The Geological Society

serving science, profession & society

12-20 October 2019
'Geoscience is for everyone'
Earth Science Week

Solihull through Deep Time

Ray Pratt

Chairman of West Midlands Regional Group of The Geological Society of London

Affiliations:
- American Association of Petroleum Geologists
- Black Country Geological Society
- Geologists Association
- London Petrophysics Society
- Norwegian Formation Evaluation Society
- Petroleum Exploration Society of Great Britain
- Warwickshire Geological Conservation Group

Careers Advise: Oliver Hutton, Hydrogeologist at Stantec & Severn Trent

The Geological Clock

- Earth is 4.5 bn years old (45000 mm ya)
- On a 24 hour geological clock man turned up in the last minute
- The **earliest** members of the genus Homo are Homo habilis which evolved around 2.8 mm ya. (Pliocene Epoch)
- First Dinosaurs 230 mm yrs ago (in Triassic). Wiped out 65 mm ya
- Five mass extinction events. The end-**Permian mass extinction**, which took place 251.9 million ya, killed off more than 96 percent of the planet's marine species and 70 percent of its terrestrial life—a global annihilation that marked the end of the **Permian** Period.
- 6 major **Glacial** events (Quaternary Period)
- There is lots of evidence in the geological record for climate change – so what's the issue ?

Did the earth move for you ?

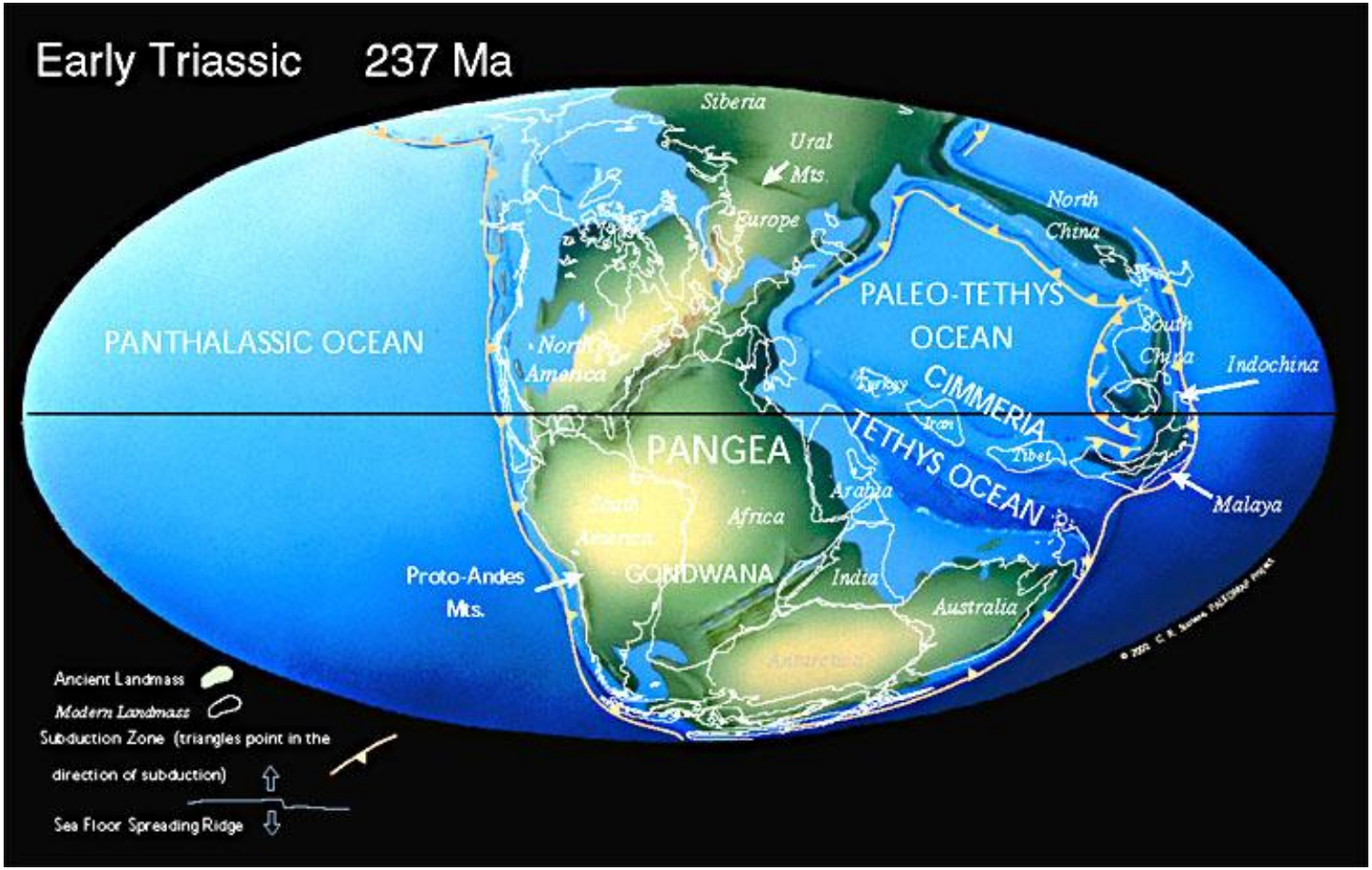
- Who has heard of Continental Drift ?
- Who has heard of Sea Floor Spreading ?
- Who has heard of Plate Tectonics ?
- Where is Solihull ?
- 52.4118° N, 1.7776° W 132m elevation Above Seal Level
- During 100 years will move 1-2m further north and east

