6 Opportunities for interpretation, involvement and enhancement

Well-planned earth science interpretation not only highlights the importance and relevance of geological interest, but also has enormous potential to contribute to, and enhance, the understanding of features and sites of parallel interest. It is recommended that in the first instance an 'Interpretive Master Plan' should be produced for the area's geodiversity. This should provide ideas and an approach for communicating the stories associated with each geological site in a way where "the whole" becomes greater than the "sum of its parts". The whole story should be coordinated and take people on a journey of discovery through Limestone Landscapes. To inspire wider interest in the relevance of the geological heritage of the area, natural, scenic, historical, cultural, archaeological and recreational qualities need also to be woven into the interpretive themes for each site as well as key messages and related stories.

Context, corridors and connectivity — Make people want to look a little further and show them how/where to do it. Museum to field and vice versa. Tie in with existing community initiatives

Much has been written about the geology of the area at a whole range of levels from the most complex geological description to the very broad. However, accessible information that enables a good understanding of the geodiversity to be reached by the non specialist is very hard to find. Even within sites noted for their geological importance the features of interest are commonly not conserved, displayed or interpreted to best effect for appreciation by the local or wider community (Plate 14)

A variety of methods of communication should be adopted. Getting to and examining sites and following trails could lend itself to modern techniques incorporating GPS, mp3 and podcasts. Instead of interpretation boards information could be delivered to mobile phones or ipods etc and linked with GPS. However, some people will prefer to use more traditional methods.

Business, health, education and heritage need to be signposted explicitly in any Partnership communication material so that the attention of these sectors is gained. Specific projects are needed to encourage the involvement of non specialists.

6.1 Working with organisations and communities

There are already a few good examples of geodiversity in action within the area, but these are apparently happening in isolation. The following organisations should be consulted in addition to the partners and others already involved with Limestone Landscapes.

The North East Geodiversity Forum is a potential link with organisations and local geologists active and with an interest in the area.

The National Trust owns a part of the coast with dramatic geological exposure in the north of the area and has already put in place some interpretation, but there is considerable potential for further involvement with geodiversity along the lines of the Trust's geological policy (http://www.nationaltrust.org.uk/main/w-chl/w-countryside_environment/w-nature/w-nature-geology.htm)

- The Trust will care for the natural and cultural geological significance of all our properties.
- The Trust will inform conservation and manage change in the geological environment and its features through learning, identifying, recording, understanding and communicating its significance.
- The Trust will share the geological significance of our properties with members, visitors and stakeholders for all to appreciate and enjoy.

Durham University is active in scientific outreach in the North East and has a number of schemes that might be able to contribute to the geodiversity in the area (the current co-ordinator Dr. Paula Martin is an earth scientist)

(http://www.dur.ac.uk/science.outreach/outreachschemes/) .

Sunderland Museum has long been a proponent of the geology of the region It has recently (2008) purchased an important collection of Permian fossil fish.

Durham Wildlife Trust and the Natural History Society of Northumbria have contributed to the understanding and protection of geodiversity.

The Tees Valley RIGS Group is active in the southernmost part of the area and has designated RIGS sites, some of which are proposed for incorporation in Limestone Landscapes. The group should have a prominent role in any projects within their area of jurisdiction (http://tvrigs.org.uk/tees-valley-rigs-group).

The nascent Northumbria RIGS Group should be encouraged to participate.

A number of community groups are active in areas that are suitable for geodiversity development (e.g. Tunstall Hills Protection Group)

Durham Heritage Coast
(http://www.durhamheritagecoast.org/DHC/usp.nsf/pws/Durham+Heritage+Coast+-+Durham+Heritage+Coast+-+Welcome)

6.2 Suggestions for major themes that could be developed and/or interpreted

Unusual rock types

There are some very unusual rocks types exposed in the area (e.g Cannon Ball Limestones, Spherulitic beds in the Concretionary Limestone; Collapsed Beds). These are unique to Britain, some possibly to the world (Plate 15). Interpretation could include:

- Creating a sensory rock trail with interpretation for visually impaired — the rocks of the area have possibly the widest textural variation of any in Britain and variations can be easily distinguished by touch. Such a trail could gain fame well outside the area and provide inspiration for similar initiatives in the UK. An example of a sensory trail in South Africa that includes rocks is shown in (Plate 16).
- Creating trails with opportunities for design, photography and sketching of mineral and crystal development (with discouragement of collecting)
- A calendar of rock types
- What do we see — art work

