Geoconservation Research

Letter to Editor

Cave explorers and Geoconservation in the North of England – a Changing Paradigm?

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Introduction

Caves are defined as accessible natural cavities in rock formations. Most caves are initially formed by hydrological processes acting on slightly soluble rock forming minerals giving rise to karst landscapes characterised by solution caves, sinkholes, lack of active surface water courses and an efficient integrated underground drainage system. Caves act as nature's archives. By isolating material emplaced within the cave from the processes of erosion, they delay the destruction of otherwise rarely preserved materials. Cave interior deposits therefore provide a source of palaeoclimatic, palaeontological and archaeological data from times when surface evidence has been destroyed or greatly reduced. The processes by which materials are emplaced within a cave are selective so it must be assumed that the records of surface change deciphered from these deposits have been subject to filtering and are not a perfect record. The deposits within a cave are also subject to in-cave geomorphological processes such as floor slumping/collapse and reworking by invasive streams, having their own unique microclimate and occasionally by biological intervention during their geological past.

Caves pose a number of problems from a geoconservation perspective. The interior deposits are, by definition, not laterally extensive so must be considered a finite resource. They are also generally deposited on the floor of the cave so the vertical extent of the deposits is difficult to determine. Areas close to the entrances are often inhabited or used by burrowing animals today such as rabbits or badgers so stratigraphy can be disturbed or destroyed. The emplacement of deposits is often episodic and the overall rate of deposition can be very low making traditional stratigraphic analysis rather difficult as materials of widely differing ages can be deposited laterally adjacent rather than superposed. In spite of these potential biases, the study of cave interior deposits has become central to palaeoclimate reconstruction and has provided crucial archaeological evidence. It is no accident that many of the important sites from where evidence for early human evolution has been recovered are caves.

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Karst landforms in the British Isles are limited to a few geographical areas, mainly those underlain by massive limestones of Lower Carboniferous age (Waltham et al. 1997). The uplands of the Yorkshire Dales in the Pennine hills, forming the backbone of northern England, have the greatest extent of known cave development (Waltham & Lowe 2013, 2017). The area is a classic glaciokarst – a karst area where glacial processes have played an important part in landscape evolution. The effects of glacial action have included subdivision of the area by glacial incision as major U-shaped valleys radiate from the palaeo ice centre, draining of the cave network due to base level lowering with consequent roof collapse due to loss of buoyant support and the infilling of truncated passages on the valley sides with glaciogenic sediments. A review of the statutory body responsibility for landscape conservation in the area including caves is given by Hinde et al. (2012).

The karst of the Yorkshire Dales provides significant opportunities for recreational caving and cave descriptions are widely available to enable this (e.g. Cooper 2007, Allshorn & Swire 2017). A number of the caves are also used by outdoor education providers aimed at a range of end users including school groups and adult leadership training. A significant portion of the recreational caving population have an interest in seeking to discover previously un-entered cave passages. This affords one of the few opportunities to discover something unique. One of the main ways to achieve this in the Yorkshire Dales is to dig through the blockages which exist as a result of the glacially derived infilling. This could be through blockages in the passages to gain access to previously unvisited unfilled continuations or through now blocked surface entrances. There is a long history of undertaking such digging in the area (e.g. Cook 2004, Murphy & Chamberlain 2008) and this has been traditionally separate from the activities of archaeologists and antiquarians who also have a long history of activity in the bone caves of the area (O'Connor & Lord 2013).

History

The history of cave exploration in the region lacks an overall review; however, a burst of exploration in the 1960s resulted from the availability of reliable lighting and neoprene wetsuits giving greatly improved insulation and comfort. Following from this new period of exploration, the idea that the previously considered isolated sections of the caves could be linked was proposed (Brook 1968, Waltham and Brook 1980). This concept of the mega cave system would span parts of three administrative counties – Cumbria, Lancashire and Yorkshire ; thus, the idea was named the Three Counties System. Exploration by both digging and diving proceeded through the following three decades

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but by the turn of the millennium the idea was beginning to look like a real possibility (Walsh 2010, Pacey 2010). Groups of cavers had become highly proficient at dismantling underground and surface blockages (referred to as 'chokes' – a shortened form of the term 'boulder choke' - by cavers) and putting in place supporting structures to keep the excavated routes open. By 2011, the last parts of the system were finally linked (Allen 2011, 2012 a & b) and the Three Counties System became a reality to a nationwide media fanfare, being featured on the television and newspapers (Allen 2012c; "Into the abyss: Stretching over three counties and 70 miles", 2010; "Potholers break through the final Three Counties link ", 2011). The combined system is over 86 km long (Allen 2014) making it the longest in the British Isles and the 26th longest in the world. Caving, being a marginalised and regionally focussed activity, usually receives only a limited and generally negative media coverage in the UK, so this was a welcome exception.