- https://www.youtube.com/watch?v=g_iEWvtKcuQ&list=PLMAaf3X_LlwNI7mcmNOQnXt7djytFAC_u&index=17&t=0s

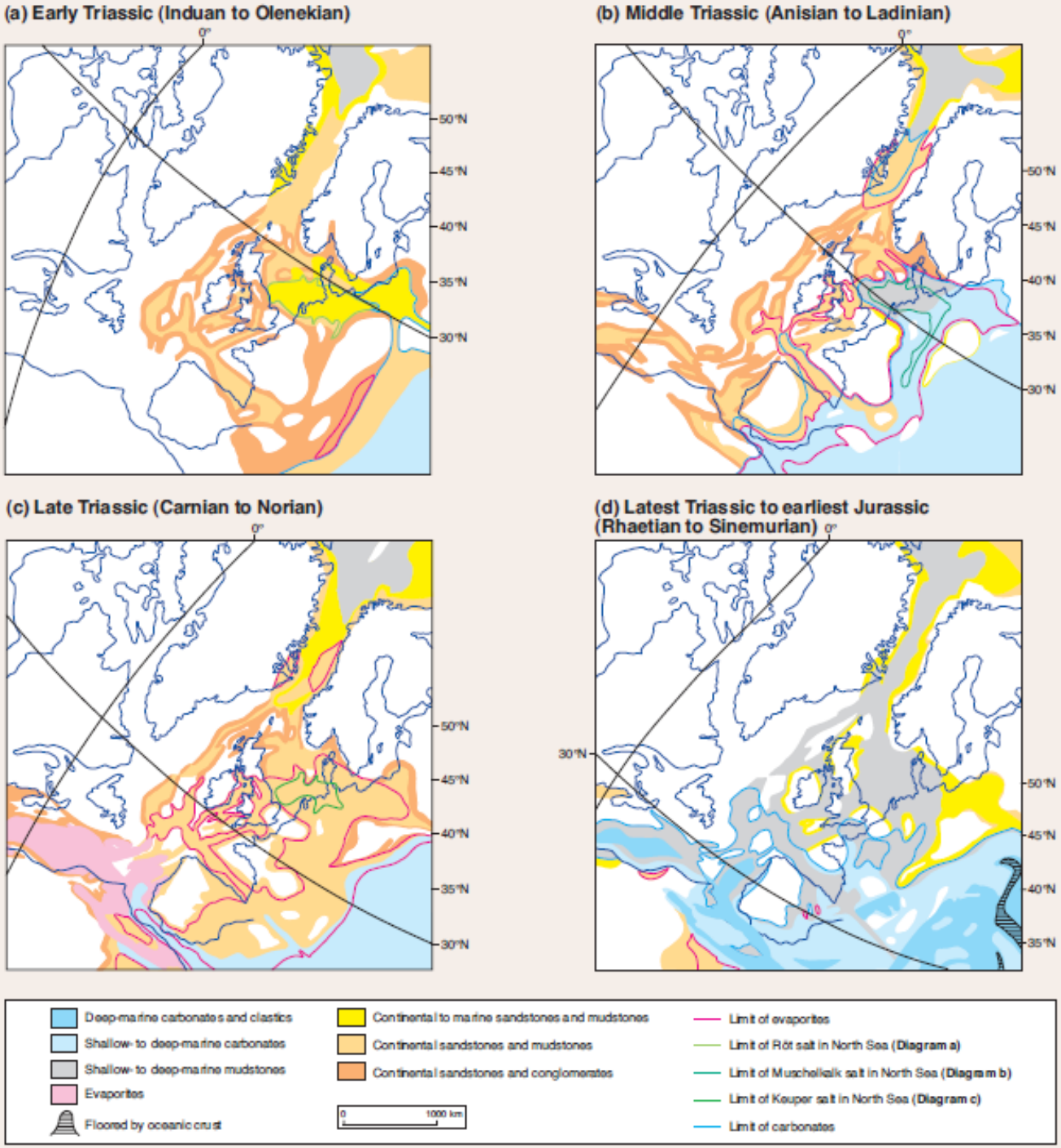
"IF THE 'DRIFTING CONTINENTS' THEORY IS VALID, THEN WE SHOULD SIGHT LAND IN ABOUT TWO MILLION YEARS."

