Manchester Geological Association

President: Niall Clarke MSc

March 2021

www.mangeolassoc.org.uk

Founded 1925

Dear Member
Welcome to our Spring Newsletter.

There have been some changes on Council at the AGM. Peter del Strother takes over as Outdoor Meetings Secretary and Ken Jacobs is the new Membership Secretary, which includes sending you email updates of forthcoming events. So please look out for emails from Ken.

We are still unclear around what we may be 'permitted' to organise by way of physical meetings but our intention is commence them as soon as practicable. The initial field trips this year will be virtual, but we hope that towards the end of the summer real trips into the field will take place. If those members who we don't currently have an email address for could let us have one, we can all keep up with the dynamic situation and not miss out on anything (please email niallclarke01@gmail.com). Jane Michael has left Council after many years, but has left us with a well-developed programme of meetings for the autumn and winter ahead. One event I would like to flag up is the Broadhurst lectures scheduled for November 13th. Cathy Hollis is organising a full day of lectures by way of a tribute to Tony Adams, our former president, recently departed.

Finally, may I thank you for your continued support; the turn out for our Zoom events has been fantastic.

Best wishes
Niall

Quick Diary

Zoom Meetings

14 April 2021	Shallow hydrothermal dolomitization of the Middle Cambrian Cathedral Formation by Jack Stacey, Basin Studies and Petroleum Geoscience, University of Manchester.

Who's Who in the MGA

Officers

President: Niall Clarke MSc

Vice-President: Dr Margaret Hartley

General Secretary: Sue Plumb BSc

Membership Secretary: Ken Jacobs

Treasurer: Jennifer Rhodes BA

Indoor Meetings Secretary: Vacant

Field Excursions Secretary: Peter del Strother MBE Mphil

Newsletter Editor: Lyn Relph BSc (Hons)

Webmaster: Peter Giles MSc

Other elected members of Council
Prof. Ray Burgess
Nicola Fowler BSc (Hons)
Peter Gavagan BSc (Hons)
Penny Heyworth Mphil
Steve Donovan

Ex officio members of Council
The Immediate Past President, Manchester Geological Association: Prof. Cathy Hollis

RIGS Representative: Dr Chris Arkwright

The Association's representative on the North West Geologist's editorial team: Peter del Strother MBE Mphil

President of the Student Geological Societies of the University of Manchester
MGA Archivist: Dr Derek Brumhead MBE

MGA email addresses
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For field visit enquiries: outdoors@mangeolassoc.org.uk

For indoor meeting enquiries: lectures@mangeolassoc.org.uk

For newsletter correspondence: newsletter@mangeolassoc.org.uk

For other enquiries: info@mangeolassoc.org.uk

Borehole Geology and Public Water Supplies

by Niall Clark

This article is an edited down version of the Presidential Address made to the 2021 AGM. I hope members find it interesting and the links to some of the references used in the talk useful.
The address looked at the contribution groundwater makes to the public water supplies in the north west and some of the issues faced.

Introduction

Across the north west, boreholes contribute 10% of daily supplies – some 160-170 million litres per day, water sufficient for 700,000 people. If you would like to read more on this aspect, search for *United Utilities Final Water Resources Management Plan* in the 'Corporate' section of their website. There has been much written on aquifers and a search on line generates a wealth of resource. What is important in terms of real-world hydrology is to note that you seldom get pure examples of the different types of aquifer you see in text books. Aquifers are complex heterogeneous systems with flow governed by localised characteristics close to the borehole as well as factors on the scale of the entire aquifer.

A useful document is the BGS publication '*The natural (baseline) quality of groundwater in England and Wales'* http://nora.nerc.ac.uk/id/eprint/3578/1/RR07006.pdf. The cover picture is a clever illustration of the key concerns in the field of groundwater.

