousands, even millions of years, to create a gigantic cave the size of a cathedral.

Caves are only formed under certain conditions. They can develop in very different ways, depending on the rock and the climate, but the following four conditions are of importance:

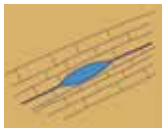
1. Soluble rock, mostly limestone, occasionally gypsum
2. Carbon dioxide in the water to dissolve the rock
3. Slopes in the system, so the water can flow freely
4. Time, time, time!

In Laufental the interaction of the four factors are evident.
After the formation of the Jura through geological folding 10 to 3 million years ago, the Laufental we see today was a wide valley in which the Birs flowed towards the Rhine. The river began to eat into the valley floor and thus initiated the creation of the caves.

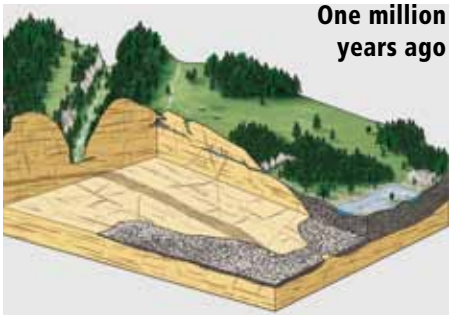


Two million years ago

Initially Ibach created a gentle Kaltbrunnental. It is, as is the Schällbach, one of the many tributaries flowing into the Birs. The oldest caves begin to form.



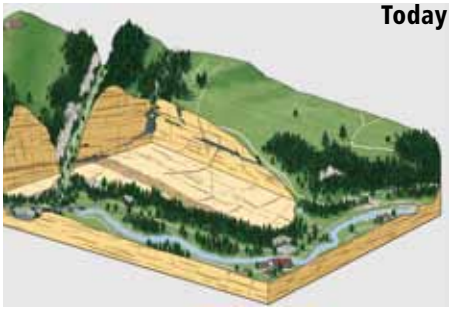
Corrosion
During the first stages of the formation of a cave, water containing carbon dioxide enters through minute cracks and layer interfaces into the rock. It dissolves the surrounding rock through corrosion (chemical dissolution). After a sufficiently long time a large passage is created. During this part of their formation, caves are usually entirely filled with water.



One million years ago

Birs has further incised the valley and Ibach deep into Kaltbrunnental. The cave entrances are already so large that Schällbach disappears into one of them. It is possible that it flowed through what is today called Bättlerloch into the Birs.

Erosion
The larger the passages, the more water is able to flow through them. When this carries clay, sand and boulders with it, they grind the rock walls – the rock is eroded. It does not matter if the cave is full of water or has just a stream flowing through it.



Today

The Birs valley lowered to its present level. Ibach has carved Kaltbrunnental to the shape we see today. In the meantime many new subterranean water courses have developed. Schällbach seeps into the Schällbachponor and flows via as yet unexplored cavities into Kaltbrunnental, where it reappears as a piped spring.

Breakdown
When a passage has reached a certain size, roofs and walls may begin to collapse, depending on the stability of the rock. The passage changes its character. If a stream flows through it, the fallen boulders are dissolved by corrosion and carried away by the water. The passage increases in height and can, in extreme cases, break through the ground above (see Panel 8 Dolines)

Erosion	Mechanical wearing away, mostly by the interaction of water and the debris and sand it carries with it.
Breakdown	Natural collapse of roofs, walls or the floor of a subterranean cavity because of statics.
Corrosion	In the formation of a cave the chemical dissolving of limestone by water containing carbon dioxide.

5 Animals in caves

Life without light

So far 48 different identified cave species have been found in the Basel and Laufen region.
On closer inspection it becomes apparent that most of them are only temporary visitors. The most famous of them are the bats, which use the caves as roosts and winter quarters.
The animals can be divided into three groups: genuine cave animals, troglophiles and trogloxenes.
Only five of the 48 animals are genuine cave-adapted animals, all the others are troglophiles.

The genuine cave animals are:

Two snails (Stygobionte Arten)	
Bythiospeum diaphanum	Silberloch (Röschenz)
Bythiospeum acicula	Ibachhöhle (Brislach)
one Pseudoscorpion (terrestrial troglobiontic species)	
Neobisium aelleni Vachon	Schällloch (Brislach)
two Springtails (terrestrial troglobiontic species)	
Pseudosinella vandeli ssp. relicta Gisin	Schällloch (Brislach)
Pseudosinella duedecimpunctata Denis	Kohlerhöhle (Laufen)

Bats in this region

Although bats are able to fly, they have more in common with man than with birds. They are mammals. They give birth to live young, suckle their babies, and their bodies are densely covered with hair.
Caves, galleries and crevices in rockfaces are important habitats for many of the 30 native bat species.
The caves in Switzerland are too cool for the rearing of young, but they provide frost-free winter-quarters for Daubenton's bats, brown long-eared bats, greater mouse- eared bats and others.
All native bats are insecteaters. They hibernate between November and February, when food is scarce. Hibernating bats live in a state of metabolic depression, relying on their fat reserves. When the high humidity in their living quarters condenses on their fur, they appear to be dead. Such bats must never be disturbed. The waking-up process consumes a large amount of energy which, due to the lack of food, is impossible to replenish.

Kuhl's pipistrelle (Pipistrellus kuhlii)

Greater mouse-eared bat (Myotis myotis)

Barbastelle bat (Barbastella)

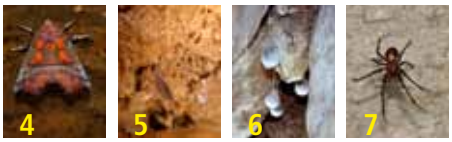
Genuine cave animals (Troglobites)

These animals dwell exclusively in caves and are unable to survive on the outside. They are adapted to life underground, as is apparent, e.g., in the loss of skin pigmentation, the partial or total reduction of eyes, elongation of the organs of touch or smell, and in lower breeding rates than in surface dwelling types. The group is further divided into stygobiontic (living in water) and aerobiotic (land-living) types, such as crabs, worms and springtails.
The olm (European salamander) occurs only in caves in Slovenia and Croatia.

