



# Communities, Quarries and Geoheritage—Making the Connections

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## Abstract

Successful geoconservation increasingly depends on securing understanding and support from local communities and the decision makers within them. As most people do not understand geoscience, value geoheritage, or support geoconservation, it is extremely important that ways of raising awareness of geoheritage and building support for conservation are found. Connecting communities to their geoheritage is central to achieving this, and can be done in a variety of ways. Quarries and quarrying, including mines and mining, are perhaps the most effective means of engaging communities with their geoheritage as every quarry is ‘man-made’, and as such has a cultural connection with the community that worked it. Using examples from England, different connections between communities, quarries and geoheritage are described, and ways of making these connections are explored. Innovative approaches to making these links, such as those that involve physical engagement and activities with the community, and which contribute to a wider social agenda, are highlighted. The concept of an Anthropocene epoch, emphasising the links between society and its visible impact on the natural environment, including the geological record, provides a new context within which to use quarries to link communities to their geoheritage.

**Keywords** Geoheritage · Geoconservation · Quarries · Quarrying · Communities

## Introduction

Quarries, used throughout this paper to include both quarries and mines, are of fundamental importance to science and education, providing ‘windows’ into the geological past which enable geoscientists to study, describe and interpret the history of the earth and the evolution of life. They are also places where the skills needed to locate and extract the natural resources on which society depends can be developed and honed. Such man-made exposures are particularly important in inland lowland areas, providing access to geology in places which often lack the exposures that occur naturally in mountainous or coastal environments. Quarries are important in geoconservation too (English Nature et al. 2003; Prosser et al. 2006; Thompson et al. 2006; López-García et al. 2011; Parkes and Gatley 2018; Prosser 2018) and feature heavily in most geoheritage inventories and

geoconservation action plans in most countries. This may be as operating quarries, or if not infilled or highly degraded once operation has ceased, as disused quarries. Either way, they can provide a valuable resource for scientific research, education, training, recreation or geotourism (Prosser 2003, 2018; Stefano and Paolo 2017; Mata-Perelló et al. 2018). In fact, many protected, managed and interpreted geoheritage features occur in quarries that provide a spectacular, safe and accessible place where geoheritage can be accessed, promoted and used as a means of engaging with local communities. These local communities, including the politicians and decision makers associated with them, are extremely influential in determining whether or not geological exposures in quarries are conserved in the long-term, or lost to quarry in-fill or other development.

## Linking Communities with Their Geoheritage

Gray (2013) argues that if geoheritage is both ‘valued’ and ‘threatened’, then, there is a clear need for geoconservation. Whilst a range of ‘threats’ to geoheritage exist and have been described in some detail (e.g. Prosser et al. 2006, 2018; Gray 2013; Crofts and Gordon 2015), there is still little ‘value’ attached to geoheritage by society at large. In order to help address

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this shortfall in value, and thus to create conditions where action to conserve threatened geoheritage takes place, it is essential that local communities are encouraged to engage with their geoheritage, building understanding, value, and support for geoconservation in the process.