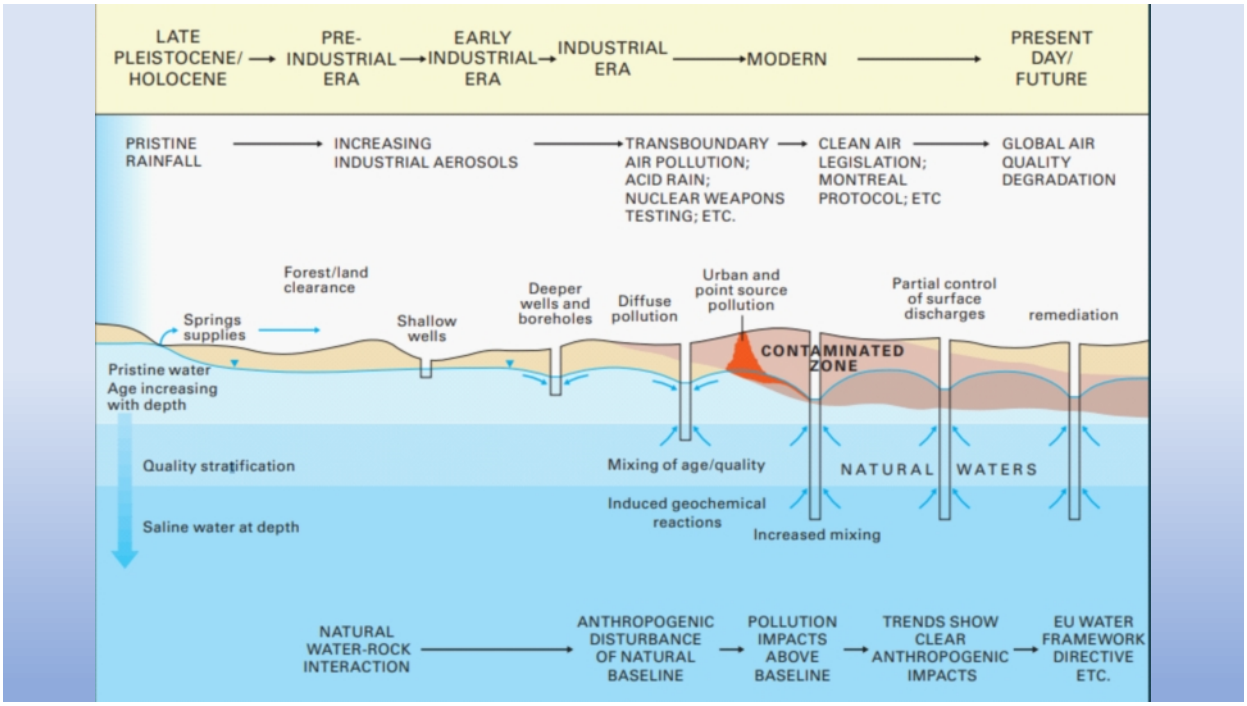

Figure 1 A model for groundwater

From left to right it plots the increasing anthropogenic influence on aquifers as we dig deeper, abstract more and perhaps not caring about the catchment. It plots the transition from a pre-human pristine state, through what we hope is a transitory phase of contamination to a future state of partial or complete remediation.

It also points to the Water Framework Directive. This provides the legal framework for remediation. Some ground waters are directly fed into water supply following treatment. Others are pumped into reservoirs and support the surface reservoir water before going to treatment. Groundwater makes a locally significant contribution to supplies in West Lancashire, Wirral, Cheshire, and north and west Cumbria. The extensive borehole field on the Fylde is of regional significance. These boreholes can be used to support supplies across Lancashire and enable more Lake District water get to Greater Manchester.

The EA have defined 18 groundwater catchments in the north west. A good starting point for understanding these is:
https://environment.data.gov.uk/catchmentplanning/ManagementCatchment/1009.
Figure 2 illustrates the areal extent of these catchment and where they sit stratigraphically.

Public drinking water supplies come directly from all bar the Quaternary aquifers but we will see later the role of the Quaternary is not unimportant. What clearly stands out is the unique importance of the Permo-Triassic Sherwood Sandstone formation.