1. Amphipods Niphargus. These crabs get their food mainly from preying on smaller cave dwellers
2. Diplura (Campodea staphylinus)

Troglophile animals

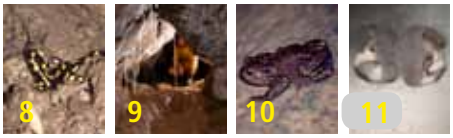
Such animals are temporary cave-dwellers or live in cave entrance regions, because they favour the protection, the regular temperature and the constant high humidity in the caves and crevices. They have not adapted to the total darkness in the cave, so some of them leave the site to find food or to mate, some live in the light of the entrance region or only come to hibernate. They include some bats, spiders, birds, gnats, beetles and butterflies.



3. Freshwater isopod, (Asellus cavaticus)
4. Herald moths, Scoliopterix libatrix
5. Fungus gnat, (Speolepta leptogaster), a troglophile

Trogloxenes

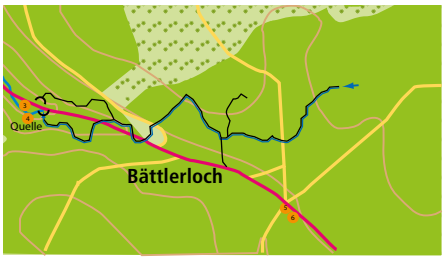
These are only brief visitors to cave entrances. They are unable to exist in caves. Some land there only accidentally, e.g. fall into a crevice or shaft, are washed into the cave or carried in by other animals. They are unable to survive for long and die quickly. They thereby become part of the subterranean life-cycle in the form of food for the other two groups.



6. The cocoons of the cave spider Metidae hang from the cave roof like lanterns
7. The cave spider Meta menardi is widespread in our region
8. A fire salamander that has fallen into a shaft (a trogloxene)
9. Speleologists love caves, but they cannot survive inside them for long without technical support (trogloxene beings)
10. A toad in the Réclère cave in the Jura (a trogloxene animal)
11. Dormice like to hibernate underground, shown here in the Bernese Jura.

Biospelaeology	The study of life in caves
Cave animals	Dragons and monsters appear only in fiction! Cave animals are creatures that spend some, most or all of their lives in caves. Genuine cave animals are mostly very small and can often only be seen on close inspection.

6 The protection of caves



Here we are close to the end of the known section of Bättlerloch (ca. 150m to the north and 16m below ground)

It is the catchment area of the cave stream. So far the source of the water has not been investigated. Presumably it seeps into the ground under the forest floor via the surrounding dolines and the many small cracks in the rock.

Why are caves worth protecting?

A cave and its content is a more or less sealed biotope, which reacts to a variety of changes and is unable to regenerate itself. Caves contain scientifically important information about the development of human civilisations, the formation of the landscape and the effects of climate change.
Although caves appear to be hostile to life, as biotopes they contain a myriad of minute life forms which, in some cases, have developed totally independently of external influences.
Most caves have been created by water and serve as subterranean drains in limestone areas. Unlike ground water in the gravel of valley floors, water in limestone is rarely self-purifying. Material that is washed into crevices, caves or dolines, reappears after a few hours or days almost unchanged at the spring.
In the Jura area, but also in many alpine regions, countless communities draw their drinking water from springs in the limestone.
Any waste-disposal into dolines, basins and shafts endangers the quality of the spring water.
That is why we need to respect, value and protect caves in their entirety.

A few guidelines for visitors

Please do not touch... Every touch leaves traces and may interrupt processes that have been going on for centuries. Dripstones (even broken ones) belong to the cave environment, and not on bookshelves as ornaments.

Caution! Ceiling ... Caves are not always suited to our height or gait. Careless movement can cause irreparable damage and ruin.

One track is enough...Visiting a cave without impairment is impossible. We can keep the damage to a minimum by following in the tracks of earlier visitors.

Refuse...People who are environmentally aware avoid creating rubbish whenever possible. This is even more important in caves with their limited space. "What you carry into the cave, you have to carry out again".

Fauna... It does not take much to upset the biological balance of the biotope that is the cave in a major way (rubbish, batteries, carbide residue, excrements, smoke etc). Often caves are winter quarters for bats. Disturbance can initiate an awakening from hibernation. Repeated disturbances may lead to the death of the animals.

Water circulation and its pollution

Potential influences:

1. Agriculture with fertilizers, liquid manure and pesticides
2. Road traffic carrying dangerous goods and fuel
3. Towns and individual buildings with their sewage and waste
4. Refuse of all kinds that are deposited in shafts, caves, dolines, crevices, ravines etc
5. Industry, craft and trade with their wastewater, poisons and refuse

This illustration represents the typical karst landscape of the Swiss Jura. It is clear to see that a wide variety of situations have a direct connection and influence on the subterranean world and its water courses. They not only endanger the subterranean ecosystem, but also greatly threaten the karst springs that provide drinking water.

Animal bones and carcasses in Kleinen Hölloch, Gempen

Animal carcasses in a shaft

Graffiti in Schindelbodenhöhle

Industrial waste in Kleinen Hölloch, Gempen

Clean-up of a cave in the Swiss Jura

Doline	Doline (slavonic): Valley. Funnel- or basin-shaped indentation with subterranean drainage in limestone areas.
Fracture	A break created by movement in the rock (tectonic movement)
Carbide residue	Remnants of calcium carbide (calcium hydroxide). Carbide is the fuel for acetylene lamps.

