May 2017

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GENERAL NEWS

Website. Dave Briggs is overseeing the construction of the club website, check it out at www.nelsonrmc.org, it is being continually updated. It contains news on latest meetings, local geology, projects and studies, micro minerals and so much more. It is a great source of information for the use of members and non members.

SUBS: If you have not yet paid your subs please contact Hub.

MEETINGS Currently being held at Nick Smiths rooms, Quarantine Road. We will return to the usual Richmond Library as soon as they open it up again. Please check your emails for updates.

Diane Toole moved back to Palmerston North in February. Diane has been the club secretary for many years, and one of the most active members of the club. To say that she will be missed is a huge understatement.

Luckily Lis Martins has stepped up to take over the role, and although Diane was a hard act to follow, Lis is proving to be a huge asset too.

Kevin and Mary will be moving to Rai Valley at some stage in the near future. This will mean an upheaval for the clubs equipment which is currently set up at their Nelson property. The committee is looking into suitable alternative arrangements. This might mean that the equipment will soon be unavailable for a while, so use it while you can.

EARTHQUAKE ROCKS: A FAULTY TOUR

Rick Sibson

March 16, 2017

Rick Sibson discussed his choice of PhD topic (Structural Geology in the Outer Hebrides of Scotland) and reminded us of the 1949 film "Whisky Galore" made by Ealing Studios, the story of a united community successfully challenging officialdom and authority. The film gave us a unique portrayal of whisky as The Water Of Life – social lubricant, panacea, energiser, revelation and - undoubtedly - an aid to structural analysis. Rick described some of the geology around the village of Castlebay on the Island of Barra where the film was shot. He provided us with a framework with which to classify fault rocks(see also Sibson, 1977) and showed us some examples from major faults (hundred of kilometres in length) in NW Scotland, such as the Outer Hebrides and Moine Thrust Zones. In the Outer Hebrides the fault zones are marked by a dark, glassy or very fine grained rock that occurs as veins or as the matrix in a breccia. This rock (known as "pseudotachylite", Figure 1) is interpreted as having formed by the frictional melting of rocks along the fault during a seismic event, i.e. an earthquake. Rick published an article on this in 1975, entitled "Generation of pseudotachylyte by ancient seismic faulting". Rick emphasised that pseudotachylyte is not always found along major faults (for example, none has been found along the Moine Thrust), even where displacement is many tens of kilometres.

Other rock types associated with faults include cataclasite and mylonite. Cataclasite forms by the progressive fracturing and communition of minerals during faulting, resulting in a cohesive, non-foliated rock consisting of angular clasts in a finer-grained matrix. Mylonite, on the other hand, involves a reduction of grain size by dynamic recrystallisation of the constituent minerals at temperatures >c. 350° C. Rick noted that the famous English Geologist, Charles Lapworth (1842-1920) was the first to recognize mylonite related to the Moine Thrust, where he interpreted (correctly) that older rocks were lying upon younger rocks near Durness (about 10 km east of Cape Wrath, Scotland), an idea "*which at the time conflicted with orthodoxy*". Lapworth was obviously a giant of his time as he is perhaps even better known as the pioneer of faunal analysis using index fossils, especially graptolites and he was responsible for identifying the Ordovician Period (between the older Cambrian and younger Silurian Periods).

Rick also took us on a "tour" of faults through the earth's crust, illustrating how faults move discontinuously near the earth's surface (by, e.g., earthquakes) to continuous ductile shearing at depth. The cataclasite-mylonite transition likely defines the base of seismic activity at depths of 10-20 km in crustal fault zones. Rick described a number of examples, including the 1989 Loma Prieta earthquake and the 1971 San Fernando and 1994 Northridge Thrust Ruptures, all in California and part of the San Andreas Fault System, which marks the zone where the Pacific Plate is moving to the NW along the North American Plate. Examples from Japan were also discussed, e.g. western Honshu.

Rick finished the talk with a brief discussion around the relationships between faulting and mesother-

mal gold vein mineralisation. A critical point is that earthquake rupturing 'refreshes' fracture permeability in fault zones. He discussed examples from the Mother Lode area in California (Figure 2), the Hollinger Mine in the Timmins Camp (Ontario) and the Sigma Mine in the Val d'Or Camp (Quebec). Rick introduced us to the concept of the 'Fault-Valve'action, where gold veins arelocalized along high-angle reverse faults that are inferred to slip periodically as a result of build-up of fluid pressure around the base of the seismogenic zone; during slip a large volume of fluid is released giving rise to fault-valvebehaviour (Sibson et al., 1988).

Both during and after the presentation we were able to examine a large basket of hand specimens that exhibited many of the lithological types and structural features described in the talk.