The Upper Permian reef

The Zechstein reef of north-east England has long been known to geologists as one of the classic collecting grounds for Upper Permian marine faunas. Tertiary uplift has given the reef a gentle southerly tilt and consequently most of the main exposures of the reef base and core occur in the Sunderland area. Further south successively higher stratigraphical levels are exposed within the reef where they have not been removed by erosion. The reef has produced a rich and varied invertebrate fauna of international significance. Included are numerous brachiopod, bivalve, nautiloid and bryozoa species, together with rarer examples of echinoids and corals. Much of the shelly fauna was exhaustively collected and described in the nineteenth century. Today it is extremely difficult to distinguish fossils in the exposures. From its northerly outcrop at Down Hill, the reef can be traced southwards through the western suburbs of Sunderland into County Durham, where it is known to extend a short distance south-west of Hartlepool, a total distance of around 32km (Hollingworth and Pettigrew, 1988).

Development could include:

- Interpretation of reef localities

- Guides and explanations to identifying fossils
- Links to the fossil collection in Sunderland Museum
- Route linking reef outcrops
- Enhancement of Tunstall Hills, in conjunction with the Tunstall Hills Protection Group (http://www.tunstallhills.org.uk/index.html)
- Enhancement of Ford and Hawthorn quarry sections, perhaps involving selective re-excavation.

Fossils of the Marl slate

The Marl Slate Formation has yielded a wealth of extremely important vertebrate and invertebrate fossils for which it is internationally renowned. It is locally rich in well-preserved fish, especially species of Palaeoniscus. Fine examples have been recovered from several sites in the east of the county. Middridge Quarry, which has yielded bones of the Upper Permian reptiles Protosaurus, and Adelosaurus together with the amphibian Leptosaurus, is regarded as Great Britain's finest Upper Permian reptile locality. The site has also provided Britain's most diverse assemblage of Upper Permian plant fossils. Part of a skeleton of Coelurosaurus, a reptile believed to have been capable of gliding flight, and one of only a handful of such specimens known from Europe, was discovered in 1978 in the Marl Slate at Eppleton Quarry, Hetton-le-Hole. The interpretation of the Marl Slate could be enhanced by:

- Links with fossil collection in Sunderland Museum
- Encourage stockpiling of Marl Slate from active quarries
- Fossil trail
- Interpret and develop Middridge Quarry (Plate 17)

Building stone

Prior to about 1800 the rocks of the Magnesian Limestone were used mainly for building purposes, and most of the early settlements along the Permian escarpment were built of local stone. Many of the stone quarries were opened in the evenly bedded Lower Magnesian Limestone (Raisby Formation) which provided the most suitable building material. With the exception of reef-rock, which has been used on a small scale in buildings at Hawthorn, Easington, Peterlee and Hesleden, the dolomite of the Middle Magnesian Limestone is too soft and variable for building purposes, but the Upper Magnesian Limestone was formerly worked in large quarries at Hartlepool, and forms the substance of nearby churches, harbour works and private houses. Magnesian Limestone was quarried to build the Roman Fort at Arbeia, South Shields. Good examples of building in a variety of styles with Magnesian Limestone can be seen in Whitburn (Plate 18).

(Plate 18) Use of magnesian limestone as building stone in Whitburn.

- Identify and match the stone in buildings to those in quarries
- local community/school projects

Coal Mining

For a long time there was speculation and uncertainty as to whether coal lay below the Magnesian Limestone. Coal was first proved to exist here by the sinking of a pit at Haswell in 1811 but the first great deep pit in the region was sunk at Hetton in 1821. Sunk to a depth of over 1000ft, it became one of the most productive pits in the region as well as a focus for some of Stephenson's important locomotive developments. Monkwearmouth, 1700 ft in 1846 was the deepest coal mine in the country. The methods introduced to mine coal from deep beneath the limestone plateau at the beginning of the nineteenth century were taken up throughout Britain and indeed the world.