7 Schällbachponor

Schällbach is a stream on the surface that has its source in the meadows above Breitenbach. It snakes through the woods until it seeps into the ground at several drainage sites a short distance before and after Schällbachponor. The Schällbachponor is a much older, fossilised stream drain.
The vanished water can be found at the lowest point of the cave, where it collects in a siphon and reappears in the pipe-spring in Kaltbrunnental (as demonstrated with dye tracing).

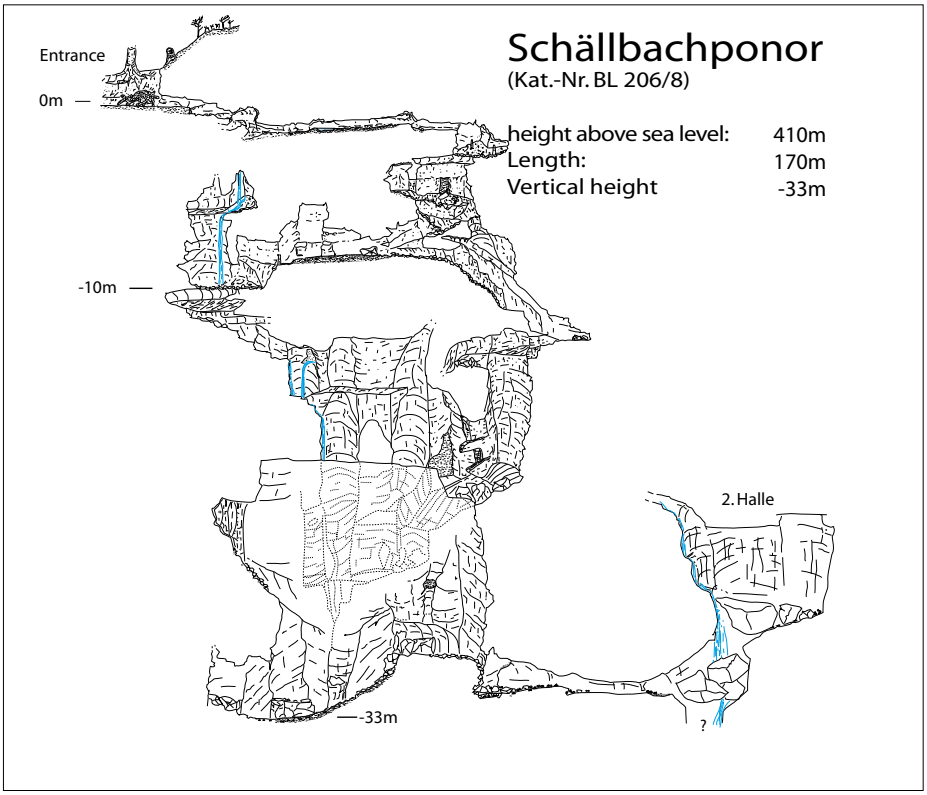

In the narrow entrance passage


Entrance area

After heavy rain the drainage sites are not always capable of absorbing the whole stream. Its water then runs into the cave entrance. The stream can sometimes be dammed up to 2m above the cave entrance.
Schällbachponor, with its length of 170m and a depth of 33m, is the deepest cave in this karst area and forms, together with its two end halls, the largest known cavity in this region. In September 1973 blasting made access possible. The second hall was only discovered on 2 July 2002. The entrance area with a diameter of 60x50cm and a length of 8m is a psychological as well as a physiological challenge even for experienced cavers.


In the shaft area


Entrance area at high water (when flooded)



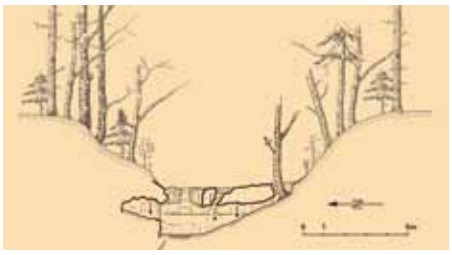
Fossil drain	A stream drain which is no longer active
Karst	The name of an area near Trieste. It has become the overarching term to describe all similar limestone regions with underground drainage and signs of erosion by dissolution such as caves etc.

Ponor caves

Ponor is the serbo-croatian term for a drainage site of a stream (or lake). Usually streams are not present in karst. But as soon as water from neighbouring regions or from areas sealing it off on the surface (e.g. cover from a moraine) reaches the karst below ground, it is swallowed up. Occasionally such stream drains are accessible to man. We call them ponor caves.
They are very different from the random runoff of rainwater or water from melted snow. In most of the karst areas in Switzerland random drainage is far more common than the spectacular localised disappearance of a stream into a ponor. Ponors are not unusual, but mostly occur in the form of narrow clefts or are blocked up by washed-in debris (clay, rubble, tree branches) making them inaccessible to cavers. (The positions of the drainage sites are constantly changing, allowing only short periods of time for the formation of large cavities). Real ponor caves are rare in Switzerland, especially in the Jura region.

Caution: when the weather is uncertain (thunderstorms, rain) a visit to Schällbachponor without proper equipment and without prior experience should not be undertaken. Rescuing a casualty is almost impossible – there is a real danger to life.

8 Double doline in Schäll



This double doline is just one of many random dolines here in the forest.
They were created by the collapse of the roof of a horizontal underground passage. This passage is blocked at both ends by fallen earth.

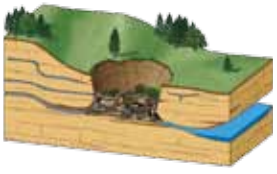
Dolines

Dolines are common karst formations occurring in the shape of funnels, basins, or as shallow dents in the karst landscape. In the slavic languages 'doline' is the word for valley but also for small closed cavities in the karst.