Geoconservation Aspects

What are the effects of all this activity on the underground environment? The removal and disposal of many hundreds of tonnes of sediment along with the emplacement of supportive metal and woodwork into the underground environment has been mainly undertaken without much thought as to the environmental effects. Very little work has been undertaken as to what exactly happens to the engineering materials in the underground environment, but as a result of cavers' revisiting old dig sites searching for the right place to dig, now they had access to better cave maps and surveys, resulting in an appreciation that materials do decay over time and that abandoned digging sites need to be tidied up and cleared of tools and debris once digging has finished – something the previous generations of cave explorers rarely did. This has resulted in a community drive to clear up old dig sites (Allen 2015) spearheaded on the caver community web forum UK Caving (Ukcaving.com , 2018).

Geoconservation Case Studies of Good Practice in Cave Environments

A growing appreciation of the potential scientific value of the sediments has resulted in a closer cooperation between sporting cavers and the archaeological community. The number of caves in the Yorkshire Dales region now known to contain vertebrate remains has been boosted by cavers reporting new finds as a result of digging. The listing of caver reported sites has now reached 57 (Murphy 2018) whereas only 34 are reported from the archaeological literature. (Chamberlain 2018). This shows the incredible potential of the region for future archaeological, palaeological and palaeoclimatological studies. The analysis and subsequent publication of an intriguing early Holocene vertebrate assemblage which has provided new insights into the paleoclimate of the region (Lord et al. 2016) only occurred as a result of cavers' reporting finds during exploratory digging activities (Ramsey 2011). One outcome of this increased appreciation of the need to conserve the underground environment has been the development of minimal impact caving guidelines (Minimal Impact Caving Guidelines 2016) by the British Caving Association – the national body for caving in the UK. The guidelines cover new exploration activities as well as recreational visits.

The development of new less destructive and more controlled rock removal techniques has allowed passage enlargement to be achieved without the unnecessary removal of excess rock. Such techniques are now used routinely to pass constrictions, but as a result of minimizing rock removal, the physical challenge of the caving trip is maintained. This has led to the exploration of a number of new 'deep and tight' cave systems in the region where passing constrictions has been enabled but the physical challenge of the caving trip is maintained (e.g. Ramsey 2008, St Lawrence 2009, Swire 2009).

An appreciation of the limited life of support materials used to keep the cave passages open has resulted in a series of innovations to promote longevity of the emplaced supports. A common means of keeping a dug entrance open was to place an oil drum from which the top and base had been removed in the unconsolidated materials. Over the years, many of these have rusted and collapsed. The replacement with large diameter ribbed twin walled plastic tubing sourced from the underground utilities industry avoids any recurrence of the oil drum failure and has been undertaken at a number of sites in order to prevent entrance collapse (e.g. Benn 2012, Brown 2009). The use of steel scaffolding as support materials has been widespread and has been observed to fail after approximately 10 – 15 years. Replacement is now undertaken using galvanised scaffolding which has an expected life span of 25-30 years though this does have significant added cost implications (e.g. Hill 2017). The removal of generations of rusting metal work and replacement with concrete from one of the region's most popular vertical entrances is described by Duffy (2016). Increasingly, the intention is to avoid introducing metalwork at all and to use the dug passage fills to build supporting walls. These can be dry (without mortar) or cemented into place. Such techniques have recently been used successfully and are increasing in popularity amongst the cave digging community (e.g. Walker 2012).

Conclusions

The crowning achievement of cave exploration in England has been the linking together of the fragmented Three Counties system to create a cave system of world stature. A side effect of this exploration has been a growing appreciation of the importance of conservation in the underground world among the caving community and an increased involvement in practical cave conservation. Such considerations will hopefully be at the forefront of the next generation of cave explorers in the region as there are still many opportunities to find new passage and the idea of an even more extensive integrated cave system has been suggested (Brook 1971). Perhaps, the geoconservation lessons learned in the very well explored karst area of the Yorkshire Dales could be applied to other areas around the world where cave exploration has moved beyond a case of entering open passages but now requires digging, either at the surface or underground.

Conflict of Interest

Authors declare that they have no competing interest

References

- Allen T (2015). If in doubt – bring it out. Descent 245: 20
- Allen T (2014). The longest cave. Descent 240: 36
- Allen T (2012a).The final piece of the jigsaw. Descent 224: 18-21
- Allen T (2012b). The final piece of the jigsaw. Descent 225: 19-21
- Allen T (2012c). The three counties media circus. Descent 225: 24-26
- Allen T (2011). At last, a reality. Descent 223: 32&33
- Allshorn S & Swire P (2017). Northern caves - The Three Counties System and the North-West. Leeds: High Mead, UK.
- Benn G (2012). Restoring Christmas Pot. Descent 227: 13
- Brook D (1971). Trans Craven: 3rd generation cavers could complete a 200 mile giant. Descent 18: 16-18.
- Brook D B (1968). The Three Counties System. University of Leeds Speleological Association Review 3: 15-19.
- Brown T (2009). Whitewell pot restoration. Descent 211: 10.