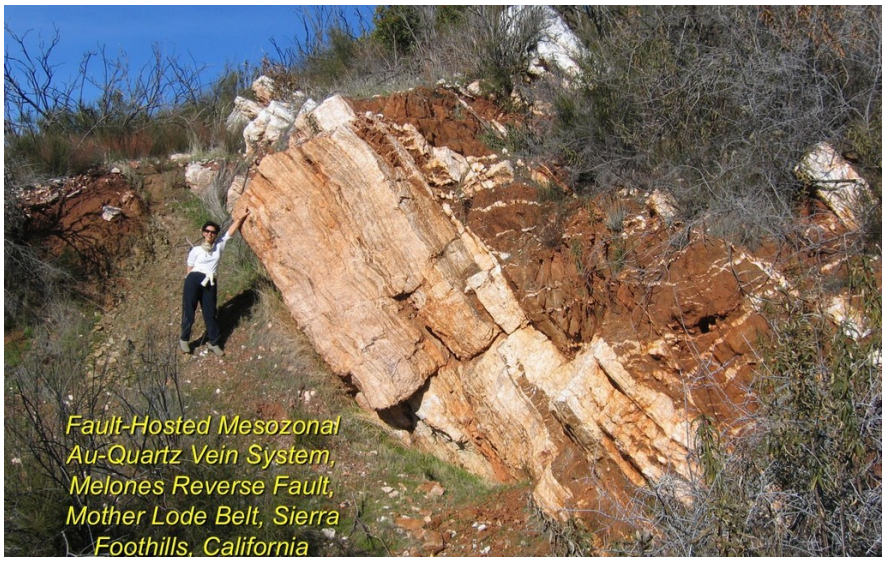
Sibson, R.H. (1975): Generation of pseudothachylite by ancient seismic faulting; Geophysical Journal of the Royal Astronomical Society, v. 43, p. 775-794

Sibson, R.H. (1977): Fault rocks and fault mechanisms; Journal of the Geological Society, v. 133, p. 191-213

Sibson, R. H., Robert, F., & Poulsen, K. H. (1988). High-angle reverse faults, fluid-pressure cycling, and mesothermal gold-quartz deposits. Geology, 16(6), 551-555

Fig 1 Pseudotachylyte in Outer Hebrides Thrust Zone

Fig 2 Outcrop of the Mother Lode Au-Quartz mineralisation



Canaan Downs Field Trip 18th , 19th March written by Mike Blowers

Six members signed up for this trip, which was to check out the overnight accommodation at the Canaan "Woolshed Bunkhouse" and enable members to explore further afield than has been the case with our previous one day trips there.

As it transpired the "Woolshed Bunkhouse" was in fact the old farmhouse and was spotlessly clean and well appointed, with good comfortable bunk and bed accommodation for 9 or 10 persons. There was a spacious open lounge/kitchen/ dining area with table, chairs, wood fire, Rayburn range, gas stove and sink, so we were comfortable and warm enough that we did not require any heating. Lighting at night was powered by electric solar.

Three members had to pull out of the trip at the last minute for various reasons, so we made our way individually to Canaan Downs on Saturday morning. Clyde had set off earlier than me and by the time I reached his car, parked a kilometer from the farmhousehe he had already collected a large sample of rock from the low hill above the road which he thought showed buff coloured patches of scheelite, which was confirmed that night by its fluorescence under UV light.

I picked up a bit of road metal which proved to be a schist with numerous small garnets showing on its surface, (photo 2) presumably it had come from a road quarry a few kilometres back towards the main highway.

We proceeded to the farmhouse, unloaded the cars, had lunch and set out for an afternoon's exploration. We commenced at the small stream bed which disappears into the ground under a rock face, not far from the farmhouse and worked our way upstream. The stream bed was

a jumble of mixed rock, quartz, limestone, granite and schist, with metamorphosed fragments containing showings hornblend and epidote and the brown staining of oxidized sulphide mineralization. Eventually we reached an area of extensive quartz outcropping, the “large quartz vein” marked on Ed Sixtus plan of the area. This is an area which has probably been well picked over by generations of fossickers, but undoubtedly there are still interesting minerals to be found there and we commenced working through the debris of quartz reef close to the outcrop, breaking blocks into smaller pieces looking for mineral inclusions. We spent an hour or so at this endeavor and were rewarded by showings of Pyrite, Chalcopyrite and Galena as well as various stages of oxidation of these minerals. Another common and interesting mineral form we noted was areas of jumbled,small micaceous plates, oriented every whichway (see photo 3), undoubtedly a result of some sort of metamorphism. We also found small quantities of talc, usually close to the micaceous jumble. We were unable to locate the contact between reef and country rock because of plant growth and soil cover, but above the outcrop there was a cleared area of grassy pasture, dotted with individual blocks of rock which we examined. Mostly the blocks consisted of a schist or granite, but in the middle of the field were some blocks of a black and red brown colour, very dense, like a Magnetite or oxidized iron ore, which we surmised might be a skarn - some of this material was indeed magnetic (see photo4).