The diameter of dolines varies between just a few metres and 1500m, with depths of up to 300m. They may appear isolated or occupy whole fields or form in extended rows along the edges or breaks in the rocks.

Dolines are formed in places where surface water seeps deep into the ground. These are weak spots in the rock formation, such as clefts, rock edges or breaks.

The only exception to this rule is the collapse doline, which can be caused by the instability of the overlap of the underlying cavity.The two most important factors in the creation of dolines are precipitation (rain or snow) and the presence of soluble rock such as limestone, marble or dolomite.



AZ 4242 Laufen

WOCHENBLATT

Nearly swallowed up by a doline

Suddenly the ground collapsed under the feet of a hiker

Last week, near Brislach, a lady was nearly swallowed up by the earth, because the forest floor collapsed under her.

Martin Staub

South of Archhof at Breitenbach the ground often opens suddenly, creating holes. Such dips in the middle of agricultural land appear from time to time. They are due to the karst substructure.

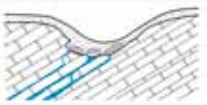
The water running through it dissolves the surrounding limestone (gypsum), creating cavities. The weight of the soil above can cause it to collapse into them. Walther Wyss from Hof Arch tells us, that these holes, with a diameter of up to several metres, run in a south-easterly direction towards Lindenberg.

A lucky escape

One lady was especially lucky last Friday when she was walking with a group in the forest east of Brisach in the so-called "Einschlag".
On the Grellinger path the floor suddenly collapsed under her. She had a lucky escape, because the situation could have been much worse. She only sank into the ground with one leg, although almost to her hip. She might have disappeared into the ground altogether if it had not been for her other leg, which prevented her fall, but fractured in the process. On the ensuing inspection, the hole, with a diameter of around 80cm, proved to be the opening to a very large cavity. Its diameter is 2 metres and it is almost six metres deep.

What a surprise for a layman/woman: the ground suddenly gives way!

Dolines formed through solution



They are formed when the rock under the soil is dissolved, thus enlarging an existing crack. Fine rock particles are washed away, and the resulting cavity fills up with soil from the surface. Flat indentations or basins are formed in this way.

Subsidence dolines

These are formed by the slow downward movement of the surface. Erosion below ground dissolves and moves rocks. Rocks from further up move into the gap.

Alluvial dolines

These are a mixture of solution dolines and subsidence dolines. Here the cracks in the rocks (drainage paths) are large enough to carry away surrounding loosened material. This encourages the process of erosion (destruction, transport and deposit of rock) on the surface and below ground. The loose material at the top drops down, the rock below ground settles, and a funnel is formed.

Collapse doline

They are usually the result of a single rapid event, caused by the closeness to the surface of hollow spaces. Such a collapse can be triggered by a heavy weight, e.g. a tractor or a cow, or a roof that breaks when it becomes too heavy above an expanding cave. With luck this will open a new access to a cave.

Karst formations	The term for depressions, caves, dolines (funnel or basin-shaped) etc. found in limestone above or below ground.
Limestone	A sedimentary rock easily soluble by weak acidity. Calcium carbonate.
Marble	A hard rock of limestone or dolomite, created by strong external influences.
Dolomite	A form of rock with properties similar to those of limestone, but often harder, more brittle and more porous. Calcium-magnesium carbonate.
Subsidence	In geology: the process of a lowering of a large area of the earth's crust over several million years.
Erosion	Mechanical wearing away, mostly through a combination of water and the gravel and boulders it carries.

9 Ibachhöhle

The Ibachhöhle is a small cave with a spring and the typical elliptic profile of a bedding plane passage. The origin of the water is unknown. It probably comes from the seepage water entering the small dolines on the surface just above the cave (double doline in Schäll).

The Ibachhöhle is safe to access.
Test the acoustics. At the first bend you can try to achieve a booming sound by humming at a certain pitch.

Typical passage formations

Openings in caves are almost always influenced by clefts, gaps in layers or breaks. On the one hand they can be described as crack passages, cleft passages and layer gap passages. On the other hand these openings are classified descriptively according to their cross-section (elliptic, key-hole, cupboard or cleft profile) or according to their shapes (labyrinths, halls, shafts, dead-ends or overhangs).

Bedding plane passage


These form below water. Their profile is generally that of a flat ellipse. The entrance to Ibachhöhle is a good example of an elliptic profile. Often clefts and layers are creative elements in the formation of corridors. Clefts influence the direction of a passage, the layers its horizontal course and its profile.

Cleft passages


Are also formed below water along clefts. Influenced by the drainage direction such a passage keeps only rarely to the same cleft for any distance. Rather, the corridor follows a different cleft or cleft system, and therefore also its direction. For these passages a tall, narrow profile is typical.

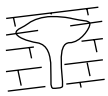
Crack passages


These passages, created by breaks that happen without corrosion are fairly widespread in Northwestern Switzerland. They can be several hundred metres long and reach a depth of 35 metres. Such caves are generally found immediately at the back of prominent cliffs and run in a straight line parallel to the cliff.

Overlays

When passages such as those described above are covered by other formations during the creation of the cave, the result is often a key-hole profile or meander.

Key-hole profile



A key-hole profile is created when bedding plane passage with an elliptic shape (the stem of the key) is later undermined by running water forming a ravine (the head of the key). Whereas this form of overlay is not very common in this region, the key-hole profile in alpine caves can reach a depth of 100 metres.
The term 'key-hole profile' is derived from the shape of the cross-section of such a passage.

Meander

A meander is created when a bedding plane passage forms on an incline or steep slope or cleft. It does not run straight, but meanders downwards, eating deep into the surface. Its course is similar to that of a meandering watercourse on the surface, but in the third dimension.
Contrary to the key-hole profile, the meander is characterised by its course and not its cross-section.