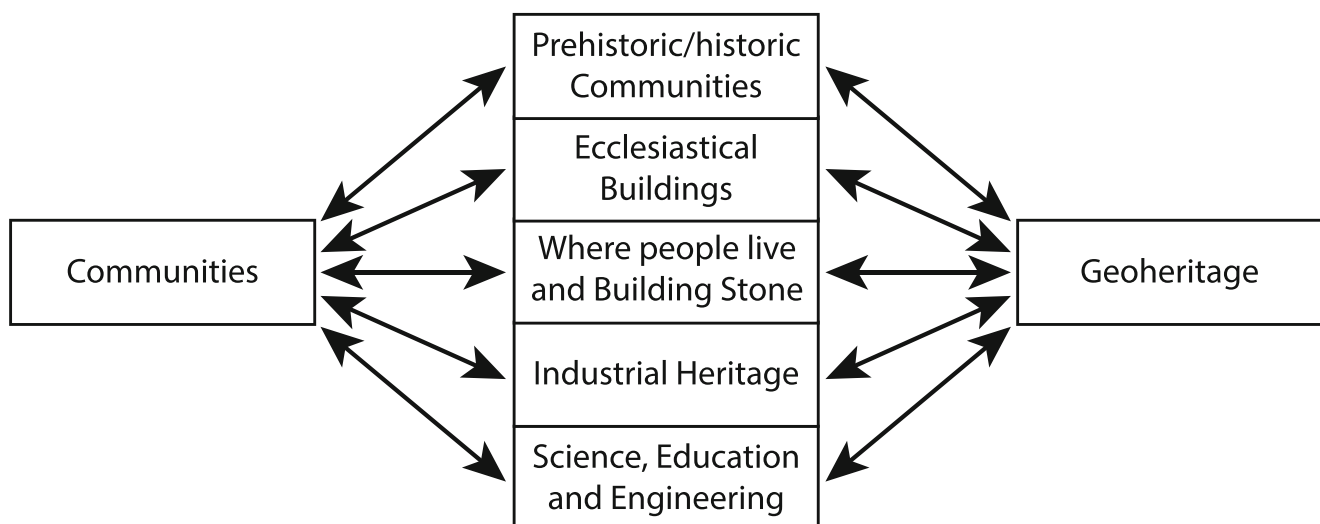
This need to make connections between communities and their geoheritage in order to generate appreciation of geoheritage and support for geoconservation is well understood (e.g. Parkes 2004; Gordon et al. 2012; Larwood 2017; Reynard and Giusti 2018). Such links can be made in many ways but often are made through seeking to bring ‘culture’ and ‘nature’ together, highlighting the long-standing cultural links between people, often local people, and the geology and landscapes with which they interact. Examples of such connections from the UK include linking people and society with:

- rock caves as prehistoric dwelling places e.g. Creswell Crags, Derbyshire and Nottinghamshire. <https://www.creswell-crags.org.uk/>
- raised or protruding geological or geomorphological landforms as sites of fortification and safe dwelling e.g. prehistoric hill forts such as British Camp, Herefordshire, England, Hadrian’s Wall constructed by the Romans in northern England, and medieval castles such as Harlech Castle, Gwynedd, North Wales.
- landscape and folklore e.g. the legend of the construction of the Giant’s Causeway, Northern Ireland by the giant Finn McCool (Briant 2017).
- fossils and folklore, for example, the ancient belief that fossil oysters are the ‘devil’s toenails’, and that belemnites are ‘thunderbolts’ sent down from heaven (e.g. Bassett 1982).
- geological features as artistic inspiration, for example, Mendelssohn’s Hebrides Overture, inspired in part, by the basalt columns of Fingal’s Cave on the Scottish island of Staffa (Gordon 2012).

## Using Quarries to Connect Communities with Their Geoheritage

Although the use of landscape, folklore and artistic inspiration as a means of linking communities with their geoheritage can be extremely effective, quarries provide some of the very best opportunities to connect communities with the geoheritage under and around them. Not only are quarries often more geographically widespread than are unusual or curious landforms, or geological artefacts that may inspire folklore or artistic creation, but they all have an obvious and direct link to local communities in that every quarry is a reshaping of the landscape resulting from the physical endeavour of people, most often local people. Thus, whilst coastal and river cliffs, mountain crags and gorges may provide attractive natural exposures of geology, quarries provide man-made exposures resulting, by definition, from human activity. A quarry exists because people chose to excavate it, usually to support a way of life at any given time in history. In other words, quarries reflect the way people lived, and the needs of society, at the time in history that they were being worked. This strong link is a powerful means through which to relate the culture and history of a community, via quarries, to its geoheritage.

Policy makers are now putting increased emphasis on valuing the ‘services and benefits’ for people that arise from nature conservation, rather than just on the intrinsic value of nature itself (Gray et al. 2013; Brilha et al. 2018). As such, the social, cultural and historical narrative associated with quarries provides a means of linking communities to their geoheritage, building understanding of how geology has supported the community in the past, and why conserving this geoheritage, and the evidence of how it was exploited in the past, is important. Whilst any support for geoconservation is extremely welcome, support for the conservation of geoheritage in quarries can be particularly important given



**Fig. 1** Illustrating some of the links where quarries and quarrying can be used to connect communities with their geoheritage

that there is often pressure from local people to infill disused quarries on public safety grounds, or to restore them to their original level on aesthetic grounds. Leaving exposed

geological features is rarely a first thought for local communities, but it is the overriding objective for geoconservation (Prosser 2018; Prosser et al. 2018).