The Plate Tectonic Story

Solihull was in a landlocked position in the continent of Pangea some circa 30 degrees north of the equator. Approximately equivalent to the location of Algeria today. The climate was arid with seasonal mega-monsoons.



[Early Triassic Paleo Geography]


(a) Early Triassic (Induan to Olenekian)
(b) Middle Triassic (Anisian to Ladinian)
(c) Late Triassic (Carnian to Norian)
(d) Latest Triassic to earliest Jurassic (Rhaetian to Sinemurian)
0°
50°N
45°N
40°N
35°N
30°N
Deep-marine carbonates and clastics
Shallow- to deep-marine carbonates
Shallow- to deep-marine mudstones
Evaporites
Floored by oceanic crust
Continental to marine sandstones and mudstones
Continental sandstones and mudstones
Continental sandstones and conglomerates
0
1000 km
Limit of evaporites
Limit of Röt salt in North Sea (Diagram a)
Limit of Muschelkalk salt in North Sea (Diagram b)
Limit of Keuper salt in North Sea (Diagram c)
Limit of carbonates

The Rocks – Pre Cambrian

- The earth is 4.5 billion years old. The **oldest** known **rock on Earth** was dated to 4.031 ±0.003 billion years, and is part of the Acasta Gneiss of the Slave craton in northwestern Canada.

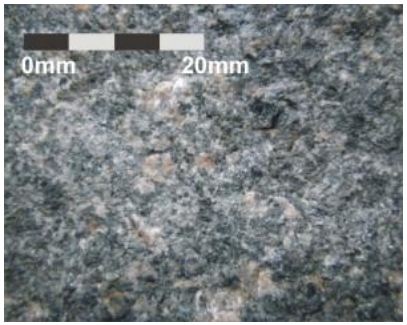
  (*Photo by Pedroalexandrade - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16249191)*

- The **oldest rocks in Britain** are found in NW Scotland and the western isles. This **ancient** Lewisian gneiss is almost 3,000 million years old!

