Cave and Karst Science Explained

Charlie Self gives layman's summaries of Cave and Karst Science issues 37(2) and 37(3), featuring UK speleohistory, sandstone caves in India, the largest caves in China, and more.

Issue 37(2) of C&KS contains a major hydrology paper from Iran plus four shorter reports.

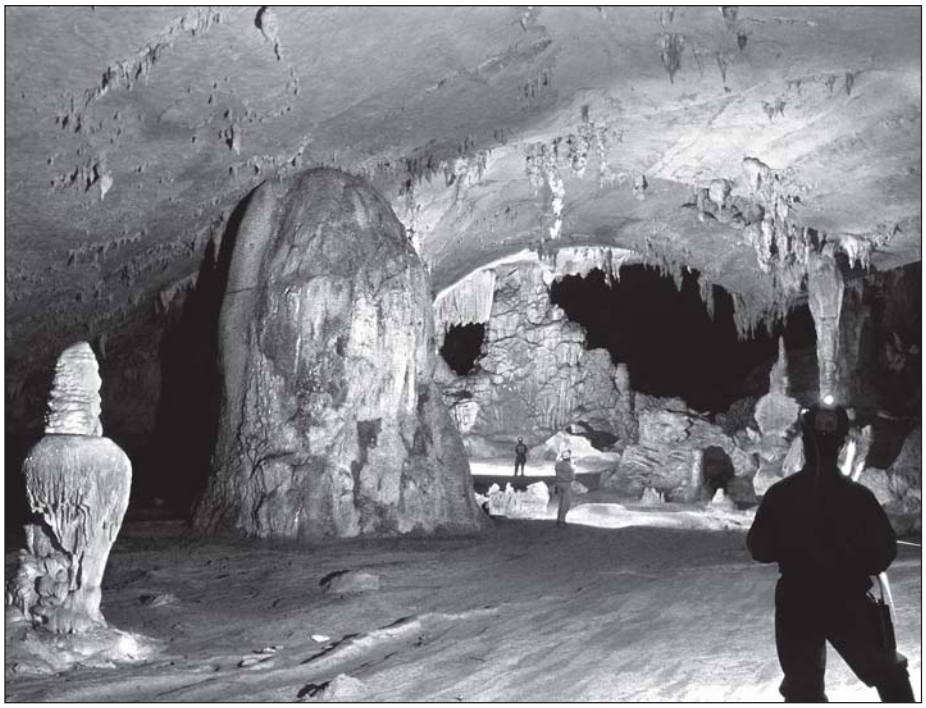
Conceptual Modelling of Brine Flow into Aquifers Adjacent to the Konarsiah Salt Diaper, Iran

Mehdi Zarei and Ezzat Raeisi

Fresh water is perhaps the world's most precious natural resource, since it makes life possible: directly as drinking water, indirectly when used for agriculture. In dry and semi-arid climates, there is a problem of contamination of groundwater by salts — as a result of concentration by evaporation (amongst other reasons). Karst groundwater is particularly important in such regions.

Deep beneath the surface in the Zagros mountains of southern Iran, there is a massive deposit of ancient rock salt — the remains of a dried-up sea. Because salt has a relatively low density, it deforms plastically and can intrude up into the overlying denser sedimentary rocks. This is known as a salt dome. At Konarsiah, deep faults have allowed the salt to rise all the way to the surface as a salt 'diapir', where it spews down-slope as a salt glacier. The salt diapir and glacier are in direct contact with nearby karst aquifers, turning them brackish and unusable.

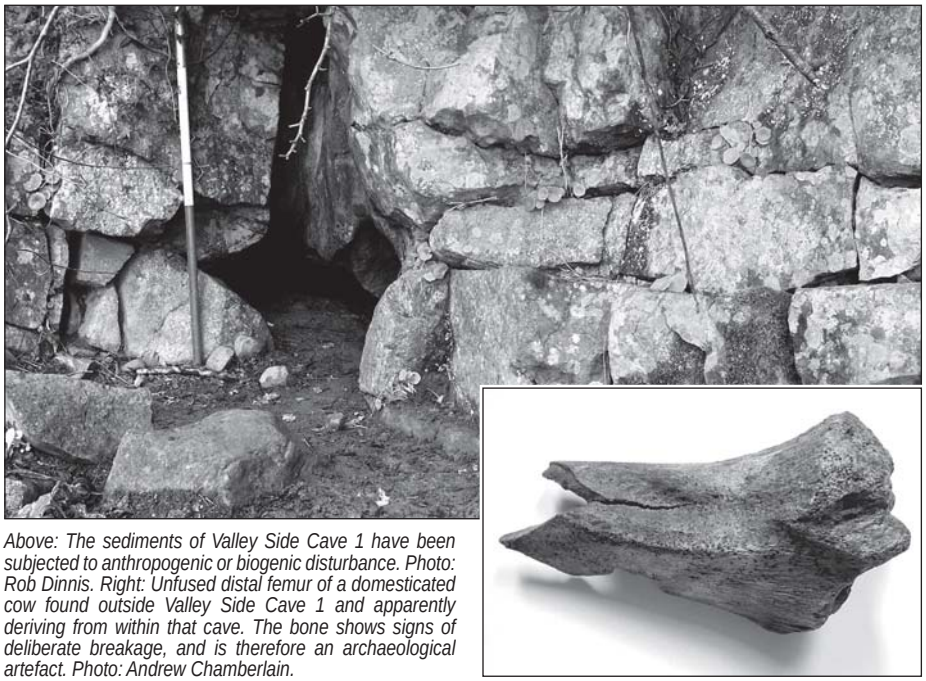
The authors have made a detailed hydrological and geological study of these aquifers in an attempt to model the flow paths of the groundwater and to determine where salt pollution enters the system.