The first person to demonstrate that a steady light could be employed in coal mines without the danger of external explosion, was Dr. William Reid Clanny, of Sunderland. On May 20th, 1813, he announced his discovery at a meeting at the Royal Society of Arts in London, when he presented the Society with the first miner's 'Safety Lamp'. A modification of

this lamp was used in Herrington Mill Pit, in 1815, making it the first colliery in which a safety lamp was used https://www.welshminerslamps.com/. Items that can develop the mining aspects of the area include:

- Importance in history of coal mining
- Social history
- Personalities involved
- Interpretation and trails
- Community Pride in history

Some interpretation on coal mining is already in place e.g Seaham '3 Pits' sculpture, Easington Shaft and Adventure through time leaflets, Information Board on Haswell Cycleway (Plate 19) and (Plate 20)

(Plate 19) Display board on cycleway near Haswell.

Coastal change

There is considearble potential for examination of historical records/photographs/illustrations to see how the coast has changed. Coastal change in the area reflects both natural processes and man's influence, both negative and positive, with links to scientific exploration, social history and archaeological studies. BGS holds a a set of sketches of the Durham coast prepared by D B Smith in the 1950s, and pictures taken for the geologist Carruthers glacial undermelt theory. Significant archives of material must be available elsewhere.

Eminent geologists and naturalists of the Magnesian Limestone

The Magnesian Limestone has been studied for more than 190 years and the names of some of the early workers — Geinitz, Murchison, Phillips, Sedgwick and Sorby — would grace any geological hall of fame. More recently Trechmann and Smith have made great advances in the understanding of the rocks. A number of naturalists, such as John Winch studied both the rocks and the flora and fauna of the district. Trechmann wrote about geology and archaeology. Despite this formidable assault, and the efforts of a host of later workers, the Magnesian Limestone still retains many of its secrets.

- Research into the history of these workers, including biographies, paintings and photographs could prove an interesting link to social history.

Geodiversity and biodiversity

- Explaining the geodiversity interest at some existing biodiversity sites, such as nature reserves, would serve to provide added interest to those sites in the winter and when the nature interest is not at its height.
- Link sites with biodiversity interest to those with geodiversity interest and similar geology.
- Build on MAGical Meadows project

Quarrying

- Links to agriculture — With the increasing use of lime for agricultural purposes in the early part of the 19th century, a number of quarries in the Lower Magnesian Limestone and some new ones, including the large Tuthill Quarry near Haswell, in the Middle Magnesian Limestone (Ford Formation), supplied ground or burnt lime.
- Links to industry — quarries also supply crushed limestone and dolomite for use as building aggregate, building lime and road metal. Substantial amounts of dolomitic limestone were formerly employed in the chemical industry, particularly in the making of refractory products and as a flux in steel-making, though this use has declined markedly in recent years (Dolomite. Minerals Planning factsheet).

- Research into social history and links with industrial archaeology, e.g 200 years of quarrying at Aycliffe http://www.aycliffehistory.org.uk/html/AycliffeQuarry.htm

Active Quarries

Active quarries (Plate 21) and (Plate 22) have high potential for local geodiversity involvement on a periodic and planned manner. Indeed some already encourage such activity on a controlled basis. Active quarries are listed in Appendix X. Recent examples of methodologies and procedures for recognising and managing geodiversity, particularly in association with quarry operators, are summarised in the publication "Creating environmental improvements through geodiversity" (Scott et al., 2008; http://www.sustainableaggregates.com/docs/revs/t3b_geodiversity.pdf)

- Quarry trail (see above)
- Permanent viewing area and interpretation
- Education (see below)
- Active quarries are usually keen to work with local communities on conservation and enhancement projects

Funding may be available through the Aggregates Levy Sustainability Fund

Walks and trails

Incorporate geodiversity in existing walks or cycle trails, combine with other heritage interests, prepare new geodiversity-centred trails