**Fig. 2** Map of England showing the location of sites referred to herein to illustrate the ways in which connections have been made between communities and their geoheritage using quarries and quarrying. BCUGGP Black Country UNESCO Global Geopark Project, GG

Grimes Graves, HW Hadrian’s Wall, H&WEHCC Herefordshire and Worcestershire Earth Heritage Community Champions, ICP Irchester Country Park, IoP Isle of Portland, KE Kinver Edge, P Peterborough, S Stamford, Sh Stonehenge, SLP South Lodge Pit







◀ **Fig. 3** Peterborough Cathedral (a) constructed of Middle Jurassic limestone. The former mediaeval quarries at nearby Barnack (b) from where the stone for the cathedral was sourced—now a National Nature Reserve. The connections between the cathedral and this historic quarry are being promoted through guided public walks

Having set out the strength of the links between communities, quarries and geoheritage, it is self-evident that quarries have a key role to play in promoting geoheritage and building support for geoconservation. This potential has long been realised, and such links have been made for many years, even if only in an ad hoc way. For example, disused quarries/mines feature in all UNESCO Global Geoparks in the UK, with links between geoheritage and communities being emphasised in many instances, for example, through the mining and export of copper from Parys Mountain at GeoMôn UNESCO Global Geopark—Anglesey, Wales; lead mining from the North Pennines UNESCO Global Geopark, England; and chromite from Shetland UNESCO Global Geopark, Scotland.

### Potential Connections

There are many potential connections between communities, quarries and geoheritage that can be used to promote awareness and support for geoconservation (Fig. 1). The exact nature of these, and the most appropriate to use in any given circumstance, will depend on the geology exposed and extracted from a quarry, the size, physical form and character of a quarry, the way the quarry was worked, the use the extracted stone was put to, whether or not the stone extracted is still visible and accessible in local buildings or walls etc., who worked the quarry, historical links with local families and local communities, the way a local community views itself (does it regard itself as a mining community?), and the use and potential use of the quarry today—is it accessible and safe to visit, is it scientifically important, is it, or can it be, used for research, education, or recreation, or does it have potential for geotourism? The most appropriate links to use will also depend on the nature and attitudes of the local community and the expertise and skills of the geoconservationists or geologists involved in seeking to engage with the community.

The following examples drawn from England (Fig. 2) illustrate how some of these connections have been used, or could be used, to bring communities closer to their geoheritage.

### Prehistoric/Historic Communities, Quarrying and Geoheritage

Where they exist, examples of prehistoric quarrying and the use of stone by prehistoric communities provide a compelling way to link people to geoheritage by illustrating the long-standing relationship people have had with geology. In

particular, the value placed on stone for making tools and for ritual purposes illustrates why stone and its extraction has always been fundamental to human society. Grimes Graves, Norfolk, in eastern England (<https://www.english-heritage.org.uk/visit/places/grimes-graves-prehistoric-flint-mine/history/>), for example, shows evidence of extensive neolithic mining involving over 400 pits. These pits consist of shafts of up to 13 m deep and subterranean galleries excavated with great effort using antlers. They were dug in order to extract high-quality black flint for tools, weapons and ceremonial objects that were used locally as well as being traded over long distances. Similarly, Stonehenge in Wiltshire, southern England (<https://www.english-heritage.org.uk/visit/places/stonehenge/>), also demonstrates the importance that neolithic communities placed on stone, and the effort undertaken to locate, quarry and transport the ‘correct stone’ to meet their ritual needs. In this case, doleritic ‘bluestone’ was extracted and brought some 225 km from Pembrokeshire in South Wales to construct part of the internationally renowned stone circles of Stonehenge (Bevins et al. 2014).

In northern England, the 120-km-long Hadrian’s Wall World Heritage Site including the wall and its associated forts and settlements are built of local stone and take advantage, in terms of their physical location, of the geologically influenced topography (<https://www.english-heritage.org.uk/visit/places/hadrians-wall>). Constructed by the Romans, starting in AD 122, they provide a range of opportunities to link local communities, and the many tourists which visit the wall, to the local geoheritage, including carboniferous sandstones and the extensive dolerite Whin Sill intrusion, via the quarries created by the Romans to source the stone needed. For example, the Stone Sources reports for Vindolanda, accessible at <http://www.vindolanda.com/excavate/reports>, illustrate how interdisciplinary research can be used as a basis through which to connect geoheritage, via roman quarrying, construction and history, to people who live near or visit Hadrian’s Wall.

