# Newsletter May 2022

**UPCOMING EVENTS**

The field trip in Chopwell Woods has taken place and there will be a report in the next Newsletter.

A reminder of further trips:

26th June Liddesdale with Gordon Liddle; We will be exploring the eastern end of Liddesdale, the Hutton Unconformity, a destructive plate margin and sedimentary basins together with striking fluvioglacial landscape effects.

17th July (To be confirmed) Ian Kille

28th August Garrigill – South Tyne Karl Egeland-Eriksen

25th September Wards Hill Rothbury Gordon Liddle

Please contact Gordon if you wish to attend (gordon.liddle@hotmail.co.uk)

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**FIELD TRIP / LECTURE REPORTS**

**March 25 Lecture**

**Diamonds: Fact, Formation and Fable**

**Dr Andrew Moore University of Cape Town**

Andrew began with a pair of aphorisms, nicely juxtaposed:

The mining company De Beers say, "A diamond is forever" while the prospector says, "A diamond takes forever to find" and "Not all crooks are into diamonds, but everyone into diamonds is a crook" (!)

Botswana, a country Andrew knows well from his research, is the second largest (after Russia) producer of diamonds, chiefly from the western Kalahari – Andrew added that the area has an interesting wildlife developed around its inland delta including a unique species of swimming lion.

Diamonds are a carbon crystal. Graphite is another crystalline form of carbon. In a diamond each carbon atom links to four others covalently (sharing electrons, as distinct from donating or receiving them as happens with ions – for example in sodium chloride).

Diamonds are weighed using the "carat" measurement. This word originates from the name of the Carob tree, where the bean was used an example of a small weight. One carat approximates to 0.2grams.

Diamond crystals may incorporate impurities, commonly Nitrogen or Boron. The former absorbs the blue part of the visible spectrum and may produce a yellow colour. Andrew described how Type IaA,

IaB and Ib diamonds refer to the pattern of incorporation of the nitrogen atoms, while Type IIa have no Boron or Nitrogen, and Type IIb have some Boron impurity, which can produce a blue colour. Elsewhere other sources of diamonds are famed for their distinctive hue, including for example the Pink Argyle diamonds from Australia, where the colour is attributed to a deformation of the crystal lattice.

The largest diamonds mined include:

The Cullinan (1905) from the Transvaal – 3106 carats – presented to Edward VII as a birthday present and the Sewelo (2019) from the Karowe mine, Botswana – 1758 carats (both Type II)

The Lesedi la Rona (2015) a Type Ia, also from the Karowe mine, Botswana – 1110 carats, which sold for $53m

The Constellation – 813 carats – sold for $63.1m

The formation of diamonds requires extremely high pressures and will only happen naturally at depths below 120 km.

The mining of diamonds is linked to the location of Kimberlite "pipes" – vertical channels of igneous rock believed to arise from the area of the upper mantle/crust interface bringing up diamonds with them as xenoliths from depths of 150 km and more. The name comes from the site of the mine in Kimberley (named after the then Secretary of State for Colonial Affairs) in South Africa where the discovery of the Star of Africa diamond in 1869 triggered a rush to mine in this area where an enormous open pit, the 'Big Hole' was dug.

As well as directly digging into these "pipes" diamonds are found in the erosion products from further afield. In Namaqualand, in Namibia, so-called alluvial diamonds were found in the early 20th century along the coast, brought down by the Orange River. We learned of Jack Carstens whose find of alluvial diamonds in 1927 is seen as the starting point for this part of the story. Alluvial diamonds, while smaller, are of high quality as the journey in the river is believed to fracture defective gems.

As an aside Andrew told us the story of The Grosvenor, a ship returning to England from India that was lost off the coast of South Africa in 1782. In the 1920s an alluvial diamond was found which turned out to resemble examples found in India. The claimant was accused of fraud, and some now consider that the gem was from the shipwrecked 150 years earlier, which was known to be carrying diamonds.

Andrew stressed that it is important to understand that diamonds (and garnets) appear in kimberlite as xenoliths – they are not formed within the kimberlite itself but transported upwards in the "pipe." They occur within peridotite. This is an igneous rock described as ultramafic, that is it has a high magnesium content, containing as it

does 60% olivine and 30% orthopyroxene. This material is dated at 2.5-3bn years old where kimberlite itself is a mere 90m years old. Another xenolith brought up is called eclogite, which may be a metamorphosed basalt. This is a mafic rock, where garnets are more commonly found, especially a type known as pyrope for their orange/red colouring (from the Greek for "fire" and "eye").

Andrew touched on the source of kimberlite. He said that the content of the "pipes" tells us something about the upper mantle (that is below 120km deep) and referred to the "subcratonic lithospheric mantle" as being considered the origin of these igneous flows. He went on to tell us that geologist have calculated that some of the larger Type II diamonds may have originated as far as 600km down. He acknowledged that controversy surrounds some of the ideas around the origins of larger Type IIa diamonds found within megacrysts in kimberlite.

Other sources of diamonds?

Astronomers surmise that cold dwarfs (collapsed stars) may have diamond cores, and that a planet in the CANCER (CRAB) constellation may have a diamond core (but it is fifty light years distant!).

A type of diamond mineral known as a CARBONADO contains microcrystalline diamonds, along with graphite and amorphous carbon. It is found in alluvial sediments in central Africa and Brazil. Its origin is not known, and hypotheses include ideas about extra-terrestrial origins from meteorites heating up in the atmosphere to residua of exploding supernovas. A carbonado diamond ("Enigma") is the largest cut diamond.