- Use Existing walks — link 2 or 3 nearby sites – eg grassland, archaeology and quarry via public footpaths. Students could make mp3 recordings at school (Plate 23)
- New geological trails, e.g. coastal trails such as those produced by Scottish RIGS groups
- e.g.view of landscape from the jubilee walk
- Create new cycle trail (eg see North Pennines AONB 'Wheels to the Wild' cycle route that has been designed as a voyage of discovery taking in the fascinating landscapes and geology of the area.
- Trail linking old collieries
- Durham coastal footpath: This long distance footpath traverses some fascinating geology and landscape, some of which are of world renown. An easy to follow guide to the features, which can be seen along the footpath, would greatly enhance understanding and enjoyment of this route.
- Quarrying trail — to demonstrate the past and present importance of stone, for buildings, roads and a host of constructional and industrial uses. The trail could incorporate landscapes affected by quarrying, buildings which incorporate interesting examples of stone, as well as pointing out characteristics easily discernible from publicly accessible footpaths, picnic sites etc. Operators of working quarries should be encouraged to participate in preparation of the trail, perhaps by facilitating access to workings on special occasions.
- Permian trail — The Permian rocks of the area are of international fame. They include coastal exposures of these famous limestones, celebrated outcrops of Permian desert sands and the fish-bearing Marl Slate. Not only are these fascinating rocks with a remarkable story to tell, they give rise to a highly distinctive landscape, including the fine Durham coastal cliffs, as well as a rich and beautiful assemblage of plants and associated fauna. The MAGical Meadows project and booklet demonstrate the interdependence of the geodiversity and other heritage features, but leave much scope for the explanation of the geological history.

Viewpoints

Identification of main viewpoints — eg Tunstall Hills, Beacon Hill, Views of escarpment, View towards Frenchman's Bay.

- Leaflets
- Interpretation Boards

- web-delivered information to ipod etc
- Trail linking best viewpoints

View of the Easington—Elwick Moraine [NZ 431 364] Road from A19 to Hutton; [NZ 447 382] and [NZ 460 386] Road from Castle Eden to Blackhall Rocks

Tunstall Hills [NZ 391 544]

Beacon Hill [NZ441 454]

Penshaw Monument [NZ 335 545]

Quaternary geology/Geomorphology

Considerable scope exists for the explanation and interpretation of Quaternary features and landforms in the area.

Education

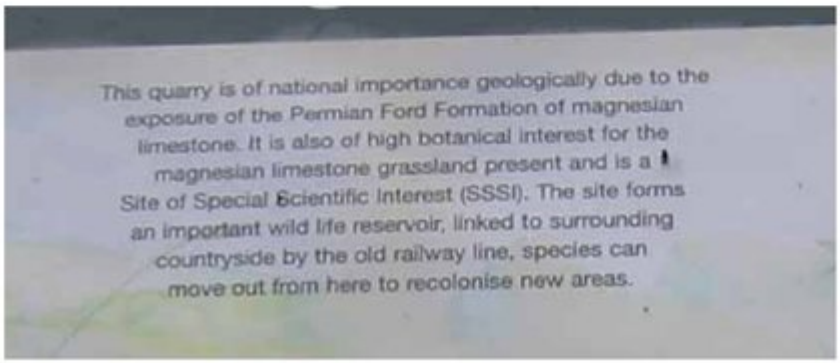
Many educational opportunities exist at all levels including School/University/Community/U3A

these can be enhanced by:

- RIGS educational project eg to explore coastal sites.
- Field guide at school level
- Comparing the past to the present:
  - Zechstein sea to North Sea
  - Fossils to current species. eg the Coelacanth was believed to be extinct until a fish was caught off South Africa in 1938.
  - Yellow Sand -Ancient desert dunes to modern dunes (or coastal dunes) (plates 24 and 25)
- Quarry companies already have national educational programmes that could be utilised:
  - Tarmac welcomes school visits to most of its operational quarries and its Quarryville website (www.tarmac.co.uk/QUARRYVILLE/teachers/visits/) is an education resource for schools that supports key content areas of the National Curriculum, Key Stages 2 and 3. Use of the pupil activities will meet many of the aims of the curriculum, especially those related to Science and Geography. However, there are opportunities to incorporate other subjects, notably ICT and Citizenship.
  - Lafarge Aggregates & Concrete UK is committed to developing relationships with schools close to their sites. The company also supports national education initiatives such as Enterprise Week. Schools and other education groups are welcome to visit operational sites including hard rock and sand & gravel quarries, landfill and recycling centres and Readymix plants.
- Establish local children's geology club on the lines of North Pennines 'Rock Detectives' or the Geologists' Association 'Rockwatch' club for young people.

(Plate 4) Dolomitic limestone of the Raisby Formation at Aycliffe Quarry.

References



(Plate 14) Information Board at Trimdon Grange Quarry – note mention of the importance of the Ford Formation (detail), but no further explanation of why it is geologically important.

(Plate 15) Rock textures exposed in Fulwell Quarry and surroundings.

(Plate 16) Example of wheelchair accessible trail incorporating description of rocks suitable for the visually handicapped. Karoo Botanic Garden, South Africa.