Satisfied we returned to the farmhouse for supper and bed.

It was grey and overcast the next morning with cloud hiding the hilltops, but it started lifting and we headed off to a more southerly area where Clyde had previously collected some magnetite skarn and wanted to pick up the rest of the sample he had left behind – we found the sample, however to Clyde's disappointment there was no magnetite in the piece, so he left it and we found no more skarn material in the vicinity. We then progressed up mineral creek to the north of the farmhouse, but rapidly becoming hemmed in by bush we headed back to the farmhouse for lunch where we encountered the third member of our party Ian Wishart who had arrived earlier in the morning. After lunch Ian headed up the river bed we had walked the previous day, whilst Clyde and I explored the hills to the west of the farmhouse and various quartz intrusions occurring there. I spent considerable time on the lower outcrop of quartz veinlets in crystal valley, which proved largely unmineralised.

Late afternoon we cleaned up the farmhouse and headed homewards.

It was a pity that more members had not availed themselves of the opportunity to stay at the farmhouse, perhaps this trip was too soon after our day visit last July, but for myself and Clyde, who had also been on the July trip, this trip had been well worthwhile.

TRACING THE GOLD IN PAPUA NEW GUINEA

Mike Blowers.

Mike's talk traced the history of Papua New Guinea and its gold from the time of Gondwana to the present.

Like New Zealand, Papua New Guinea is an outlier to Australia, and though more connected to the Australian plate, like New Zealand, much of it is composed of erosional debris from the Australian landmass and it has also been raised from under the sea bed by plate collision and subduction. It has along the length of its mountain ranges a ribbon of ophiolite, much like our own ophiolite belt and has an assemblage of granites and metamorphosed sediments, similar in many respects to our own rock assemblages.

Historically the island of New Guinea was partitioned into Dutch, German and British colonies, but its development was slow because of its covering of thick tropical forest, high mountains and warlike tribes in the interior. From the mining point of view, the exploration and exploitation of minor gold occurrences progressed slowly from about 1800 as individual prospectors moved across the more easily accessible smaller islands and coastal margins. Although there were those who believed that greater riches would be found inland, it was only a few who had the courage and persistence to go there and a number paid for it with their lives. One of those who persisted was Sharkeye Park, who prospected and mined secretlyduring the first world war in German held territory. He followed a trail left by earlier prospectors to an area called Morobe, which was to develop over time into a world renowned mining area. After the war, the German Territory became an Australian administered protectorate and other miners followed Sharkeye to the Morobe field, though it was still a very remote outpost. These miners concentrated on the accessible rivers which carried payable gold and it was not until 1925 that a group of five miners were able to struggle up one of the feeder rivers, over a waterfall to a high basin that was unbelievably rich. Their story tells how they filled sugar bags with gold, then socks, beef tins, jam tins, buckets, even trousers and shirts with tied legs and sleeves in five days of panning. This brought the field to the notice of the world and more miners arrived, small companies were floated and gold bearing loads were discovered and mined. One man,C.J.Levine,had masterminded the accumulation of leases and the formation of a company,Bulolo Gold Dredging Limited, a subsidiary of Canadian company Placer Development Ltd., to dredge the vast alluvial deposits. All the parts of eight massive dredges were flown into the inaccessible goldfield (three to five days walking from the coast) and the company operated very profitablyright though the depression era, disabling the dredges during the Japanese advances in the Pacific war and finally ceasing operations in 1965. An early newsreel documentary was shown to illustrate the task of flying in the dredge parts, assembling them and then operating the dredges in the Bulolovalley.

Mike illustrated the geology of the goldfield with maps of the deposits and of the rivers distributing the erosional gold from the loads and veins. One of the peculiarities of the goldfield deposits is the wide variation of the gold and silver ratios in the different deposits. Most of the gold had been deposited epithermally, but the silver gold ratios were governed by the timing and depth of deposition. The gold purity varied from 92% to 50%, or even less with some of the deposits with a manganese association. This variation in the deposits is compounded by the river systems draining the area as the alluvial gold is moved and mixed. (The size, shape and form of the various gold materials from loads and rivers was shown in a series of slides) The work of Australian geologist N.H.Fisher in the 1940s indicated the contribution of gold from the different sources by collecting thousands of gold and silver assays from the mining operations up and down the rivers and working out the ratios of the gold contributions at the junctions of rivers where concentration changes which would show how much each river contributed to the change. The formulae to use look like this :-

