Geology Matters

The newsletter of Malvern U3A geology group
November 2017

The leader

Well the winter programme is now fully underway and so good to see 74 members present at our first meeting. Thanks must go to Jim Handley for his talk on the calcrete below his house and also to our main speaker, Dr Robert Vernon, who talked about the Metal Mines of Spain. I certainly didn't realise what a huge investment Great Britain made in mining operations in Spain from the late 19th Century. Our next speaker is Dr Robert Waller from Keele University speaking on the subject of Glaciology.

Many of you will have attended the lecture earlier in the year by Prof Ian Fairchild on the Anthropocene. He explained that the Anthropocene represents not just the time when humans have occupied the planet, but the changes they have brought about; not only climate change caused by the huge rise in the burning of fossil fuels but also rising sea levels, habitat changes and mass extinctions. He explained that since the Second World War, there has been a much greater pollution of the planet due to nuclear tests, the manufacture of plastic and concrete, increasing uses of pesticides and fertilisers as well as the proliferation of cars. The term has not yet been officially approved as a recognized subdivision of geological time but work is continuing with the aim of ultimately doing so.

One of our members sent me this extract from the BBC Wildlife Magazine:

> "As geological time-scales go, we are most familiar with the periods (Jurassic, Cambrian, etc.) which are subdivided into epochs. Many believe we are entering a new epoch - the Anthropocene - which recognises the influence of humans on Earth's biological, atmospheric and geological systems. There's much debate over exactly when the Anthropocene started. One possibility is 1945, the date of the first nuclear tests, which will leave a distinctive radioactive signature in the rock strata of the future."

It would be quite nice for those of us born before 1945 to be able to say that we have lived through 2 epochs!

Global demand for coking coal set to revive Cumbria mining

This recent Financial Times headline tells you both about the next story and

the general theme of this month's offering. Geology is not just about explaining plate tectonics or wonderful scenery, but also about economic exploitation of natural resources.

There are reasonably extensive coalfields in the west of Cumbria, but like other British coal, they have succumbed to the drive for clean air and carbon emission reduction**.** The Cumbrian coal, however, is known as metallurgical grade and is to be used exclusively in steel production.

The coal is baked in a coke oven which forces out impurities to produce coke, which is almost pure carbon. Modern steel plants, the likes of which are predominantly found in the UK and Europe, include extensive gas treatment and capture to significantly reduce emissions. The steel that is produced is used in our daily lives in cars, kettles and cookers as well as in the manufacture of wind turbines and nuclear power stations, our alternatives to coal-powered energy.

The coal seams from which the metallurgical coal is intended to be extracted are located offshore, from the Cumbrian coast. To gain access, drift tunnels will be created from land to sea. The drift tunnel will access the coal offshore, reaching a depth of around 550m below the coastline.

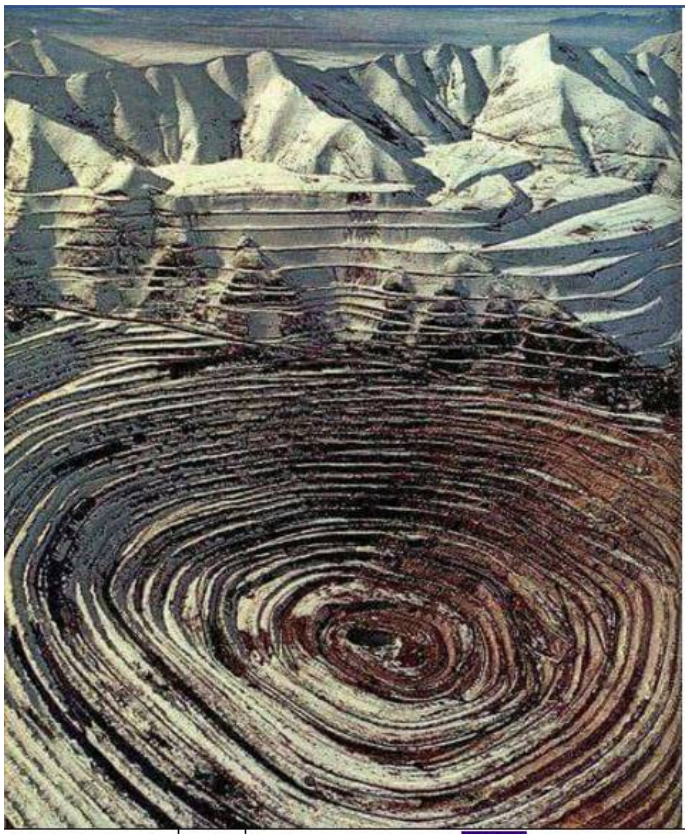
What is a drift mine?

Seams of coal and other ores sometimes outcrop on the surface and the seams then disappear horizontally or on a gentle slope into the ground. These seams are exploited very simply by tunnels that directly follow the seam – so no need for deep vertical access shafts. We don't need to go far to find examples – just to neighbouring Gloucestershire and the Forest of Dean, where both coal and iron ore were mined in this way.

Lambsquay iron mine Forest of Dean

But to change the scale somewhat

The largest mining operations on the planet, where the geology allows, simply involve removing surface deposits (overburden) and then digging a large, carefully designed hole like this.



The Bingham Canyon Mine, is an open-pit mining operation extracting a large porphyry copper deposit southwest of Salt Lake City, Utah, in the Oquirrh Mountains. The mine is the largest man-made excavation in the world and is thought to have produced more copper than any other mine in history – more than 19 million tonnes. The mine is owned by Rio Tinto Group, an Anglo-Australian company.

Well are you slightly intrigued by the photograph above? It is designed to show you what the output of a large copper mine looks like. It is smaller than the Bingham mine, with a copper output of 4.1 million tonnes and is located at Palabora in South Africa.