Hollows

Particularly large hollows or other striking cave spaces often occur in the middle of passages or near the entrance. Most prevalent in our region are the following forms:

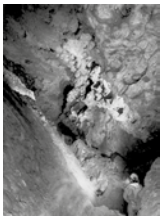
Overhang, rock shelter

These are overhangs where the rock forms a natural roof, and are generally shallow with a wide entrance.
They are mostly created by weathering such as frost cracking in winter. Most caves in this region belong to this type. Quite often they contain archaeological material, since they were then, as now convenient shelters for man and animals.

Shafts / chimneys

Shafts or chimneys are those vertical sections of passages that can only be accessed with the help of technical equipment (ropes, rock anchors, climbing equipment). Because of only minor differences in altitudes in its caves, such examples are lacking in this region.

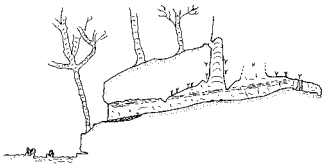
Halls



Large hollow spaces are very rare here. The hall at the end of Dieboldslöchli is probably the largest with its length of 30m, height of 8 metres and width of 5 metres.

Access	Is the term used for all modes of movement underground. Accessible = walkable, crawlable, etc. by man.
Doline	Donlina (Sinkhole) is a Slavic word for 'valley' and describes a funnel or basin shaped depression with underground drainage in a limestone region.
Cleft	Is a break created by movement in the rock.
Corrosion	In the forming of a cave: the chemical action of carbon dioxide eating away the limestone.
Meander	In the forming of a cave: a meandering canyon whose loops develop downwards
Weathering	Physical, chemical and biological decomposition on or near the rock surface, mostly resulting in loosening and wearing away.
Overlays	The changing of an existing form by new influences.

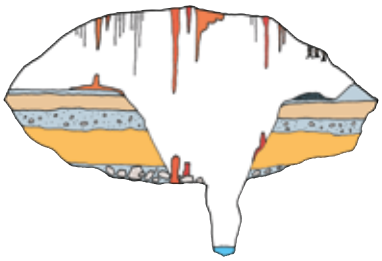
10 Contents of the cave



The Schindelbodenhöhle
The floor is strewn with angular rough-edged stones and soil to the back of the cave. At the end of the passage the floor consists of clay. The walls are partially flowstone covered, mostly in the shaft.

Cave Sediments

Sediments, precipitates and minerals are included in the term cave sediments.
Cave sediments can originate on the surface and be washed in, or can form in the cave itself.



There are three main groups of cave sediments:

1. weathered (eroded) rock (clay, sand, gravel boulder rubble)
2. chemical deposits (speleothems, gypsum and other cave minerals)
3. organic debris (from plants and animals, e.g. bat guano)

The speleothems refers to secondary mineral precipitates found in caves. The best known manifestations are the dripstones. i.e the downward hanging stalactites and the upwards projecting stalagmites.
Dripstones are produced when carbon-dioxide is produced root respiration and organic decay in the

soil and diluted in rainwater seeping as carbonic acid through cracks in the rock, dissolving limestone in the process. When such water drips into a cave, carbon-dioxide escapes in the form of gas, releasing the calcium carbonate which forms the dripstones. Evaporation is only a minor contributor.

Detrital sediments

Detrital sediments (detrital means broken) are deposits from already existing rock or mineral, e.g. boulders, round pebbles from the stream, sand and clay.

Boulders from a break down on the large passage (F1-Cave, BE)

Rounded pebbles from the stream (F1-Cave, BE)

Sand, remnants of rock carried in by water (Hölloch, SZ)

Clay-boulders created by dehydration (Hölloch, SZ)

Clay floor covered in cave-milk (F1-Höhle, BE)

Chemical sediments

Chemical sediments encompass all sorts of dripstones and calcite precipitates. Colours can change from white to yellow, red and brown to black, depending on humus or mineral content. Other chemical sediments are mineral efflorescence on walls and deposits.

Stalactite (Faustloch, BE)

Dripstone column: Stalactite and Stalagmite are merged (Faustloch, BE)

Biological sediments

Biological sediments contain animal bones, shells, guano (from bats), decaying plant material etc.

Bear skull (Y-Höhle, SO)

Frog skeleton (Hölloch, SZ)

Guano (Bat dung, (Rongkol Cave, India)

Ice stalagmites (Ice-cave, Monlési, NE)

Ice column (Vârtop, Rumania)

Ice in caves

Ice in caves is mostly present in caves where cold winter air has been trapped.

Excentrics	Excentrics are speleothem formations that grow in all directions, apparently unaffected by gravity. At their core is a fine tube, almost microscopic in size, which draws up water through capillary action. At its tip the water evaporates before it is able to form a droplet.
Cave clay	Clay is formed from the insoluble fraction of limestones, such as clay minerals, iron hydroxides and fine quartz sand (silicone). Material from the surface can also be washed down. In this way thick clay can be deposited.
Moonmilk	Cave-milk (moon-milk or moutain milk) is a whitish precipitate from limestone containing up to 90% water. Unlike speleothems it is soft and pasty to the touch

1. Curtain (Bärenschacht, BE)
2. Washed out flowstone (Bärenschacht, BE)
3. Gypsum crystal (Bärenschacht, BE)
4. Aragonite crystal (New Zealand)
5. Straw stalactite and excentrics (Faustloch, Bärenschacht, BE)
6. Dripstone column with flowstone floor (Bärenschacht, BE)
7. Calcite crystals in what was once a lake (New Zealand)

11 Prehistory, a long history

Caves as historical archives

The caves in Birstal are important archaeological archives. Thanks to natural protection from weathering (erosion), traces of prehistoric hunters and gatherers can be found in many places. These natural shelters have been visited time and again since the age of the Neandertals more than 50'000 years ago.