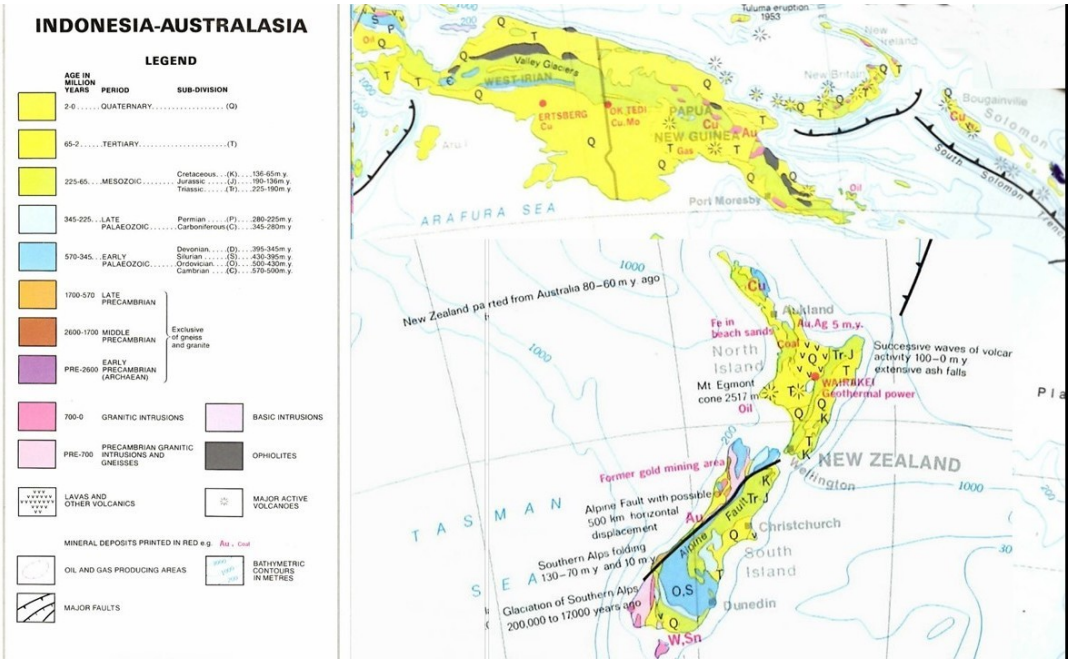
$$\frac{\text{upstream gold load stream1}}{\text{gold load after junction}} = \frac{(\text{Gold purity after junction} - \text{gold purity stream 2})}{(\text{Gold purity stream 1} - \text{gold purity stream 2})}$$

$$\text{gold load after junction} = \text{gold load stream 1} + \text{gold load stream 2}$$

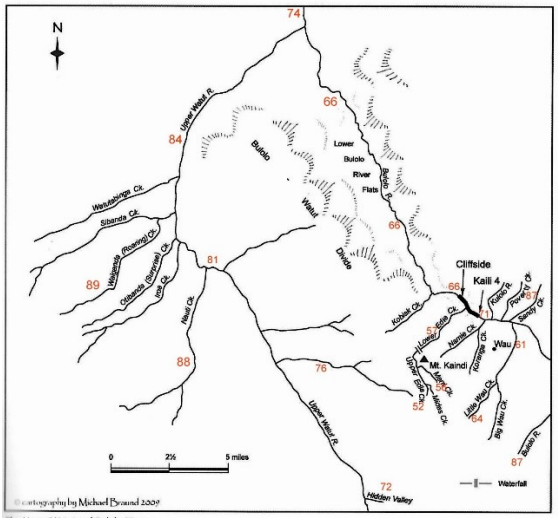
Today the remaining dredges are skeletons and the mining of gold is done by village groups using panning and slucing. Mike gave some details of the villagers operations and the surveys he had carried out there and showing the

size and purity variation of the gold they capture, some of it extremely fine, passing through a 50 micron screen.

Finally he gave a brief overview of the other major mines in New Guinea and the problems that had been experienced with building them in remote mountain regions and to numerous incidences of river and sea pollution resulting from design and operational failures.