(This was a fascinating, dizzying ride through the world of diamonds, taking on board as it did reflections on processes occurring deep down and over exceptionally long periods of time)

John McNulty

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**April 24, Dr Andy Lane: Building Stones of Sunderland**

The large group met in the Market Square, many of us had joined Andy on his earlier Sunderland trip, so were well prepared for his perceptive account of this part of Sunderland.

Andy issued a street plan with our route which proved most helpful as we worked our way through the old streets of Sunderland. He suggested we could look at many of todays 'exposures' in terms of the geological era record.

Stop one (Central metro/ rail station) was an area undergoing renovation, the buildings had a cladding of two types of possible "marble." These potentially reflected a

metamorphic environment but builders also use the term for polished limestone. The group gave the material close inspection to confirm they were heat formed material with a crystalline texture and colouration from mineral contamination. The pale "fossiliferous" material was clearly a "builder's" marble whilst the brecciated material below was heat affected- clearly care required!

Returning to Market Square we examined the reddish flag stones. These revealed a sedimentary origin with coarse, sub rounded clasts interbedded with sandy layers. Several clast rock types were identified, their size indicating a strong fluvial current was the transporting agent. We concluded the material formed in a hot/dry environment which experienced flash flooding. Clearly not a local stone. There was some granitic material framing the flags.


Members checking out the 'wetted for clarity' flagstone material in Market Square.

Moving onto the Halifax building, the cladding was very large slabs of Larvikite, it was well polished and displayed the characteristic lustre of the feldspars. This material is typically sourced in Norway.

Moving into High Street West we noted the substantial buildings were of a sandstone with a reddish tinge. This material was probably sourced from the quarries that supplied much of the building stones for Edinburgh.

The flag stones here were a porphyritic granite with xenoliths and a suggestion of foliation in some blocks. Seating pods were a brownish granite and a schist. The frontage of the M&S store was a wonder. Towering above us the colour suggested a limestone, (probably Portland Stone), fossil inclusions supported this, a marble was identified together with an exceptionally coarse rock displaying cataclastic texture. The company had clearly gone to some expense to clad the frontage.

Moving onto St Mary's Way a building (the old Argos building) had unusual cladding: large (6cm diameter) beach pebbles cemented into a framework, this covered the entire wall. The pebbles were typical Sunderland shoreline pebbles. Turning 180 degrees we looked, from a distance, at the new City Hall. A glass and steel framed (with cement type spray) building showing no geological materials.

Our next stop found us in Keel Square, this occupies the site opposite the huge Vaux brewery, now demolished. A new sculpture made from weathered iron represented a horse drawn dray,

very effective. The square itself is backed to the west by the local Carboniferous sandstone built early police station and swimming baths. Both now evolved into new functions. The square flooring was a fascinating mix of rock types, a granite framework (the planters probably from China, the edge material a Cornish granite), a sedimentary flag stone that showed much variety of structure, the now famous 'keel' of a gabbroic material etched with the names of all the ships that had been built on the Wear - an exceptionally long list reflecting the areas heritage. The 'keel line' crossed St Mary's Way connecting old parts of Sunderland. This recent redevelopment was impressive.

We moved to the old fire station, close to the Minster. More granitic flags. A very old building was noted (No 2 Church Lane), the exposed internal wall is thought to date back to the origins of Sunderland, one internal wall displays a Marl Slate like material - locally seen as belonging to the Lowest Upper Permian. The Dun Cow public house was a granite and sandstone structure.

Moving onto Church Lane an ancient wall of local concretionary limestone displayed many of the amazing structures the rock is famous for. It also demonstrated the use this rock was being used for, too porous for building and too variable for most construction roles, it is used here for wall

construction, we were to see the similar only "conservation graded" structure in Sunderland, on Green Terrace, this wall has been lowered and shortened prior to its preservation order nonetheless it displayed the concretionary limestone very well.

We moved onto the Minster, this dates to the Middle Ages, the first rector dating from 1214. It has seen several phases of extension, modernisation, and renovation in its existence. The most recent work has used the Rutland Jurassic sandstone "clipsham." The rock is a sandy-shelly material easily worked and attractive. The Minster font is constructed from a wide variety of metamorphic marbles, an astonishing variety of colour was noted. Finally, we moved into the Minster Gardens. Chinese white granite again figures as an enclosure for the "green granite" which appears to be a fine quartzite. The inner wall uses stone recycled from the old Sheepfolds industrial area- and very nicely done. The mix of limestone and handmade bricks gave a fitting end to the fascinating story Andy had outlined for us.

The whole group warmly thanked Andy for a wonderful trip. Incidentally, Andy has just published his latest book a second edition of "Bedrock and Building Stones - Geology exposed in the City of Sunderland. First

published 2014. On sale to members at the launch price of £12.50 (+postage) enquiries to andy.lane3@ntlworld.com

Gordon Liddle / Dr Andy Lane

Thanks once more to Gordon for the report on the first field trip.

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**Geological definitions – an occasional series**

**Cataclasis:** The process of mechanical fractures or break up of rocks usually associated with dynamic metamorphism or faulting – either small or large scale. Breccias are cataclastic rocks.

The newsletter is currently produced bimonthly. Contributions are welcome – email the editor at

huttonsedgewick@gmail.com