Stalagmites in the old trunk passage of Jiangzhou Cave, Fengshan, China. Photo: John Whalley.

Their findings suggest that to the west of the diaper, it would be possible to access fresh water by constructing wells. To the east, the cutting of a drainage qanat (an underground gallery) close to the diaper might prevent salty water from entering the aquifer.

This paper is written by hydrologists for hydrologists, but it is more important than that. It demonstrates how a careful investigative study can make it possible for an environmentally sensitive development in an otherwise barren and unproductive landscape.



Above: The sediments of Valley Side Cave 1 have been subjected to anthropogenic or biogenic disturbance. Photo: Rob Dinnis. Right: Unfused distal femur of a domesticated cow found outside Valley Side Cave 1 and apparently deriving from within that cave. The bone shows signs of deliberate breakage, and is therefore an archaeological artefact. Photo: Andrew Chamberlain.

Non-invasive Assessment of the Archaeological Potential of Cave Deposits: the Example of Bishopston Valley Caves, Gower, South Wales

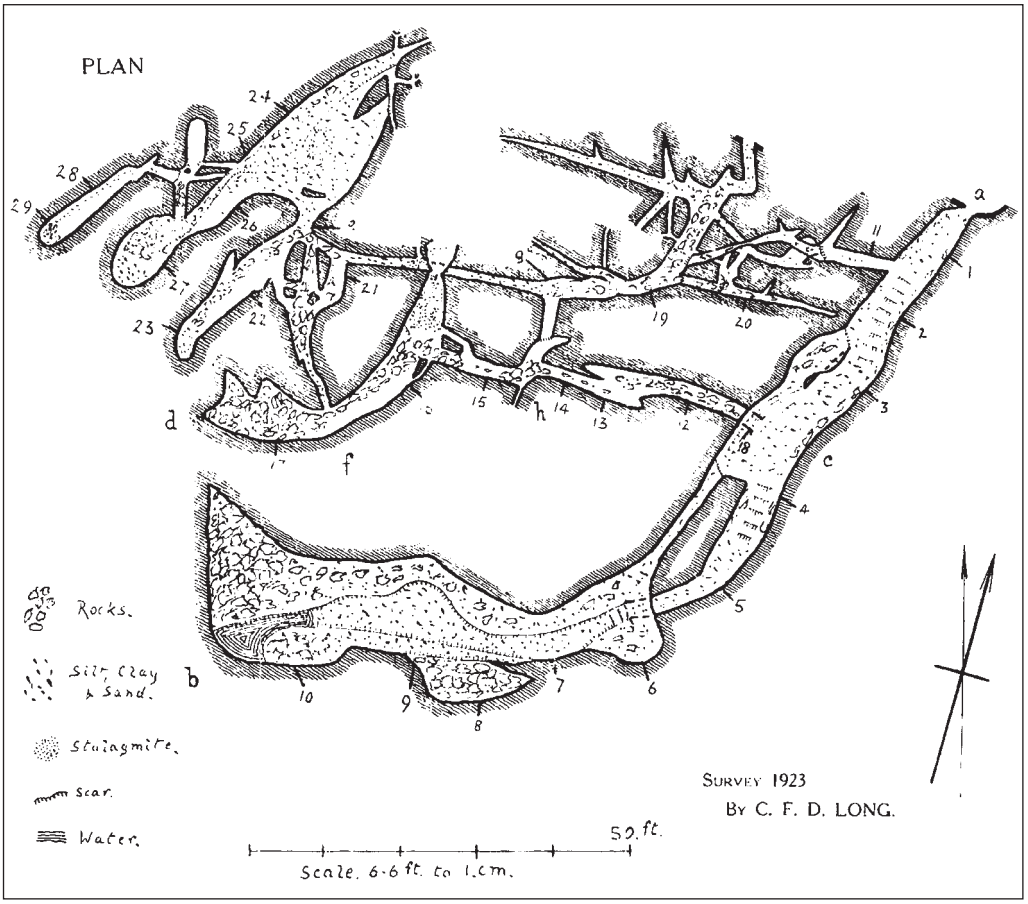
Rob Dinnis, Jesse Davies and Andrew Chamberlain