  (https://www.virtualheb.co.uk/lewisian-gneiss-rocks-of-the-isle-of-lewis-and-harris-western-isles-geology/Gallery/page2.php)

- Pre Cambrian rocks can be found in the Malvern Hills, Worcestershire (565 mm yrs old) and in Charnwood Forest Leicestershire (600mm yrs old)

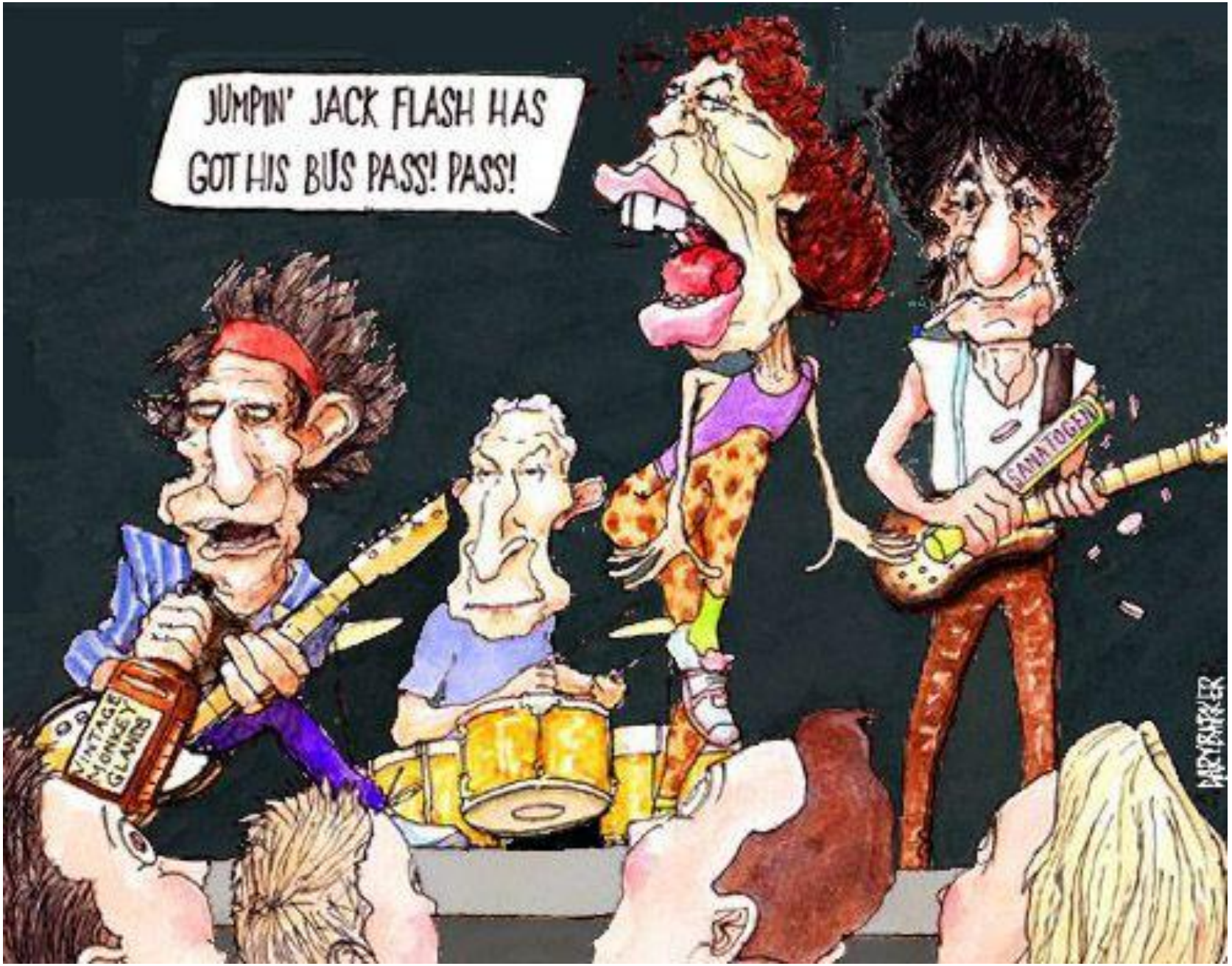
  (http://geopark.org.uk/pub/2015/06/geology-and-landscape-3/)