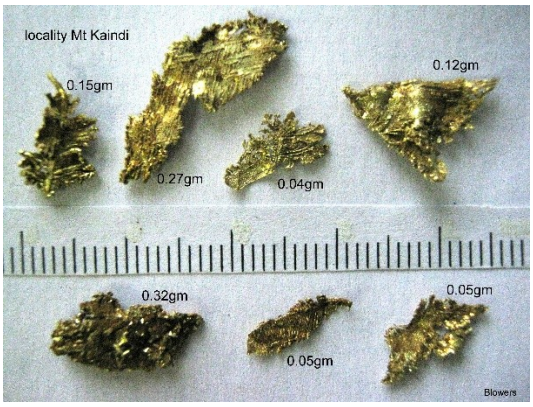


World War I to World War II discoveries



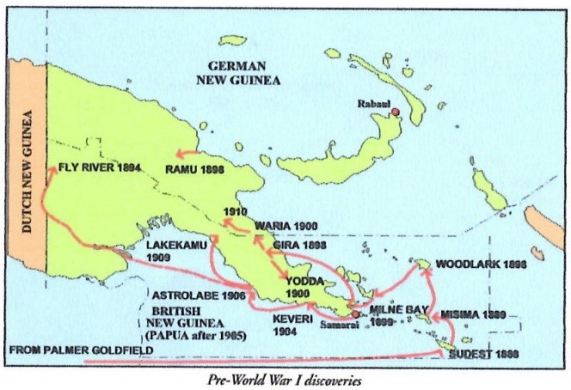
The Upper Watut and Bulolo Rivers.

Variation gold purity in river systems, simplified (see Fisher diagram for full results)



ZOOM IN ON THE PHOTOS FOR A CLOSER LOOK

Epithermal gold



Pre-World War I discoveries

Small clear village water supply wrecked by debris from road building in mountains

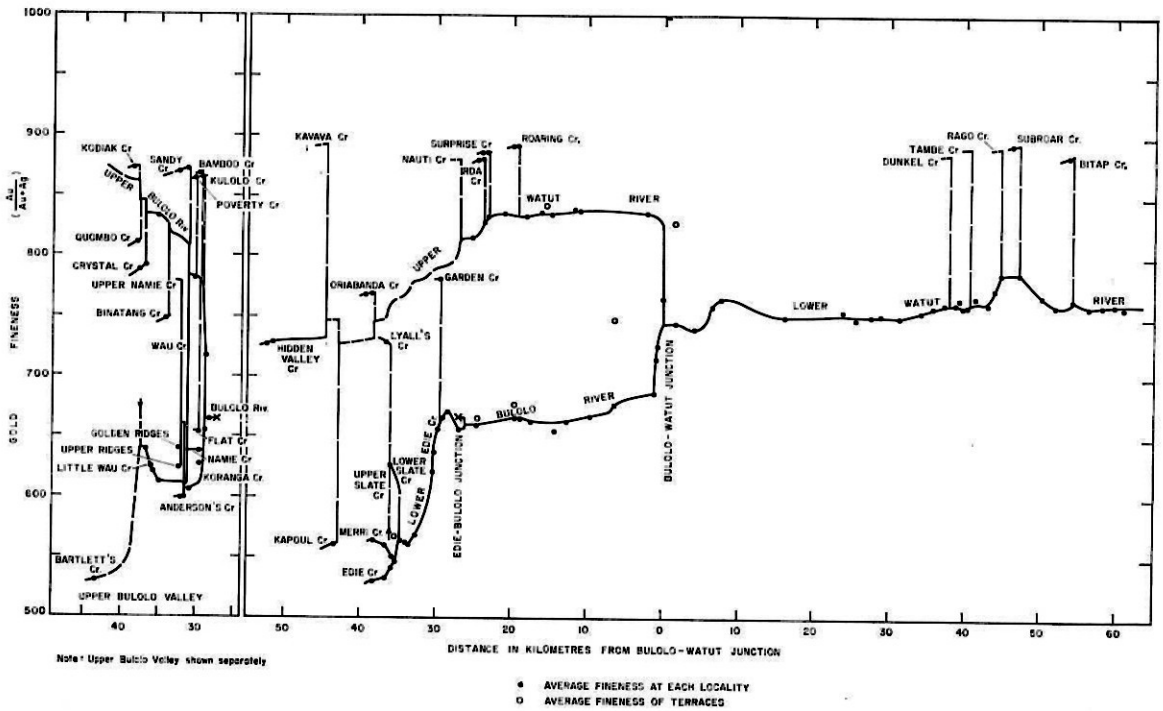


FIGURE 110. Variations in gold fineness with distance in Edie Creek, Bulolo and Watut Rivers and their tributaries (after Fisher, 1945).

Fishers chart showing gold fineness (purity range 0 – 1000 = 0%-100%) of river systems in the Bulolo River systems.