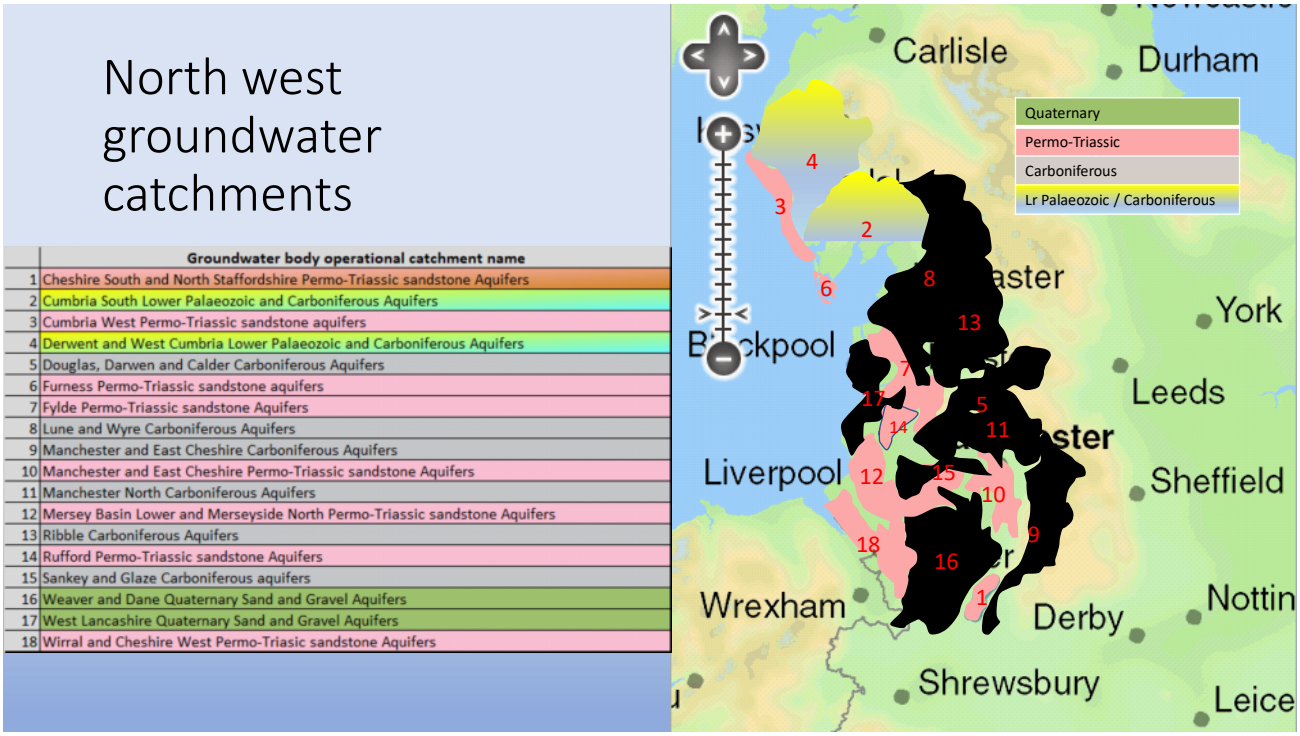

Figure 2 Groundwater catchments

Butterworth Hall in the Manchester North Carboniferous Aquifer

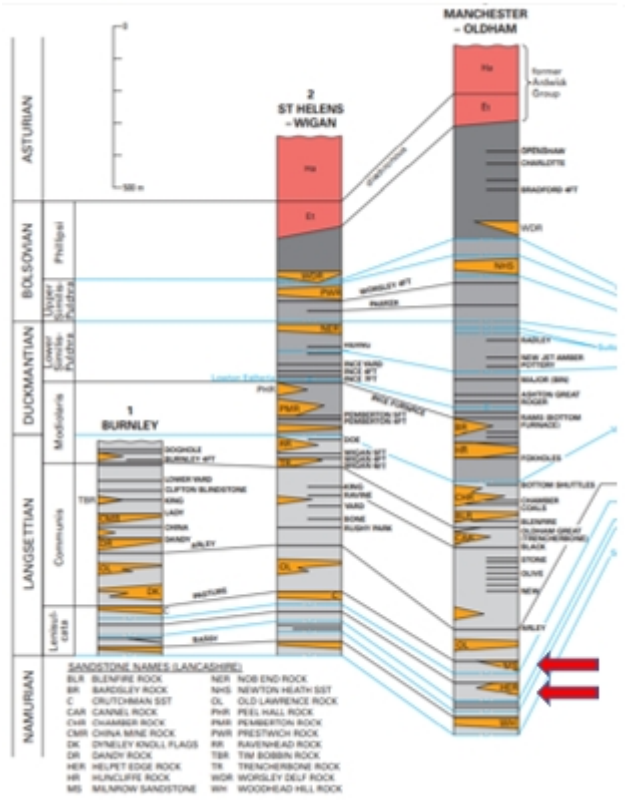

Figure 3 Butterworth Hall

The water is derived from deep in a former mine system and the borehole (some 120m deep) is used to supplement surface water supplies in drier periods, delivering in the order of 4 to 7 million litres/day.