As these open pit mines are on a huge scale, to operate them you need some giant scaled equipment and this picture shows the North Antelope Rochelle coal mine in the Powder River Basin of Wyoming, and currently the world's largest coal mine by reserve. The trucks each have a capacity of about 300 tonnes.

Mining for rarer minerals

Most natural diamonds are formed at high temperature and pressure at depths of 140 to 190 kilometres (87 to 118 mi) in the Earth's mantle. Carbon-containing minerals such as carbonates provide the carbon source, and the growth occurs over periods from 1 billion to 3.3 billion years (25% to 75% of the age of the Earth). Diamonds are brought close to the Earth's surface through deep volcanic eruptions by magma, which cools into igneous rocks known as kimberlites and lamproites.

And yes, it is real. It's the second largest diamond ever discovered and it was sold recently for £39.5m

Gold is thought to have been produced in supernova nucleosynthesis, from the collision of neutron stars, and to have been present in the dust from which the Solar System formed. Because the Earth was molten when it was formed, almost all of the gold present in the early Earth probably sank into the planetary core. Therefore, most of the gold that is in the Earth's crust and mantle is thought to have been delivered to Earth later, by asteroid impacts during the Late Heavy Bombardment, about 4 billion years ago. On Earth, gold is found in ores in rock formed from the Precambrian time onward. It most often occurs as a native metal, typically in a metal solid solution with silver (i.e. as a gold silver alloy). Such alloys usually have a silver content of 8–10%.

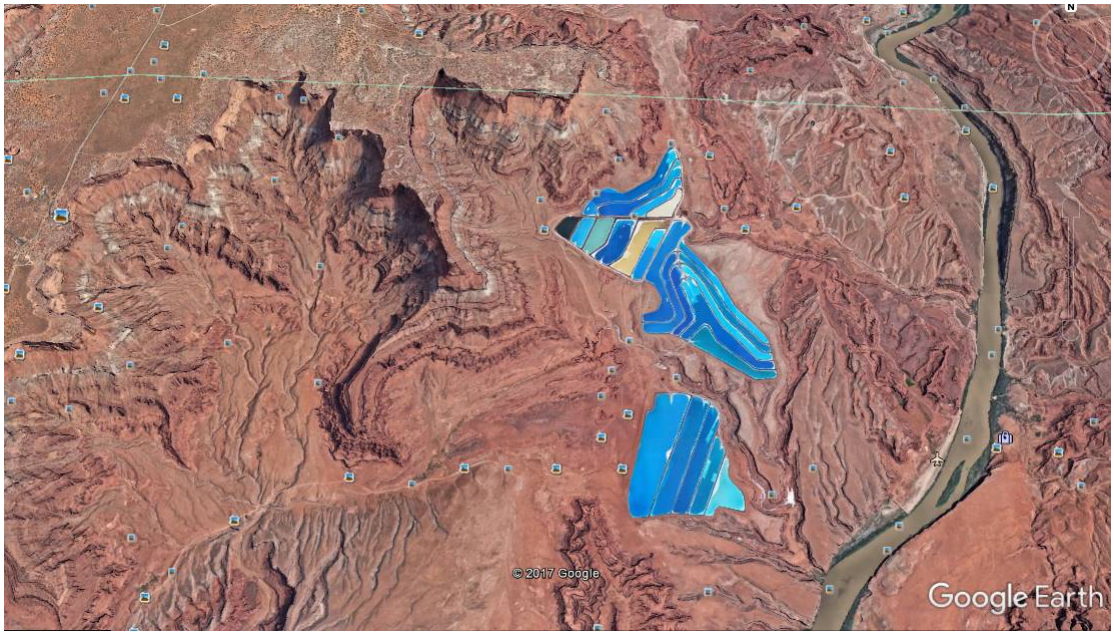
The hyperlink takes you to a couple of videos about mining these two rarities.

https://www.youtube.com/watch?v=8uLuecS_PTk

Potash mining

Potash is mined worldwide to provide potassium, an essential nutrient for food crops. Evaporite potash deposits are the largest source of salts that contain potassium in water-soluble form, including potassium chloride, potassium-magnesium chloride, potassium sulphate, and potassium nitrate. Thick sections of evaporitic salt that form laterally continuous strata in sedimentary basins are usually formed by the evaporation of warm shallow seas that were usually land-locked. At Boulby in North Yorkshire, there is a very large deposit of this material that is mined conventionally. A new deposit is to be exploited and transported by an underground conveyor system to Teesside from where it will be processed before being exported.

Elsewhere a different extraction system is used and the deposits are dissolved and then allowed to evaporate in large surface ponds. The following images from near Moab in Utah show such an operation.



The Colorado river winds its way through this arid sedimentary landscape. The second image is the ground level view from the charmingly named Dead Horse Point, which is on the extreme left of the above image.

Rock of the month

And in keeping with this month's theme, here is a metal ore – iron pyrites, chemical formula FeS_2 This particular sample originated in Peru, although the mineral is widely distributed. Sometimes called "Fools gold" – note the difference/similarity with the previous image of gold.

No comment

Spotted on a Facebook geology user group that was discussing those characteristics that are desirable when you undertake field work:

The calendar

November	8	Monthly Talk: Glaciology
December	13	Monthly Talk: Malvern Hills Geology
January	10	Monthly Talk: Effects of Meteorites, Asteroids and Comets
February	14	Monthly Talk: Speleothems
March	14	Monthly Talk: Turbidite Flows
April	11	Monthly Talk: The Plate Tectonics of Welsh Geological History
May	9	Monthly Talk: The Devonian System

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