Dinosaurs?

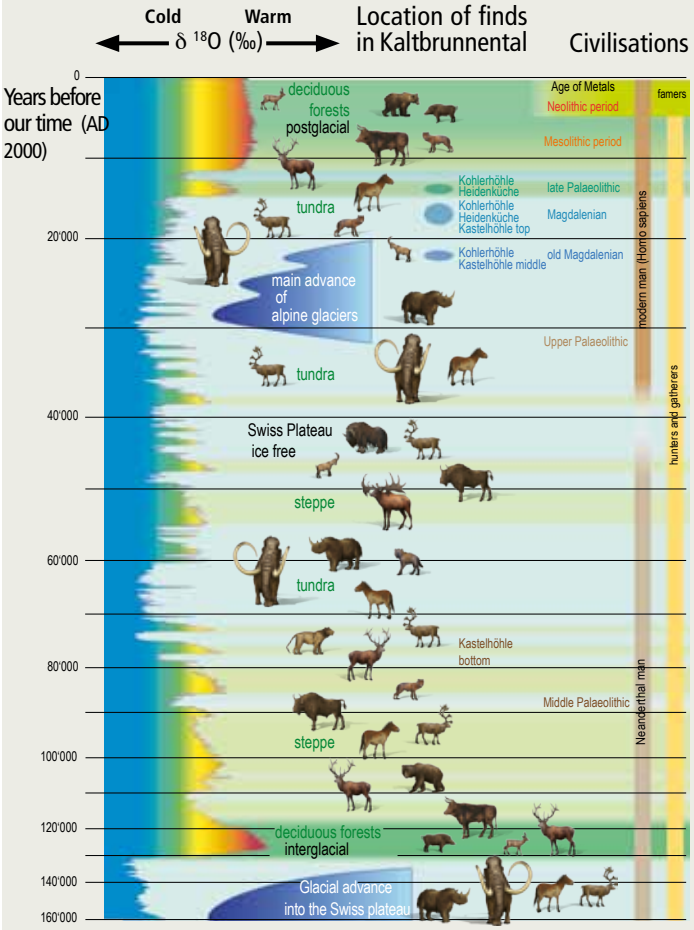
The dinosaur footprints in Courtedoux (JU) are approximately 150 million years old. They have their origin in a time long before the Jura mountains, with their karst areas and caves came into existence.

Despite the low population density during the early Stone Age, the finds from the caves along the Birs provide us with a detailed picture of human history. It is known that there were occasional raids by Neandertals in the Kaltbrunnental. Modern man, who appeared in Europe around 40'000 years ago left traces in the Birstal after the retreat of the alpine glaciers around 23'000 years ago. But continuous settlements were established only later, about ca 19'500 years before our time. More frequent archaeological finds date from 16'000 years ago.

During the last million years, the climate of the earth has suffered massive changes. Within only a few generations temperatures could drop substantially, leading to an ice ages, or rise to the point where glaciers disappeared altogether.The duration and intensity of these changes vary considerably. Many of these climate changes happned very rapidly (in both directions). Within just a few generations fundamental upheavals influenced the environment, causing great changes in fauna and flora.
Global temperatures in the way we know them today, occurred only during a few short periods in the last 1'000'000 years. During two thirds of this time the earth's atmosphere was quite cold. Here in the Jura the climate was cold and dry. During the last ice age (ca. 110'000 to 11'00 years ago) the Midlands were severely covered by glaciers between 32'000 and 20'000.

Animal and plant finds show the preponderance of a continental climate during cold periods. The land was covered by a generally tree-less tundra on which lived herds of reindeer, wild horses, bison and mammoths as well as rhinos and musk oxen. Also widespread were the great predators such as wolves, hyenas, lions and cave bears. In times of a more beneficial climate dense broad-leaved forests spread out over Europe, as today, with their corresponding fauna of stags, roe deer, wild boar and aurochs. But forest elephants and forest rhinos roamed here too. During the last interglacial period 125'000 years ago, even hippos lived in the Rhine.

In this ever-changing environment Neandertals, as well as modern man, managed to survive without problems. As an adaptable hunter-gatherer without specific ecological needs, man, unlike animals or plants, was able to adapt to the changing circumstances without having to leave the area for other habitats. Migration of animals in Birstal can be demonstrated thanks to genetic examination. The wild horses living at the end of the ice age are not the direct descendants of those at the time before the last glaciation.



Neolithic period	7000 - 4000
Mesolithic period	11500 - 7000
Upper Palaeolithic	40'000-11'500
Middle Palaeolithic	250'000-40'000
Lower Palaeolithic	2.5 Mio - 250'000

Years before our time (AD 2000)

δ ^{18}O The relation of light (^{16}**O**) and heavy (^{18}**O**) oxygen is a relative measure for climate differences in palaeo-climatology

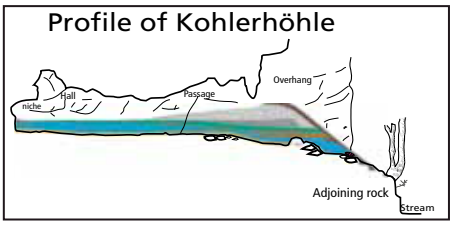
12 Archaeological discoveries

Cave dwellers?

The Kohlerhöhle and Heidenküche are two typical examples of the many stone age settlements in the Birstal. The image of "cave-dweller" is based on 19th century ideas of cultural history and is unlikely to represent the prehistoric way of life. Rather than living in the narrow confines of caves, prehistoric people settled mostly in the open air throughout this period, regardless of the prevailing climate. They lived by hunting and gathering edible plants. They hunted not only large animals such as wild horses and reindeer, but also smaller prey including wildfowl or hares, which formed a large part of their food supply.