The geology is one of alternating sandstones, shales and coal seams forming a multi-layered aquifer system. Groundwater storage is in the grit horizons and extensively worked coal seams so it isn't a case of pumping water out of flooded adits; a misunderstanding which is easy to make. The interconnectivity of mineworkings can mean large volumes of groundwater can be abstracted from what would naturally be discrete aquifers, not in hydraulic continuity, are artificially connected. This means the flow pathways are dominated by the mine geometry not geology and are very complicated and difficult to model. Figure 3 shows the aquifer units, indicated by the red arrows on the stratigraphic column (from the BGS regional geology series Northern England).

Any of the sand horizons in the coal measures would have similar aquifer potential but, as inferred in Figure 3, these do not have extensive horizontal continuity, are of variable thickness and like Butterworth Hall, have been extensively infiltrated by coal mining over the years. However, coal mining has connected them. This means the Lancashire coalfield has the potential to be a significant water resource if precautions against contamination by mine workings are overcome.

Tytherington in the Manchester and Cheshire East Permo-Triassic Sandstone Aquifer

Here there is a requirement for manganese removal prior to entering the water supply. It is not uncommon for borehole water to need treatment to remove metals prior to entering supply. The chemistry of groundwater is an important part of understanding the resource, especially in terms of protection and remediation. The BGS have undertaken a series of studies into this and you can access these at https://www2.bgs.ac.uk/groundwater/quality/BaselineUK/home.html. These reports cover wider geological aspects and are an interesting read.

The table below shows the variability in manganese in the two boreholes which are in close proximity. The manganese concentrations in borehole 2 are too high for satisfactory treatment for drinking water.

	Typical value Mn µg/l	Range Mn µg/l
Borehole 1	50	50 -150
Borehole 2	2400	400 - 2000
Aquifer	200	0 - 6000
Drinking water standard	50	50

Where does this variability in manganese originate?

Figure 4 summarises the possible sources of the Mn.

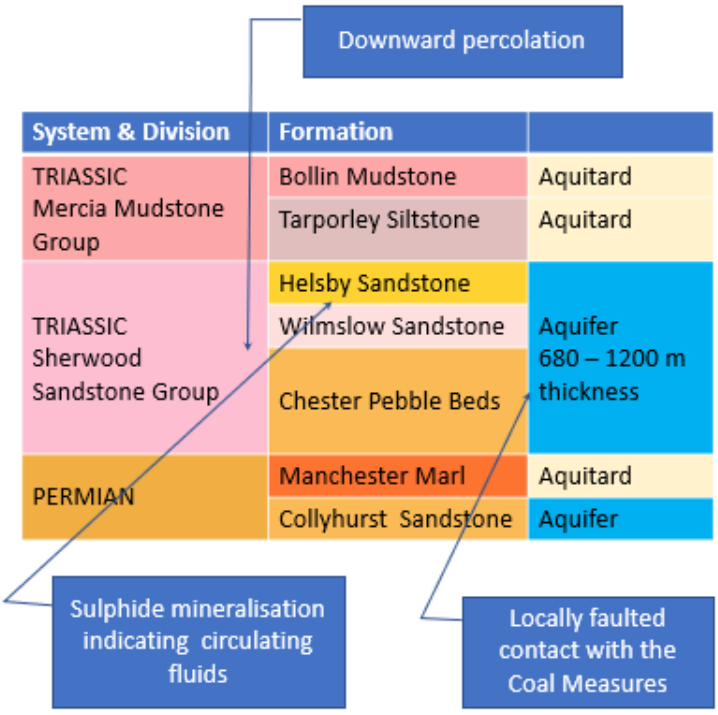

Figure 4 Possible origins of manganese

The aquifer is in the Chester Pebble Beds. Locally this is faulted up against the Carboniferous by the Red Rock Fault. During burial, anhydrite and halite were remobilised from the overlying Mercia Mudstone Group and were introduced to the aquifer sandstones via fractures to form secondary cements: bringing downward percolation of manganese. More recently pyrite within the Boulder Clay might form a contribution.