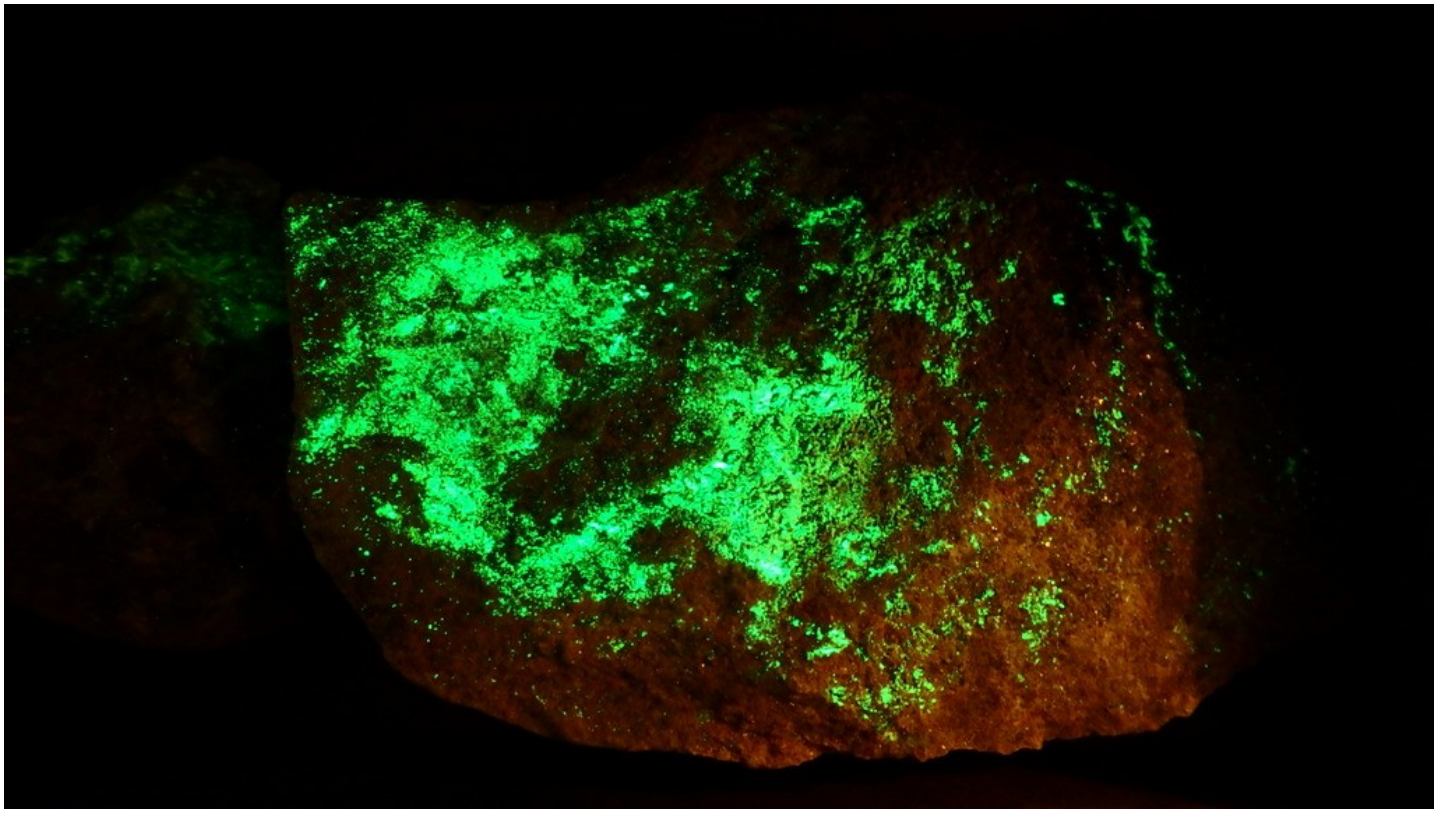
Field trip to Reefton: April 22nd 2017, by Mary Davies

After starting off with a rush in the mid-1950's, uranium was sought by the New Zealand government on and off until the 1980's when it was finally accepted that gas turbines would be used to generate power rather than radioactive materials.

The first prospectors to find uranium in New Zealand were amateur prospectors Frederick Cassin and Charles Jacobsen who were excited to make the first discovery in the lower Buller Gorge.Tasman McKee then took over, employing prospectors to seek out better quality rock.

I was happy to visit one of the adits in the Buller Gorge, thanks to John from Greymouth who drove us there. The climb was steep but soon over; we spent a few hours fossicking in and around the adit.

The uranium was deposited into the Hawk's Crag breccia as it uplifted and eroded away about 100 - 113 million years ago, in the Albian stage of the early/mid Cretaceous. I don't know if it actually formed at this time, or if it was simply re-deposited.



It was a beautiful warm day, and nice to enjoy this at a height, not to mention the view of Mt Cassin and the railway track through the gorge (we heard and saw no trains on the trip). It was interesting to see the cooking platform above the lower adits where there was a cook employed to keep the miners and other workers fed. I got some nice samples of autinite both for myself and for club members; the other two kindly picked up some pieces for Nelson club members also.