(Plate 18) Use of magnesian limestone as building stone in Whitburn.

(Plate 21) Magnesian Limestone (Raisby Formation) overlying the Marl Slate Formation (the grey layer) above the Yellow Sands Formation in the working Hepplewhites Quarry.

Rare fossil find at quarry

A 12-year-old girl discovered a rare fossil at Thrislington Quarry during a special fossil hunt organised for the wildlife explorers' club of the Royal Society for the Protection of Birds.

Stephanie Gomersall hammered apart a large piece of slate at Lafarge Aggregates' Thrislington Quarry, near Ferryhill, and found the imprint of a fish called *'Coelacanthus'* which is about 250 million years old.

She showed it to the organiser of the fossil hunt, Steve McLean, curator of the Hancock Museum, Newcastle, whose suspicion that it was a rare specimen was later confirmed by the Natural History Museum in London.

Stephanie, of Ponteland, Northumberland, was searching the last pieces of stone when she made her discovery... "I was quite amazed as it's the first time I've looked for fossils".

Her father Richard, who works in the advertising department of the Newcastle Journal newspaper, had co-ordinated the fossil hunt for the RSPB Wildlife Explorers' Club. Stephanie has donated the fossil to the Hancock Museum which is putting it on display.

Steve McLean said: "*Coelacanthus* is a rare fossil. We only have a few in the collections at the Hancock Museum. It is a very interesting type of fossil because it was thought that fish of this type were extinct until a modern coelacanth was caught by a fishing boat off the coast of South Africa in 1938. They are still being caught today.

"It's great to find this fossil specimen in Durham and I thank Lafarge Aggregates for hosting the fossil hunt in their quarry".

Quarry manager Graeme Parkin said: "Lafarge's partnership with the museum means we can organise these fossil hunts from time to time".

The Hancock Museum is also putting on display another specimen found at Thrislington Quarry. Shotfirer Keith Farley was preparing some slate for a visit of school pupils and discovered what is commonly called a shark's head fossil but in fact is the imprint of a fish called *Janassa* which was ray like and fed on the bottom of the sea.

"It is quite a rare find and although this specimen is somewhat mangled we can see evidence of the skin and the mouth and teeth of the fish", added Steve.

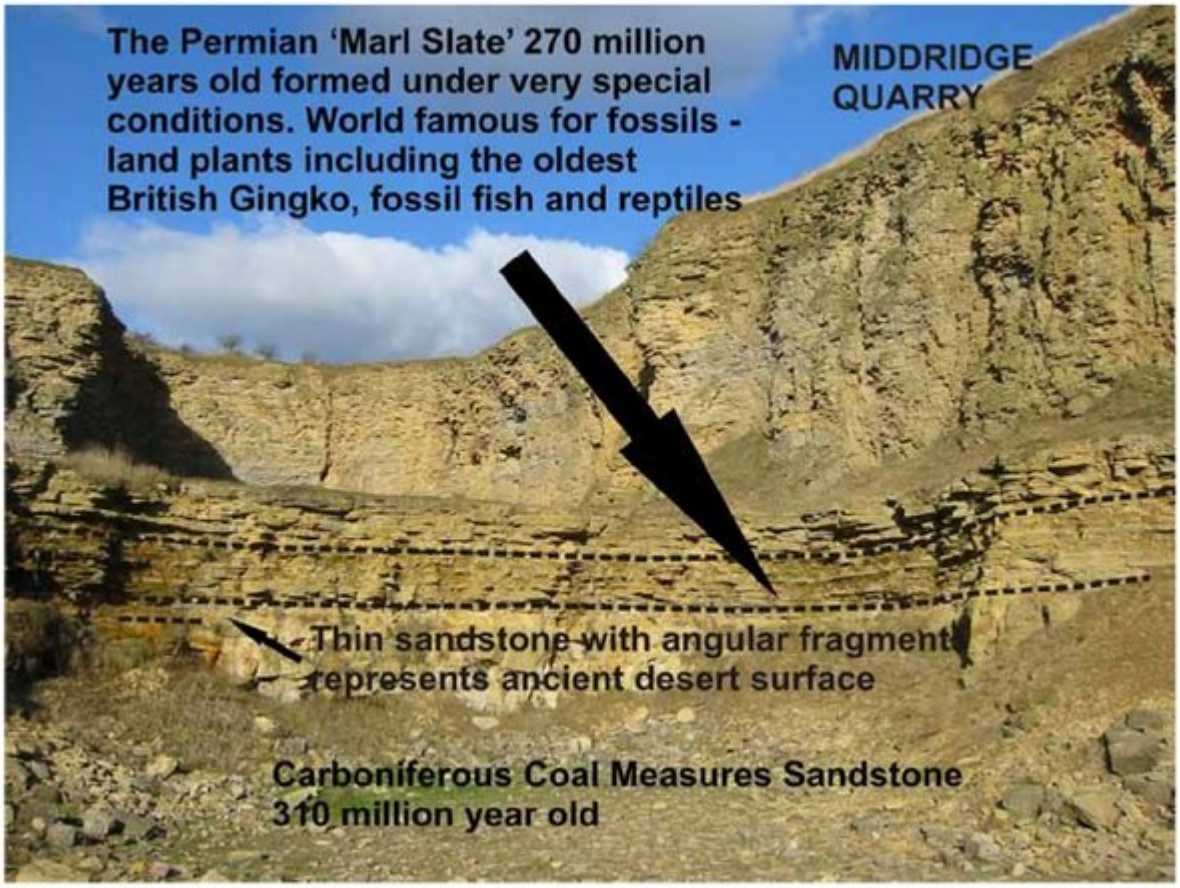
- The fossil find follows the recent unearthing of a 40,000-year-old skeleton of a woolly rhino at another Lafarge quarry in Staffordshire.