Kohlerhöhle

The entrance to this cave was almost entirely buried except for a 30 to 40 cm high hole. When it was discovered in 1934 by Heinz Kohler, he found bones and stone tools from the Magdalenian, about 15'000 years old, on the surface at the back of the cave. By 1938 the cave had been completely excavated by Carl Lüdin, who discovered more than 10'000 stone tools and many more animal bones.



Soil cover

Ceiling rubble

Upper cultural layer with hearthstones and traces of burning (last and longest occupation)

Filling layers at the front of the passage

Lower occupation layer with traces of fireplaces in the rockshelter (abri), disturbed through flooding. Smoothed rubble mostly from the Obersequan.

Clay deposit between the lower and upper layers in the rockshelter (abri) without signs of culture.

Bolus with sediments of Huppersand on the surface

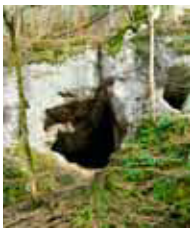
Lowest traces of fireplaces at the front of the rockshelter (abri)

Frontmost hearthstone of the rockshelter (abri)

The Kohlerhöhle is 18m long and is situated in an easily visible horizontal cleft. It is the lowest of three caves situated one on top of the other, which indicates that the course of the Ibach changed levels three times.
The archaeologists discovered an older and a more recent layer of finds. New radiocarbon (14C) dating estimates the age of the older layer as at least 23-24'000 years, a time when the Swiss midlands were still largely covered by glaciers. The younger layer contains faint traces of human occupation from about 19'500 years ago, but mostly from the late Magdalenian, 16'000 to 14'500, and, to a lesser degree of the late palaeolithic period about13'500 years ago. The finds from the late Magdalénien are composed of food waste (animal bones), stone tools to work animal skins and antlers, parts of hunting weapons, sewing needles, pieces of jewellery fashioned from animal teeth and also fossilised mussels and snails from the area around Mainz.

Heidenküche

Already in 1883 John Benedikt Thiessing discovered the first stone tools. Sporadic excavations took place until 1906. As far as can be seen from the finds kept in a number of museums, Heidenküche was in use during the recent phase of the Kohlerhöhle.



Heidenküche belongs to the first early Stone Age archaeological sites discovered in Switzerland (Kesslerloch near Schaffhausen 1873, the cave near Liesberg in 1874).
In 1864, a piece of tusk engraved with the image of a mammoth was discovered in 'La Madeleine', proving that prehistoric man was a contemporary of these now extinct animals.

Finds from Heidenküche after an original photograph of 1918.

Bolus	Bolus: loam rich in iron, is used for red pigment
Abri	a rock shelter formed by the overhang of a cliff
Magdalenian	archaeological epoch in mid- and western Europe at the end of the last ice age
Occupation layers	deposits in layers of earth with traces of human existence
La Madeleine	A rock shelter cave in the Dordogne (France) and eponymons site for the Magdalenian

13 Versturzquelle

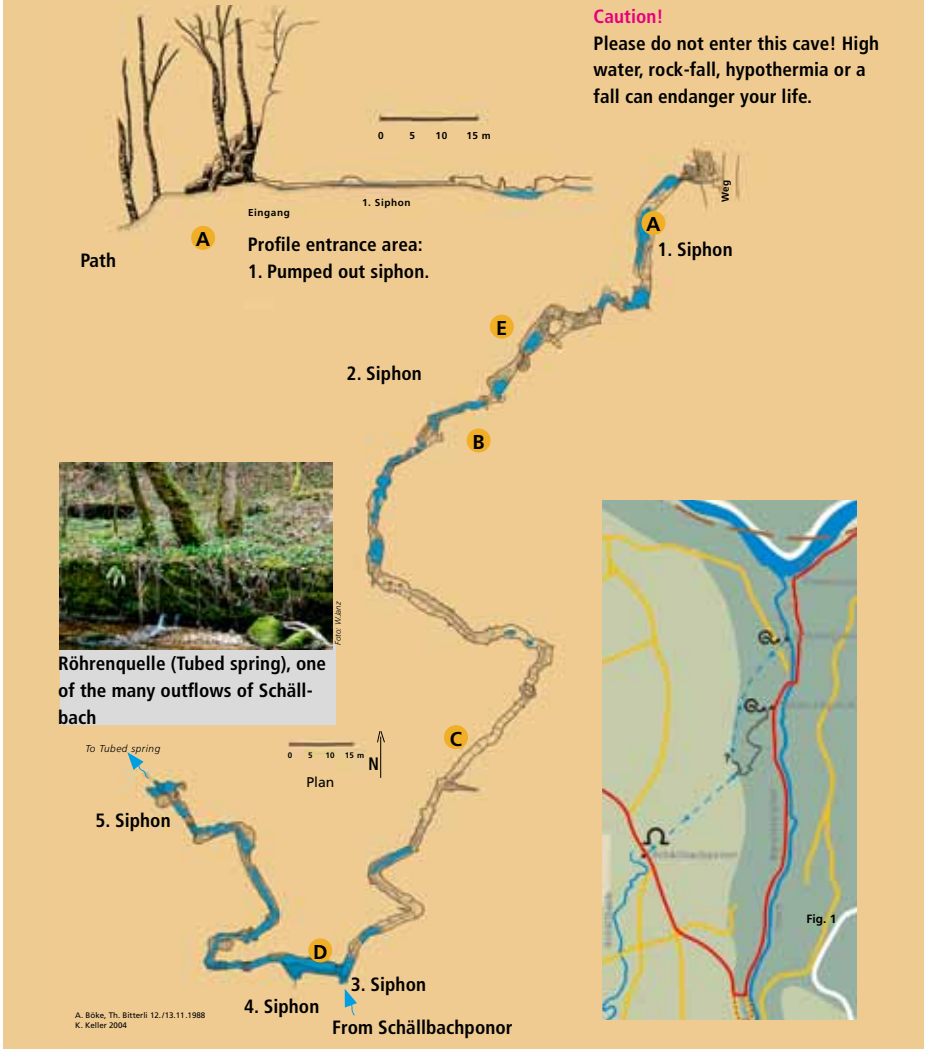
„Boulder-choked spring"

The spring of the 505m cave is part of the great Schällbach drainage system. It is only a small accessible part of it.