Adjacent to faults, complex calcite-barite-sulphides with a range of metals including Mn and Cu mineralisation occurred and replaced earlier cements we see this at relatively nearby Alderley Edge where faulting has given rise to sulphide mineralisation in the Wilmslow and Helsby Formations. These circulating fluids contribute to manganese concentration. Percolation from the Carboniferous across the fault is another potential source. All of this demonstrates the heterogenous nature of aquifers and the influence of highly localised factors in the quality of water.

This article will be continued in the next newsletter.

Sandstone Retaining Wall Awarded Scheduled Monument Status by Historic England:

Bridgewater Canal's Barton Aqueduct embankment and retaining walls at Eccles, Manchester

By Fred Owen

In January I was delighted to hear that a rather obscure sandstone wall in Eccles had been granted Scheduled Monument Status by Historic England. The application was made in December 2018 by a former work colleague who has a special interest in the history of canals and railways. He invited me to look at the sandstone in relation to another sandstone feature nearby and its possible source.

It is a rewarding coincidence that my fascination with geology in retirement created the opportunity for involvement in this significant industrial history. It brought back memories from my career in the chemical industry at Eccles when I used to cross the Manchester Ship Canal (MSC) over the Barton Swing Bridge twice every working day for 33 years, often frustrated about having to wait for up to 20 minutes while a small vessel or two sailed along the canal. The historical significance of the sandstone wall passed me by; I didn't even notice it!

Fig 1 *Historic England 1947 aerial view of the Barton swing road bridge and Bridgewater Canal Barton swing Aqueduct.*

The aerial photo clearly shows the Barton swing road bridge and the famous Bridgewater Canal Barton swing aqueduct where they cross the MSC. The line of the MSC is east towards central Manchester - to the right of the photo. Before the MSC was built the original stone aqueduct crossed the River Irwell slightly to the west of its present position, ie closer to the road swing bridge. The approach supporting embankment and retaining wall, originally built in 1761, were strengthened and re-faced in 1822-1824 (Fig 2). The '1824' date is inscribed in one of the sandstone blocks and several blocks are similarly inscribed with the stonemason's unique individual identification, as shown in Fig 3. In 1893, when MSC engineer Edward Leader Williams was designing the swing aqueduct, to allow ocean going ships to access the port at Salford Quays, the original stone aqueduct was demolished, but the approach was infilled and remains to this day. It is the infill, embankment and sandstone retaining wall for the original route across the Irwell, which remains in place that has been granted Grade 2 Listed Building status by Historic England (Listing number 1470478)

Fig 2 *Present day Bridgewater Canal aqueduct and end of the 1822-1824 strengthened and re-faced, buttressed sandstone wall of the original embankment built by Brindley. Photo ©Fred Owen*

Fig 3 *Close up of sandstone block with original stone mason's inscription highlighted. The black line shows in the buttressing profile of the sandstone blocks to strengthen the canal's embankment, dated '1824'. Photo ©Fred Owen*

Historic England concluded that this feature is unique in the development of England's canal system as being the first to follow contours rather than natural, navigable water courses. Brindley used innovative engineering skills to build bridges, embankments, cuttings, viaducts and aqueducts to cross obstacles, while maintaining the desired water level.

Geologically it is known that the sandstone for Brindley's original stone aqueduct came from the nearby Worsley Delph Quarry, on land owned by the Duke of Bridgewater. This is where the original coal was mined from the Carboniferous Upper Coal Measures and the start of the Worsley to Manchester section of the Bridgewater Canal built to transport the coal to the cotton mills of Manchester. The BGS website describes it as 'the Bolsovian Substage sandstone, cross-bedded, brown or yellow, rarely purplish, with subordinate beds of mudstone and sandy mudstone'. Whilst this fits the appearance of the sandstone of the 1824 re-faced wall it is not known for certain that it came from the same quarry.