This is a short report on a visual inspection of the caves and rock shelters of a valley in Wales whose archaeological potential was previously unknown. Such assessments are necessary for the conservation and management of our archaeological heritage, which can so easily be destroyed by thoughtless human activity. At some sites, unauthorised exploration digging has already displaced some of these potentially important cave sediments.

Two Sandstone Caves on the Southern Edge of the Meghalaya Plateau, India

Sebastian Breitenbach, Johnathan Donges, Brian Kharpran Daly, Torsten Kohn and Till Kohn

Meghalaya hosts a spectacular limestone karst terrain which each year attracts international teams of cave scientists and explorers. Small caves are also known to occur in sandstone and



Plan view from Christopher Long's May 1923 survey of Howell Cave.

sandstone conglomerate strata, but few have been recorded. Congratulations then to this German team for making the effort to survey and prepare a report on two of these caves.

Large Caves in China

Yuanhai Zhang

This overview paper presents the current statistics on all the large caves in China. Factors considered include longest caves, deepest caves, large chambers and the total length of underground drainage systems. From such a review there appears an obvious contrast between the many large caves in the humid sub-tropical provinces of south-west China, compared with the semi-arid temperate provinces to the north and west where cave systems are fewer and less well developed. The author is careful to qualify his data with additional information so that previously published statistics (measured under different criteria) are seen in context. The paper is illustrated by photographs contributed by international cavers.

The Chronic Illness of Christopher Francis Drake Long (1902–1924), Who Extended Stump Cross Caverns and Discovered White Scar Caves, in England

Stephen Craven

I am not a fan of caving history but I recognise the merit of the subject, particularly when it comes to biographies of the early cave explorers. These few (mostly young men) pioneered the techniques and equipment from which modern speleology has evolved.

One of these men was Christopher Long, founder in 1922 of the first caving club at Cambridge University. Long very clearly had mental health problems, with times of manic energy alternating with long periods of morbid depression. It was during his manic phases that he made splendid surveys of Stump Cross Caverns in Yorkshire and Holwell Cave in Somerset. Unfortunately for him, bipolar disorder was untreatable in the 1920s and he died (probably accidentally) from a self-administered overdose of sedatives in 1924. The photograph accompanying the report is the same as used in the biography of George Barton (C&KS Explained in Speleology 16), the two men being occasional caving colleagues.

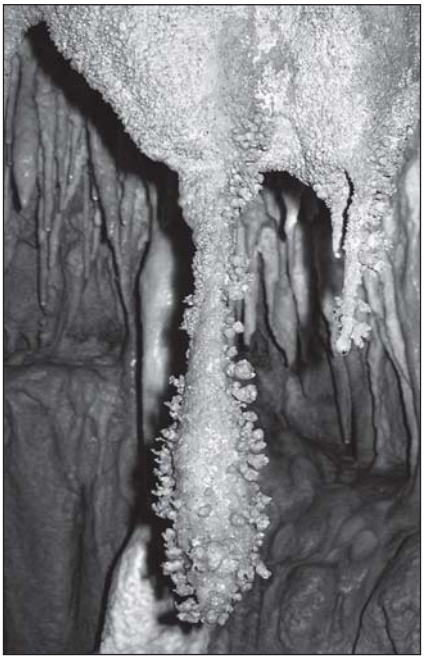
Issue 37(3) of C&KS contains a local report from the Republic of Georgia, plus two full papers from British cave scientists.

Speleology of Georgia: Aspects of its Current Situation and Perspectives

Kukuri Tsikarishvili, Shalva Barjadze, Eliso Kvavadze, Nana Bolashvili, Revaz Djanashvili and Inga Martkoplishvili

This is an interesting, if oddly presented, report from one of the world's great caving regions. Situated in the far south-eastern corner of Europe, the former Soviet republic of Georgia hosts the two deepest caves in the world plus two others that rank in the world top ten. The majority of the country's caves are in the medium and high mountain regions of the Caucasus, but there are a significant number in the foothills and intermontane plains. A few caves have developed in lowland limestone conglomerates.