West Midland Rocks

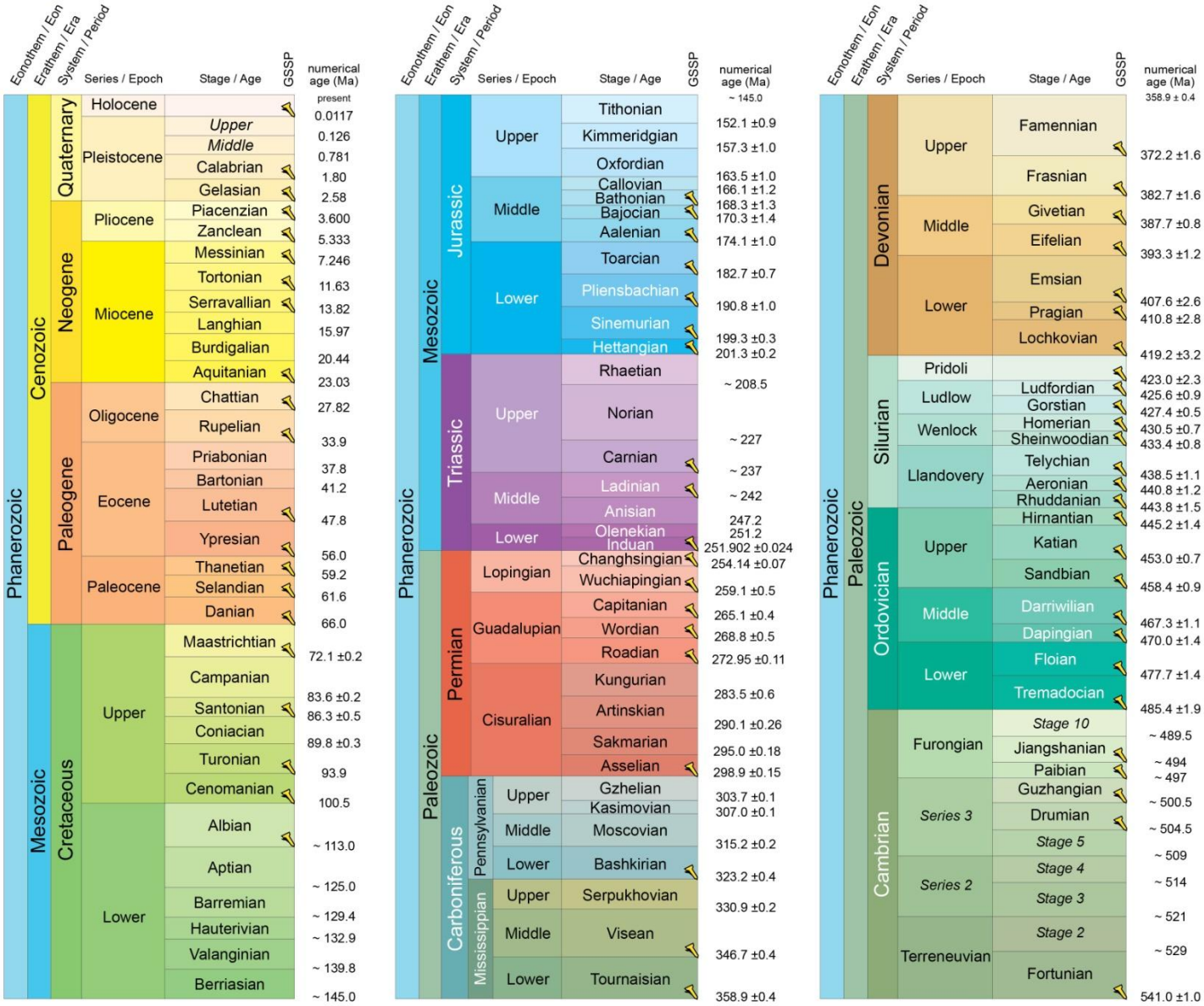
•In the West Midlands the oldest rocks are found to the west of the region in the Lickey Hills (Ordovician 440 mm years).
(Lickey Quartzite – R Pratt)