At the same time, 1822-24, the retaining wall was re-faced and the adjacent Barton Lane Aqueduct Portal was rebuilt using sandstone from the Worsley Delph Quarry. It is interesting to note, and well worth seeing, is the collection of mason's unique marks that make the definitive link between this portal and the re-faced retaining wall. The portal was dismantled in 1893 as part of the MSC construction works and later re-erected by Eccles Corporation on the north side of Barton Lane, near to the present traffic lights. This portal has also been granted Grade 2 Listed Building status by Historic England (HE Listing number 1460194).

It has been a fascinating experience to see how sharing interests with others leads to new discoveries and how easy it is to miss the significance of things around us. The link between geological resources and industrial development is ever present.

Finally, the disused, overgrown and forgotten Worsley Delph Quarry has recently undergone a £5.5 million Lottery Heritage Fund restoration project which was opened in 2019. Once Covid restrictions are lifted I will explore the potential for linking these three sites into a geo-industrial history field trip.

Fred Owen
22 March 2021

OTHER SOCIETY EVENTS

Yorkshire Geological Society http://www.yorksgeolsoc.org.uk/

22 Apr 2021 Webinar — The Whin Sill and its contact metamorphism in the Cow Green boreholes, Upper Teesdale

BCGS http://bcgs.info/pub/

19 April 2021 Speaker: Stephen Knipe in London, Ontario.

Leeds Geological Society http://www.leedsga.org.uk/

15 April 2021 A Re-evaluation of Glacial Lake Pickering.Speaker: Dr Laura Eddey University of Sheffield

GeoLancashire https://geolancashire.org.uk/lectures-and-excursions/

9 April 2021 Duncan McLean – **Pollen and Spores**

OUGS North West Branch https://ougs.org/northwest/

12 April 2021 New ideas on Archaeopteryx from synchrotron scanning
Dr John Nudds, Manchester University

10 May 2021 Undersea Rivers: giants of the deep. Speaker: Prof Jeff Peakall

14 June 2021 Discovery of a meteorite ejecta layer at the base of Paleocene lavas, Isle of Skye, NW Scotland. Speaker: Dr Simon Drake

https://www.westmorlandgeolsoc.co.uk/

This summer's field trips have been cancelled due to Covid-19

19 May 2021 The next **Extractive Industry Geology** #EIGWebinar will be "To sustain mineral benefits in mining regions, communities must be resilient to sudden mine closure and this requires good regional governance" by Rezki Syahrir, PhD Researcher, Camborne School of Mines at midday on Wednesday via Zoom. FREE registration for this & future EIG Webinars here: https://forms.gle/Mny4XtDJ5TeeSgFy5 -

Manchester Geological Association

Zoom Meetings 2021

Manchester Geological Association
Winter Lectures 2020/21
Speaker Abstract
Wednesday 14 April 2021

Shallow hydrothermal dolomitization of the Middle Cambrian Cathedral Formation

Jack Stacey, Basin Studies and Petroleum Geoscience, University of Manchester

This study evaluates examples of hydrothermal dolomitization in the Middle Cambrian Cathedral Formation of the Western Canadian Sedimentary Basin. Field work, petrography and geochemical analyses indicate that the Cathedral Formation was hydrothermally dolomitized at a very shallow depth (<1km) by a mixture of seawater and serpentinite-derived brines that convected along faults to approximately 6 km depth. Otherwise isolated faults were connected by a basal clastic aquifer, which allowed fluids to convect and dolomitize larger areas of the Cathedral Formation than would otherwise have been possible. Additionally, the presence of a shale seal above the Cathedral Formation facilitated the build-up of fluid pressure during the final phase of dolomitization, leading to the formation of saddle dolomite cemented breccias at much shallower depths than previously realised.

Wednesday 13 October	'Holiday Geology'
Saturday 13th November	Broadhurst Lectures 'Tony Adams Memorial Day of Lectures'
Saturday 4th December	'Who Are We and Where Did We Come From? Early hominoids'

2022

Saturday 15th January	'Geological Skills' day

Summer Field Excursions

Until it is safe for a group to go into the field, a number of Zoom ‘virtual field excursion’ are being arranged. Details will appear on the website.