The first half of the report is largely concerned with statistics based on the Georgian 'Cadastre of Karst Caves', which is probably similar to our own Cave Registries. The data is presented in a form that is still popular in eastern Europe — the number of caves in each size bracket is counted and their cumulative length/depth listed. The problem with this approach is that it becomes complicated when dealing with caves which have both length and depth parameters and perhaps several entrances; errors can easily be made. Our own statistical approach is to list cave systems by name according to their overall length and depth. From the text, it would appear that the multiple-entrance Tskaltubo may be the longest sub-horizontal cave system, but whether all parts have been physically connected is not made clear and only an approximate total length is given. From a table listing the deepest caves in the world, the Illyuzia–Mezhonnogo–Snezhnaya system (–1753m) would appear to be also the country's longest (24,080m).



Helictites in Tskaltubo Cave, Georgia. Photo: Amiran Jamrishvili.

The second part deals with speleobiology, in particular the authors' own palaeobotanical studies. These are of international importance. In two caves with archaeological material, twisted and dyed flax fibres were found in Upper Palaeolithic (Old Stone Age) sediments, dated at 33–30,000 BC. Younger sediments show that during the Eneolithic (Copper Age), the caves were used to house cattle.

The report contains colour photographs from a part of Tskaltubo Cave that has been developed for tourism, plus diagrams and photographs pertaining to speleobiology. The front and back cover of the journal show the landscape and caves of the high Caucasus, contributed by international photographers. I think it was a mistake for the authors to combine the two parts into one short report. Two separate full length papers would have allowed the space for a more detailed and focused account.

An External Model of Speleogenesis During Quaternary Glacial Cycles in the Marbles of Central Scandinavia

Trevor Faulkner

The first several pages of this large paper explain in great detail the history of glaciation in northern Europe and its causes. I won't claim it is easy reading, but it is a fascinating story. There follows an examination in similar detail of the scale of glacial erosion of the landscape. The general reader may wish to gloss over this, but I recommend a look at 'Table 1', which compares the different names used for the later Quaternary stages in northern Europe, Britain, the Alps and North America. This is very helpful and I will be using this table as a reference source in the future.

Seasonal ice in White Horse Cave — an example of the glaciokarst of the Arabika massif in the western Caucasus mountains of Georgia. Photo: John Gunn.

The model of speleogenesis proposed by the author will be familiar to those who have read an earlier paper (see C&KS Explained in Speleology 16). At the end of an Ice Age, when an ice sheet of several kilometres thickness melts away, the depressed land surface rebounds as a result of stress relief. This is accompanied by large earthquakes. These seismic shocks create new fractures in the otherwise crack-free marble bedrock, which can then be exploited by water to form caves. However these new 'tectonic inception' fractures are only created in near-surface strata, an empirical rule being to a depth of one-eighth of that of the local glaciated valley. This is similar to the amount of rock which is removed during each glacial cycle. Therefore a 'single cycle' cave which is created as the ice retreats is later destroyed when the ice returns. This is the main thrust of this paper: that viewed over several glacial cycles, individual caves develop down through the strata as their earlier upper levels are destroyed by surface erosion. So the few caves that have upper levels still intact are 'multi-cycle', developed over at least two glaciations. For cave development to outpace erosion in this way, the 'one-eighth' rule implies that such caves are the end result of at least eight glacial cycles.

This novel view of speleogenesis could usefully be applied to other glaciated karst regions. I know some geologists are sceptical of tectonic inception because of its perceived dependence on earthquakes. This is incorrect. In strata where bedding planes and joints are already present, post-glacial stress relief (with or without seismic shocks) will open these fractures so that penetrating groundwater will have turbulent flow, allowing rapid cave development. Could this explain why so many post-glacial (Holocene) caves in County Clare in Ireland seem to track the surface at shallow depth? And how else to explain the presence of Holocene quartzite caves in the Fell Sandstone of Northumberland?

Active vadose streamway in Bulandsdalgrotta, Norway. Photo: Martin Smith.

Some 'Lamp Floras' from Tourist Caves in Northern England

Allan Pentecost

This is a preliminary investigation into plant communities growing close to artificial lights in three tourist caves in Yorkshire. The different plant species were identified and measurements taken of the light intensity in which they grew. The bulk of the lamp flora consisted of various species of blue-green algae (cyanobacteria), with other algae (diatoms), mosses (bryophytes) and a fern species also present. One interesting observation is that cyanobacteria can alter their pigment composition in response to changing light quality — those in direct light from a fluorescent lamp were red-brown in colour, while those receiving the longer wavelengths of light reflected from muddy walls grew with a blue-green colour. Management of lamp flora is a serious concern for show cave operators and this study demonstrates the importance of both light quality as well as light intensity. ■

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P. valderianum forming greenish superficial growths on flowstone in White Scar Cave. Photo: John Gunn.