### Ecclesiastical Buildings, Quarrying and Geoheritage

Given that historic churches, abbeys and cathedrals are often constructed of stone, and that transport is the largest cost associated with stone extraction and use; most stone-built ecclesiastical buildings are made using stone sourced from local quarries. For example, Peterborough Cathedral (Fig. 3a), Cambridgeshire, England, and many abbeys, priories and churches in the same area, are constructed from shelly Middle Jurassic limestone extracted in medieval times from the village of Barnack, just 14 km to the northwest of Peterborough. The medieval quarries from where this stone was sourced ceased to operate more than 500 years ago, leaving only hummocky ground today as evidence of the workings that once existed here (Fig. 3b). This undulating ground has,

however, become colonised over time by vegetation, including rare plants, and the site, known as the Hills and Holes, is now an NNR (National Nature Reserve) for its botanical importance. In recent years, there has been an increasing recognition of the links between the impressive limestone cathedral in the city centre and this nearby nature reserve marking the site from where the stone used to build the cathedral was extracted, before being transported by cart and by river to be used to construct the cathedral that still stands today. In 2018, in order to build understanding of the connections between the fabric and history of the of the cathedral, and the historic quarries from where the stone used to construct it was sourced, an excursion was organised that visited both the disused quarries in the NNR at Barnack, and the cathedral itself, emphasising these links.

### Where People Live, Building Stone, Quarrying and Geoheritage

A relatively easy and effective way of connecting people to their geoheritage is possible when there are obvious links with the places, buildings or structures where, or within which, they live. An extreme example of this is the rock dwellings at Kinver Edge, Staffordshire, where people lived in the Holy Austin cave houses cut into cross-bedded Permo-Triassic sandstones until the 1960s (Fig. 4). These houses, now managed as a heritage feature and open to the public, illustrate clearly a strong historic link between people and the nationally important and protected geoheritage in this area. On a larger scale, it is also possible to link communities to geoheritage through the local stone used to build the villages or towns in which they live. Many places in the UK, as in many other countries, are characterised by the colour and fabric of the local stone from which the settlement is constructed. For example, Stamford, Lincolnshire (Fig. 5), is a town constructed almost entirely from local Jurassic limestone, contrasting with other towns in the UK that may be constructed from red sandstones or dark igneous rocks for example. Even where direct links cannot be made through building stone, place names such as ‘Quarry Street’ or ‘Pit Lane’ provide a connection between the local residents and past mineral extraction. More specifically, recent housing adjacent to the internationally important exposures of fossil-rich Silurian strata at Wren’s NNR in Dudley, part of the Black Country UNESCO Global Geopark Project (BCUGGP), central England, has street names including ‘Fossil View’ and ‘Silurian Mews’ (Fig. 6).

### Industrial Heritage, Quarrying and Geoheritage

Where a community, village, town, city or region has an industrial heritage associated with mining or quarrying, especially where the community has pride in its industrial heritage, as many former mining communities do, there are many

opportunities to link geoheritage to the community; in fact, the community is already doing this in its collective identity. The links may be visible already in street names, symbolism such as miner’s lamps or fossils in a town’s coat of arms, features in the landscape, the focus of local history museums, the awareness of people of their ancestors who worked in mineral extraction, or through the stone used in local buildings. In such cases, support for promoting geoheritage and quarrying as an underpinning basis for the community is usually possible to secure. The BCUGGP (<https://www.dudley.gov.uk/media/5107/leaflet-web-version-final.pdf>), central England, currently seeking admission to the Network of UNESCO Global Geoparks, has built its whole proposal around its rich geological resources of coal, iron ore and limestone, and how the exploitation of these through the endeavours of local people has shaped the history and character of the area and community today. The geosites proposed for conservation and promotion as part of the application include many disused quarries of scientific, educational and recreational interest which together tell and celebrate the story of local geology and the role it played in building and defining the community that exists there today (Fig. 7).