Thanks to John from Greymouth for taking myself and Robert to the mine.

Talk from Dr Mike Johnston at the Rock and Mineral Club AGM November 2016, report by Mary Davies

Mike, as usual, participated in the annual meeting of the International Commission on the History of Geological Sciences (INHIGEO), which this year was held in conjunction with the International Geological Congress in Cape Town, South Africa. Mike participated in two trips around South Africa, looking at diamond, gold and platinum mining, along with other minerals, rocks and fossils, some of which will be mentioned in this short report.

Mike commented on not seeing many animals in the places he travelled, but quite a lot of rubbish. And weaver birds nests on power poles! Spring flowers were out in places, which relieved the monotony of some of the, to a New Zealander, rather monotonous landscapes. The diamond mining areas are heavily protected by private enterprise but several placer mines on the Atlantic seaboard were visited along with ground restoration programmes.

Mike's trips comprised one of five days to the Bushveld Igneous Complex, which was preceded by an eleven day Craton Traverse that in a 3,200km long traverse from Johannesburg to Namibia and south to Cape Town examined all of the basic geological units that make up southern Africa. We saw geological maps showing these features.

There were stromatolites, billions of years old, which were oxygen producing single celled cyanobacteria that, layer by layer, built up dome shaped dolomitic structures now preserved in the fossil record. In doing so, over time, the bacteria changed the air from being toxic and thus made it possible for modern life to evolve. It was the very deep burial of some of these stromatolitic deposits that transformed the carbon in the carbonate into diamonds, rather than graphite, some of which have been brought to the surface in kimberlites. Erosion of the kimberlites by the Orange River and its tributaries has carried the diamonds out to the placer deposits on the Atlantic coast

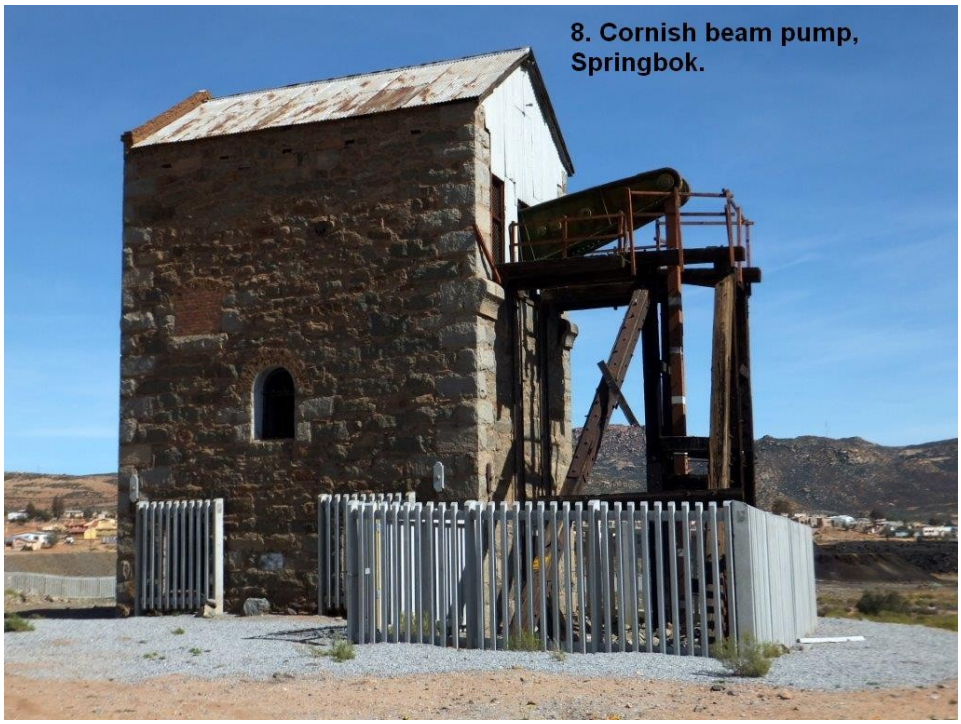
The Witwatersrand Supergroup was formed 2700 million years ago and contains gold – this formation was examined near Ventersdorp west of Johannesburg though not much actual gold was on show! The general consensus is that the gold was a

placer deposit in river gravels that now form part of the supergroup. Another mineral seen was banded iron ore, forming sishen-type deposits, in large mines working deposits that accumulated in giant sinkholes in marble around 2,100 million years ago. The marble has now largely dissolved away literally leaving flat-topped mountains of iron. Associated with the iron are manganese deposits, mostly composed of the silicate braunite, which is also extensively mined, as at one locality on the edge of the Kalahari Desert at a town called Hotazel.


Sishen-type banded iron ore.