12-year-old Stephanie Gomersall and Steve McLean, Curator of the Hancock Museum, with the rare fossil

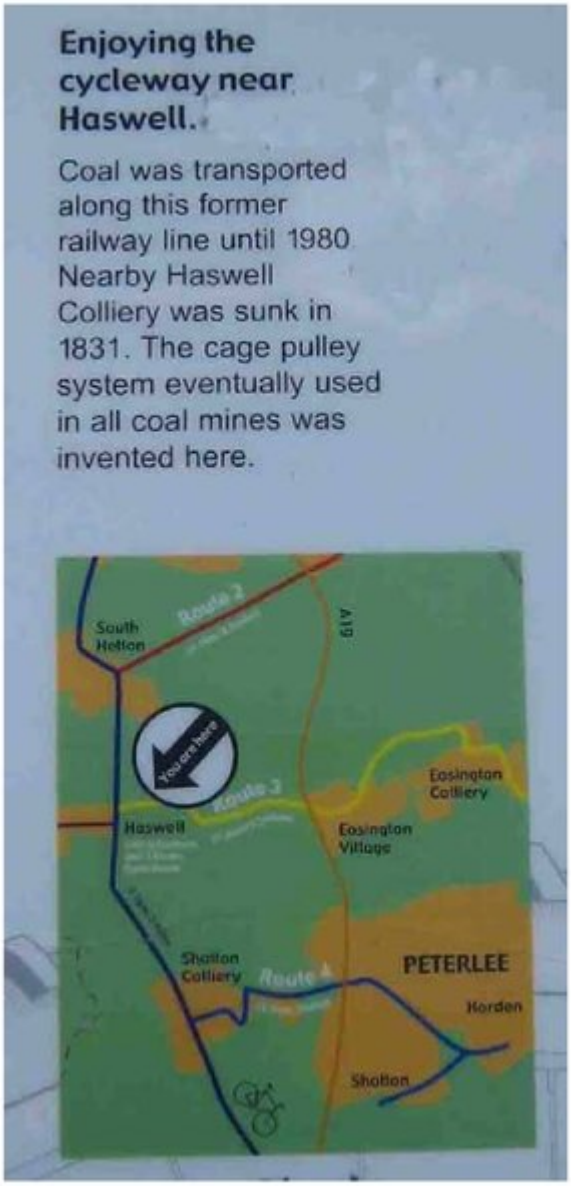
(Plate 22) Fossil found by a young person during RSPB organized visit to the working Thrislington Quarry in 2003.

(Plate 23) 'Walking Works Wonders' board south of Lizard point.

(Plate 4) Dolomitic limestone of the Raisby Formation at Aycliffe Quarry .



(Plate 17) Schematic interpretation of rock exposed in Middridge Quarry.



(Plate 19) Display board on cycleway near Haswell.

(Plate 20) The Seaham 3 Pits sculpture and a detail from the panel.