The Isle of Portland, Dorset, provides another example of how geoheritage and quarrying are being linked to local communities and at the same time being used to generate tourism. Here, the disused Portland Stone quarries, famous for providing white Jurassic limestone used extensively across the UK, and particularly in iconic buildings in London such as Buckingham Palace, are being promoted and managed as havens for wildlife as well places where visitors can learn about the fossil-rich geoheritage and history of stone extraction (<http://www.portlandhistory.co.uk/introduction.html>). In Tout Quarry, for example, a sculpture park making use of the local stone and the disused quarry faces has been established (<http://www.portlandhistory.co.uk/tout-quarry-sculpture-park.html>) and is attracting a new audience to this geologically important and previously quarried landscape.

### Science, Education and Engineering, Quarrying and Geoheritage

Although not always immediately obvious to a local community, some quarries may be of great importance in terms of the research undertaken there, either to help us understand challenges such a climate change or to inform engineering projects such as construction of tunnels. Geological exposures of phosphatic chalks at South Lodge Pit, Buckinghamshire, southern England, for example, have proved vital in interpreting geology and planning for tunnelling conditions for the A303 Stonehenge road tunnel (Mortimore et al. 2017). Alerting local communities to the wider social benefits arising from research or educational use undertaken at their local quarries,





**Fig. 4** Rock houses at Kinver Edge, Staffordshire, illustrating obvious links between people and nationally important protected geoheritage





**Fig. 5** Stamford, Lincolnshire, illustrating that local building stone serves to define the character of many towns and villages, providing a connection from those that live there to the building stone used, the quarries from where it came, and the geoheritage visible in the quarry

either in the past or the present, may serve to engender pride and build interest, in local geoheritage.

### Innovative Approaches to Making the Connections

There are many different ways to make links between geoheritage, quarries and communities. These include site based and web-based interpretation, organised walks, participation in site management, working through other interests (archaeology, biodiversity, hiking clubs), local history or ancestry projects, art or drama projects based around geoheritage or quarries, or working with others and perhaps promoting the geoheritage through projects with wider, or different, primary aims such as public recreation or improving health. As ever, the best approach will depend on local circumstances, with more traditional approaches to interpretation sometimes being suitable and more innovative approaches being required in other situations. With increased emphasis now placed on the

need for conservation to provide wider benefits to society (not just science and education), such as contributing to meeting the United Nations SD goals (<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>), innovative approaches such as those set out below have the potential to engage a wider range of people as well as to generate wider support for conserving geoheritage. Three examples from central England of more innovative approaches to linking communities to their geoheritage via quarries, and an additional potential new opportunity for doing this in future, are given below.

### Underprivileged Communities, Drama, Quarries and Geoheritage

In Dudley, part of the BCUGGP, a desire to engage and change attitudes amongst young people living in two socially deprived communities either side of the internationally important Wren's Nest NNR resulted in the creation of an innovative drama project, called Wrosne (Worton and Gillard 2013).





**Fig. 6** New housing adjacent to Wren's Nest NNR in the heart of the Black Country UNESCO Global Geopark Project. Here, street names provide the community with connections to the local geoheritage and the quarries that exposed it

Specifically aimed at 15 to 19-year-old youths with the most challenging social backgrounds, the project used the area's geological and mining history as a basis for writing and presenting a drama production about the issues faced by the two communities. It engaged approximately 100 youths, and through visits to the reserve and through creative support, it led to a geologically themed drama production, with characters taking their names from local fossils, and was performed underground in the man-made limestone caverns below Dudley (Fig. 8). As well as raising awareness of geology, geoheritage and quarrying amongst those involved, 11 performances to 1100 people meant that their families, friends and other local people were also made aware of their local geoheritage. In addition to delivering increased social cohesion, the project resulted in reduced levels of antisocial behaviour on the NNR itself. On top of improved awareness of geology and geoheritage, contributions to meeting the United Nations SD goals in areas such as health and well-being, education and reduced inequality were also achieved.