•The surficial deposits of Solihull are Pleistocene deposits from the Quaternary ice ages (age) < 1.6 mm yrs
•At 5m depth we have Triassic deposits. These consisted of Sidmouth Mudstone Fm of the Mercia Mudstone Group (247 - 230 mmyo) and Bromsgrove Sandstone of the Sherwood Sandstone Group (251-247 mmyo)
•These were drilled. Had we drilled deeper we would expect to find Permian and Carboniferous deposits


JUMPIN' JACK FLASH HAS GOT HIS BUS PASS! PASS!
VINTAGE MONKEY GLAND
SARATOGA

INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

IUGS www.stratigraphy.org International Commission on Stratigraphy v 2017/02



Units of all ranks are in the process of being defined by Global Boundary Stratotype Section and Points (GSSP) for their lower boundaries, including those of the Archean and Proterozoic, long defined by Global Standard Stratigraphic Ages (GSSA). Charts and detailed information on ratified GSSPs are available at the website http://www.stratigraphy.org. The URL to this chart is found below.

Numerical ages are subject to revision and do not define units in the Phanerozoic and the Ediacaran; only GSSPs do. For boundaries in the Phanerozoic without ratified GSSPs or without constrained numerical ages, an approximate numerical age (~) is provided.

Numerical ages for all systems except Lower Pleistocene, Upper Paleogene, Cretaceous, Triassic, Permian and Precambrian are taken from 'A Geologic Time Scale 2012' by Gradstein et al. (2012); those for the Lower Pleistocene, Upper Paleogene, Cretaceous, Triassic, Permian and Precambrian were provided by the relevant ICS subcommissions.

Colouring follows the Commission for the Geological Map of the World (http://www.ccgm.org)

Chart drafted by K.M. Cohen, D.A.T. Harper, P.L. Gibbard (c) International Commission on Stratigraphy, February 2017

To cite: Cohen, K.M., Finney, S.C., Gibbard, P.L. & Fan, J.-X. (2013; updated) The ICS International Chronostratigraphic Chart. Episodes 36: 199-204.

URL: http://www.stratigraphy.org/ICSchart/ChronostratChart2017-02.pdf

The Rocks and their depositional environments

The Overburden and Seal.

- Sidmouth Mudstone Fm of the Mercia Mudstone Group (Olenkian – Carnian 247-230 mmyo)
- Arden Sandstone Member of the Mercia Mudstone Group