The Schällbach disappears approx. 600m to the south-west of the cave entrance into the Schällbach ponor – a small shaft cave (see board 7). It runs through part of this cave, drops into a siphon and surfaces here from beneath the Boulder-choked spring (4 Siphon). After another 100m the stream disappears again (5 Siphon), and reappears farther down the valley as a tubed spring, emptying into the Ibach (comp. Fig. 1).

The Röhrenquelle (tubed spring) is no longer recognisable as such because it is hidden by the Ibach embankment. Of special interest is the fact that at hightide, this cave acts as a relief channel for the tubed spring. The water level in the cave rises by about 20m before the whole passage is flooded. It then surfaces via the boulder-choked spring entrance and flows into the Ibach (Photo A).

The cave is only accessible when the first two siphons have been pumped out, but some depressions remain full of water and require freediving or diving with adequate equipment.

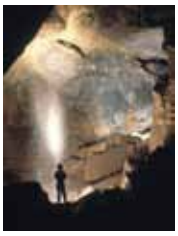


Drainage system	A network of several caves that are not connectively accessible, but are evidently linked as demonstrated by the flow of water.
Ponor	A Ponor is a hole in the ground through which surface water disappears or seeps into an underground cave.
Shaft cave	A shaft cave is a cave with predominantly vertical passages (shafts).
Boulder choke	A collection of large rocks or rubble that obstructs the passage of a cave entrance or passage, it is often inaccessible to man, but allows water to pass through.

14 Speleology

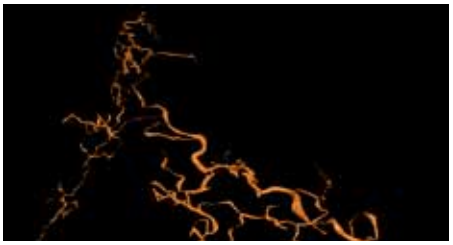
Speleology belongs to the Earth sciences. It mostly concerns itself with natural hollow spaces, concentrating on the exploration and surveying of caves, the courses of subterranean waterways, and the description of cave contents. Just like observing the endless vastness of the universe, looking at the hidden world underground brings new understanding of the past and contributes to our thinking about the future. Our everyday life benefits from the information gained from observing the underground watercourses.

Caves are no older than the rocks surrounding them. They are created by the changing conditions of the environment. Protected from short-term events, they are a valuable archive of past times. Events from geological cycles are depicted in the shape of passages and sediment.



To move around in caves safely, excellent equipment is required. In this realm of perpetual darkness, powerful reliable lamps are of immense importance.

Many obstacles have to be overcome – steep and perpendicular sections of passages with single rope technique, waterfilled stretches with diving equipment, arrow passages with patient use of one's own flexibility.



Speleology is a passion

Curiosity, the impetus of all research, is a powerful driving force. To enter into the unknown, to experience a new world, is fascinating. The most interesting challenge is to make this world visible with the help of surveys, maps and also other detailed descriptions, so as to better understand the context.
The cave leaves a strong impression on the speleologists, also during stays without scientific activity. They are comparable to those experienced by tourists visiting a cathedral or admiring jewels in a museum in a foreign town.

The drawing of cave maps depends on teamwork and requires a survey of the cave. This survey is generally carried out as a polygon course – the cave is measured between points. The measuring instruments are usually compass, measuring tape and inclinometer. Digital and laser equipment are also used. A great deal of practice is necessary to avoid measuring errors.

Cave rescue

In cave exploration accidents are fortunately rare. Any rescue is, however very difficult. That is why the Swiss Speleoloical Society (SSS) founded a rescue organisation.
The Speleo-Secours Schweiz is a country-wide rescue organisation with 220 rescuers. It performs search and rescue operations in caves and in other places difficult to reach for which the participation of specially trained rescuers who are familiar with such situations is a necessity. Speleo Secours Schweiz works in close cooperation with Alpine Rescue Switzerland.
An accident that happens underground usually makes retrieval of the casualty very difficult. The number of obstacles and the cave environment are the main reasons. It is impossible to remove a casualty by any other path than the one that brought him there in the first place. This is the big difference between cave rescue and mountain rescue, which benefits largely from rescue by air.

The Swiss Speleological Society (SSS)
is a society of friends of the underground world. It promotes Speleology in its scientific and leisure aspects as well as in the study of karst occurrences. It aims to increase the knowledge of the caves in Switzerland and to maintain their original character and beauty.
The society is composed of 42 sections with around 1100 members and hosts the Swiss Institute for Speleology and Karst Studies (SISKA).
SSS organises training courses, coordinates expeditions here and abroad, produces documentation and inventories, plays a part in scientific projects, works on guidance for health and safety and the protection of the caves, manages the rescue operation Speleo-Secours Suisse, and regularly organises national and international conferences. (see www.speleo.ch).

The SSS Basel
The Basel Speleological Society has a membership of around 110. There are regular meetings in Basel for information exchange, discussion of research projects and the planning of guided tours, camps, lectures, and other events. The principal research areas are located in Laufental and the Bernese Oberland. The society organises introductory courses in caving technique and other related disciplines. The activities of the society are documented in the society's journal and in its annual report.
Speleology in Switzerland is a hobby. Interested people of all walks of life can find out more by contacting the SSSBS or the SSS.
www.sgh-basel.ch