- Chamberlain A.T. (2018). Gazetteer of caves, fissures and rock shelters in Britain containing human remains. http://caveburial.ubss.org.uk/. Retrieved 2018.

- Cook L B (2004). Anatomy of a dig. 50-52 in: Beck H M (ed). Craven Pothole Club Jubilee Journal. Craven Pothole Club, Skipton, England.

- Cooper M (2007). Not for the faint hearted: 50 harder caving trips in the Yorkshire Dales. Privately Published. Ingleton, North Yorkshire, UK.

- Duffy R (2016).Lancaster Hole - entrance replacement. Journal of the Red Rose Cave and Pothole Club 11: 92-95.

- Hill E (2017). Penghent entrance. Descent 258: 14.

- Hinde A, Townley H, Stedman N & Brown E 2012. Cave conservation, geodiversity and landscapes in Northern England. 11-14 In O'Regan H J, Faulkner T and Smith I R. Cave archaeology and karst geomorphology of North West England. Field Guide, pp 11-14. Quaternary Research Association. London.

- Into the abyss: Stretching over three counties and 70 miles, inside Britain's vast and newly pioneered cave system (2010, 26 July). Daily Mail: World News.http://www.dailymail.co.uk/home/moslive/article-1296308/Into-abyss-Stretching-counties-70-miles-inside-Britains-vast-newly-pioneered-cave-system.html . Retrieved 20 July 2015.

- Lord T & Howard J (2013). Cave archaeology. In Waltham T and Lowe D (eds) Caves and Karst of the Yorkshire Dales Volume 1, pp 239-251. British Cave Research Association.

- Lord T. C, Thorp J. A & Wilson P (2016). A wild boar dominated ungulate assemblage from an early Holocene natural pit fall trap: Cave shaft sediments in North West England associated with the 9.3 ka BP cold event. The Holocene 26 (1): 147-53

- Minimal Impact Caving Guidelines (2016). Http://british-caving.org.uk/wiki3/lib/exe/fetch.php?media=conservation_access:micg.pdf. Retrieved 2018.

- Murphy P.J (2018). A gazetteer of vertebrate remains from caves in the Yorkshire dales referenced in caving club journals and allied literature http://bonecaves.ubss.org.uk/. Retrieved 2018

- Murphy P. J & Chamberlain A (2008). Cavers and geoconservation: The history of cave exploration and its contribution to speleology in the Yorkshire Dales. In Burek C, V & Prosser C, D (eds). The History of Geoconservation. The Geological Society, London, Special Publications 300, pp 207-215. Geological Society, London.

- O'Connor T & Lord T (2013) Cave palaeontology. In Waltham T and Lowe D (eds) Caves and Karst of the Yorkshire Dales Volume 1, pp 225-238. British Cave Research Association.

- Pacey N (2010). Closing the gap. Descent 215: 23-27.

- Potholers break through the final Three Counties link (2011, 7 Nov) The Guardian. https://www.theguardian.com/uk/the-northerner/2011/nov/07/caving-potholing-three-counties-system-gaping-gill-white-scar-caves-edouard-martel. Retrieved July 20, 2015.

- Ramsey D (2011). The Cupcake Connection. Descent 219: 30&31

- Ramsey D (2008). Rumbling Extension. Descent 200: 13.

- St Lawrence H (2009). Trapdoor Pot. Journal of the Red Rose Cave and Pothole Club 10: 31-36

- Swire P (2009). The Dead Bobbin Series, Rumbling Hole, Leck Fell. Journal of the Red Rose Cave and Pothole Club 10: 311-315.

- Ukcaving.com (2018). https://ukcaving.com/board/index.php

- Walker I (2012). Nine months in Crescent Pot. Descent 228: 42-45.

- Walsh A (2010). The Three Counties System: chasing the dream. Descent 215: 18-22.

- Waltham T & Lowe D (2017). Caves and Karst of the Yorkshire Dales Volume 2 The Caves. British Cave Research Association.

- Waltham T & Lowe D (2013). Caves and Karst of the Yorkshire Dales Volume 1. British Cave Research Association.

- Waltham A. C, Simms M. J, Farrant A. R & Goldie H. S (1997). Karst and Caves of Great Britain. Joint Nature Conservation Committee.

- Waltham T & Brook D (1980). The Three Counties System. Transactions of the British Cave Research Association 7: 121.