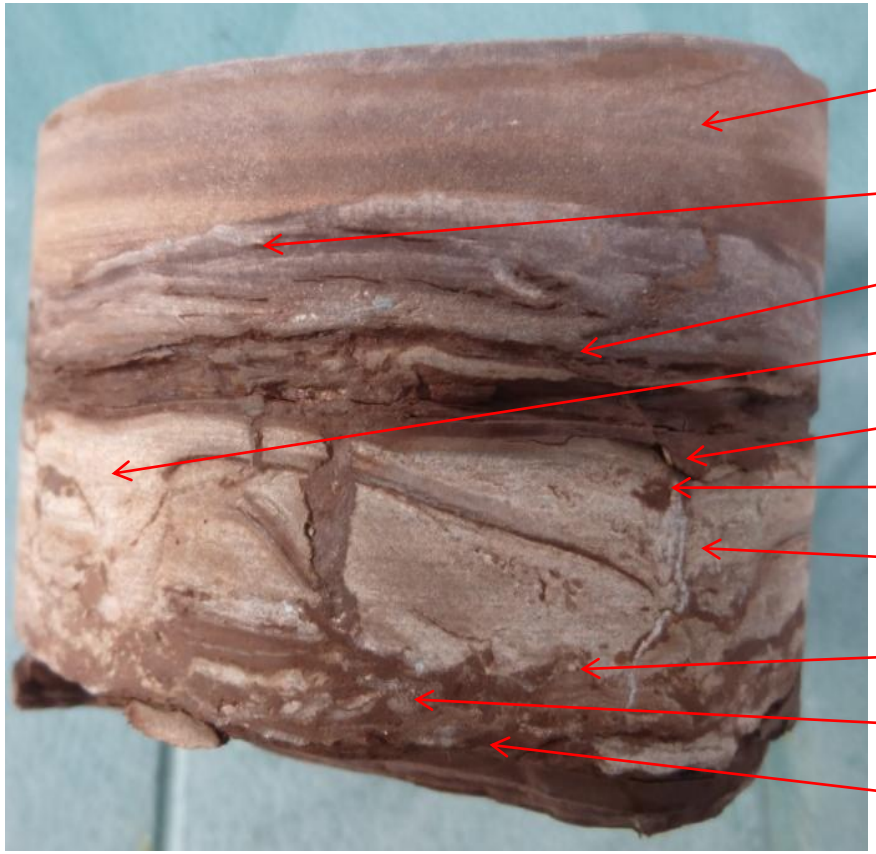
Decaying organic material after burial causes reducing conditions to occur as it rots away bleaching out the red colour by reducing Fe3+ irons to Fe2+ ions on the matrix.

Claystone 199.5m

248.62 m Claystone. Grey brown to dark red brown blocky, slickenside surfaces crumbles in hand - fracture zone

279.76m Cemented Sandy Siltstone

Fluvial Systems



The upper layers show a return to fluvial deposition (sheet flooding events).

Pre depositional scouring

Clay drapes. Possible aeolian origin (playa lake)

Scour Channel fill

Load structures

Rip up clasts give evidence of a pulse of high energy

Thin vertical fractures lined with gypsum

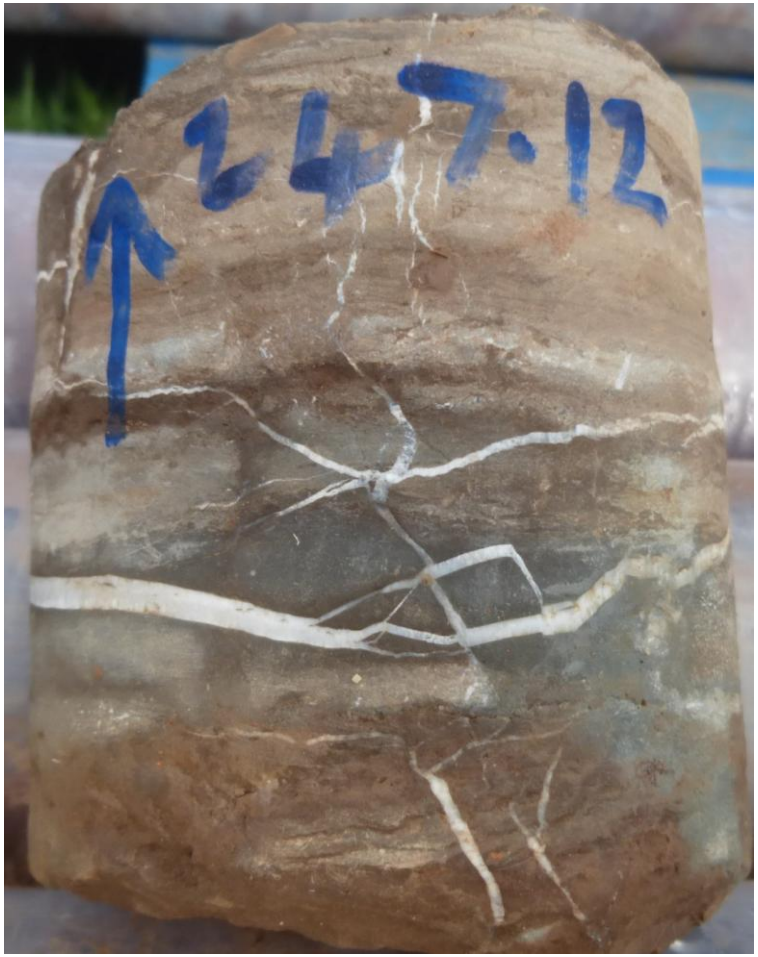
Fluidisation of the unconsolidated sediment