### Community Champions, Quarries and Geoheritage

In Herefordshire and Worcestershire, in western central England, the local geoconservation group, the Herefordshire

and Worcestershire Earth Heritage Trust, sought an innovative way to find volunteers to participate in geoconservation activity and to raise awareness of local people about their geoheritage. To do this, a group of local volunteers, Earth Heritage Community Champions, were established with the aim of enthusing and training them to promote, monitor and manage 19 geoheritage sites, including many disused quarries, across the two counties (Miles 2013). Most importantly, these individuals were drawn from the communities around the geoheritage sites and through their experience as 'champions' are able to share their understanding and enthusiasm for geoheritage with others in their community. As well as establishing converts and champions for geoheritage, this ongoing project contributes to United Nations SD goals relating to health and well-being, education and sustainable communities.

### Healthy Living, Quarries and Geoheritage

With healthy lifestyles now of increasing political importance, there are significant benefits in emphasising the health benefits associated with getting outdoors and exploring the local environment, including the local geoheritage. At a country



# The Black Country

## Global Geopark Project



## Supporting Information - Maps

The Association of Black Country Authorities  
November 2015



◀ **Fig. 7** The Black Country UNESCO Global Geopark Project is based upon celebrating the links between the local community, their industrial heritage, and the importance of geology and geoheritage in feeding and reflecting the industrial history and culture of their community

park in Irchester in Northamptonshire, at a former site of extensive mining of Jurassic ironstone, local geoconservationists have worked with a diverse range of partners, including local government, wildlife groups, archaeologists and local schools, on a £130,000 project entitled *Irchester Country Park - Protecting and Interpreting a Real Jurassic Park*. As a result of this, an accessible interpretation trail around the park has been created, explaining all aspects of the heritage of the site, from the Roman settlement nearby to the geology, quarrying, plants and wildlife (Harrald 2018). This partnership project, with an emphasis on a trail to encourage walking and a healthy lifestyle, contributing to United Nations SD goals around good health and education, has enabled these former ironstone quarries, and their geology and palaeontology to be interpreted for visitors (Fig. 9). This is something unlikely to have happened without geologists working with, and through, others, to include geoheritage as part of a wider initiative aimed at the health and well-being of the local community.

## The Anthropocene?

The establishment of an Anthropocene epoch, reflecting the impact of human activity as recorded in the geological record (e.g. Zalasiewicz et al. 2018), surely offers new and exciting potential for those interested in geoconservation, to link geoheritage, through the evidence of mining and quarrying, to modern communities. In many ways, the whole concept of the Anthropocene emphasises the links between society, the ways it exploits the natural environment, the geology it exploits, and the geoheritage which remains in disused quarries or mine tips as evidence of how communities have, and still do, interact with geology and their geoheritage.

## Conclusions

As set out above, quarries and quarrying are extremely effective as a means of connecting communities with their geoheritage, and in turn, in building the support required to achieve successful geoconservation. In short, it is possible to conclude that:



**Fig. 8** The innovative Wrosne Project in Dudley, located within the Black Country UNESCO Global Geopark Project, engaged local youths in a geologically themed drama production performed in the underground

limestone mines below where they live. It raised awareness of geoheritage as well as providing a wide range of social benefits



**Fig. 9** Launch of the Irchester Country Park's Real Jurassic Park ironstone trail, achieved through working with a wide range of partners and through including geoheritage as part of a wider project aimed at encouraging a healthy lifestyle

- Successful geoconservation increasingly requires that communities, and the decision makers within them, understand why geoheritage is important and support its conservation.
- There are many ways of connecting communities to their geoheritage in order to build understanding and support. These usually involve making connections between culture and the natural environment.
- Quarries, with their direct connection between the material extracted and the communities that excavated it in order to meet the needs of their society at the time, are one of the most effective ways on connecting communities to geoheritage.
- There are many connections, prehistoric to the present day, which can be used to link communities to geoheritage via quarries. These generally relate to how extracted material was used, whether it be as tools, ritual monuments, building material or natural resources used to fuel industry or production of energy.
- Connections can be made using more traditional on-site, or web-based, interpretation, but innovative approaches which physically engage communities in activities, or which promote geoheritage through wider partnerships and through projects delivering a range of benefits to people, are particularly effective in building understanding and support for geoheritage.
- Projects that can be shown to contribute wider social benefits, such as contributing to the United National Sustainable Development Goals, as well as promoting geoheritage, are more likely to appeal to communities.
- The concept of an Anthropocene epoch, emphasising how man has modified the natural world, provides a new context and opportunities through which to link communities to their geoheritage, through evidence of quarrying.

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