Gypsum growth causing sediment disturbance

Scouring

Silty Claystone.
very finely laminated - cleaves easily
Gypsiferous, micro micaceous, mini channels with rippled surfaces
There is lots of secondary gypsum veining above and below, injected at periods of stress

Post depositional tectonic stress features



Upper part Argillaceous **Siltstone**.
micaceous
Thin white gypsiferous laminations and nodules.
Mid and Lower part dominantly **Claystone**.
Light coloured laminations of **very fine sandy siltstone** . Gypsum cement and thin gypsum veins
Mica highlights features seen.

UK experiences several hundred earthquakes each year with only 20-30 felt by people.

Coastal sabkha facies, siltstones and mudstones of the mid-Triassic **Sidmouth Mudstone Formation (Mercia Mudstone Group)**, Radcliffe-on-Trent, Nottingham. Laminated greenish-grey or pale brown siltstones forming the more resistant beds were deposited by storm-driven **flash floods** on wet mudflats and saline lakes, while the interbedded red-brown **blocky mudstones represent wind-blown dust storm** deposits that accumulated on damp mudflats. Photo: Andy Howard, 2017.

The Rocks and their depositional environments

The Reservoir

- Bromsgrove Sandstone of the Sherwood Sandstone Group (Early Trias – Ansian 251-247 mmyo)

301 m Sandstone. Silty to very fine grained, micaceous in part. Argillaceous - wavy bands of clays.
Poor to moderate visible porosity, poor permeability.

Depositional Environment. Fluvial, possibly deposited in overbanks and small channels.

375m Reservoir – drill cuttings

Important Parameters: Reservoir thickness. Porosity, Permeability, Kh Kv values and ratio, Homogeneity v Heterogeneity . All have an impact on effect net reservoir - flow rate dependent upon all of the above .

Geothermal gradient is the rate of increasing temperature with respect to increasing depth in the Earth's interior. Commonly around 25–30 °C/km of depth near the surface in most of the world

Bromsgrove Sandstone - Holy Cross - Clent

Reservoir rocks in Solihull

Walks & Talks

- Sunday 20th October 2019: **Geological Walk around Solihull - a look at the building stones of the town**
  - Meet at 11:00 hrs at St Alphege Church Church Hill Rd, Solihull B91 3RQ
- http://www.wgcg.co.uk/solihull-trail/

Talks

- Tuesday 12th November 2019 18:00 for 18:30 2020.
  - Early Careers Award Launch. **The Importance of Targeted Site Walkovers** on Large Scale Project. Samuel Hazell (Arup)
  - **Engineering Geology of the Aberdeen Western Peripheral Route** Dan Roberts (Atkins)

  St Martin Church, Edgbaston St, Birmingham, B5 5BB

- Tuesday 3rd December 2019 18:00 for 18:30.
  - **Carbon Capture and Storage.** Sam Krevor Subsurface CO2 research group at Imperial College London.

  St Martin Church, Edgbaston St, Birmingham, B5 5BB

Bibliography

- 1971 H. Read & Janet Watson – Beginning Geology
- 1977 BSc Geology KCL 1995 MSc Management UCE
- Welcome to the **global** oil business
- Employee - Mudlogger, Pore Pressure Engineer, WSG
- Self Employed. WSG, Ops Geo, Petrophysicist
- Specialism's. Well planning, monitoring and evaluation
  - Minimising Geo-Technical Risk for drilling operations
  - Geological & geophysical logging programs and interpretation
  - Post well data management
  - Creating high performance teams
- 2016 Semi Retired.