The Pofadder Shear Zone of the BushmanlandTerrane is a 550 km long exhumed "fossilised" dextral strike-slip fault. This was visible near the Orange River and may be what the Alpine Fault will look like many of millions of years into the future.

The Blue Mine at Springbok was the first mine in South Africa developed by Europeans and the remaining mine buildings show the strong influence of Cornish mining technology. This is an abandoned copper mine but lots of chrysocolla and malachite are still visible, hosted in granites. Nearby is the Concordia Granite, which is the only area of orbicular granite in the whole of South Africa.


8. Cornish beam pump, Springbok.

Higher up in the geological column arethe Late-Cambrian limestones containing Ediacaran fossils, the name being taken from Australia where this fauna was first

found in the Flinders Ranges. Mike saw specimens of *Cloudina*, a metazoan fossil, in a locality near the Orange River – these small tube-like fossils were precursors to the modern molluscs.


10. Ediacaran fossil Cloudina (c.600 million years), near lower Orange River.

Moving to the second trip, to the world famous Bushveld Igneous Complex which lies to the northeast of Johannesburg. It is the world's best example of a layered intrusion covering some 65,000km^2 and is up to 9 km thick. It contains the world's largest reserves of chromium along with platinum, palladium and other platinoid minerals. Iron, tin, titanium and vanadium are also present in large amounts.The complex contains a large component of ultramafic rocks in the east including dunite and dominantly harzburgite. The dunite has weathered into magnesite, which is mined for magnesium.

There is large scale chromite mining, and unlike Dun Mountain where there are only small pods up to tens of metres in length, here chromite layers are in the order of a metre thick and can be followed for hundreds of kilometres. Where they crop out they are worked by open casting but elsewhere, particularly where mined for the platinoid minerals they contain, there are large underground mines.

The most famous of the platinoid-rich chromite layersis the Merensky Reef and we saw photos of where it was first discovered. The host rock is a feldspathic pyroxenite. We were then shown underground mining at the Two Rivers Mine, along with lesser amounts of palladium. Mike's trip took participants underground and a photo of the Reef (with the roof anchored against rock falls) shows gently dipping anorthosite which is feldspathic with chromite layers. The uniformity of the chromite layering is spectacularly shown at the Dwars River.

We saw a photo of ferrochrome plants that, using electricity, produce ferrochrome, an alloy of chromium (50-70%) and iron, which is largely used to manufacture stainless steel.

It is theorised that the Bushveld Complex came up from a magma chamber and spread out into the host rocks as a giant mushroom shaped intrusion or lopolith. However, the supporting evidence is open to debate and some consider that it originated from a meteorite impact. There is a large impact crater not far to the south at Ventrefort but this is a little younger than the rocks in the complex. Whatever the origin the complex is not an ophiolite, such as the Dun Mountain Ultramafics, which are associated with subduction zones between crustal plates. The upper part of the

complex contains layers of magnetite.


14. Nkomati Nickel Mine.

Also visited was Nkomati Nickel Mine, which lies within Uitkomst Complex, a 2044 million year old subsidiary intrusion of the Bushveld Complex.A photo showed the mine and machinery, and some of the infrastructure, such as ventilation and access shafts, that makes it run. It is both an opencast and underground operation although ore is currently only extracted from a large pit. Maps used to exploit the deposits are based on ore grades rather than in rock units.

Another subsidiary intrusion is exploited at the Vergenoeg Minewhere a hematite deposit is mined for the fluorite it contains. The Transvaal Supergroup lies between the Witwatersrand Supergroup and Bushveld Complex, and contains dolomite with spectacular stromatolites.

A great talk, as always thanks Dr Mike, filled with lots of tantalising information that makes you want to run for a geological map and the internet to find out more and more.


2. Dragline dredge, diamond placer mine.

UPCOMING EVENTS

If you have done anything of interest relating to Rocks and Minerals, why not submit a short article for possible inclusion in the next newsletter, as the other members would love to hear about it. This newsletter is great forum for sharing ideas and activities.

Large tumbler for hire: Takes two drums. Operates off main. Size: 1m x 300depth x 900high.including table. Grit available. Cost: $10/month plus the cost of grit. Contact Kevin.

Future program (possible, but definitely not finalised– Check your emails for updates)

18th May Club night	***Mineral identification from crystal form***	***Stephen Eagar***
21st May FT	***Upper Takaka, Waitui Valley***	***Ian***
15th June Club night	***Geol top of Sth, Faulting and movements***	***Paul Woperis***
18th June FT	*Look at local faults*	***Paul Woperis***
20th July Club night	***Life of a fossil***	***Dave Briggs***
23rd July FT	***Mapping and fossil field trip***	***Ian***
August Club night	***? Copper Mines***	***James MacDonald?***
August FT	***??? Mike Johnstone re Ultramafics***	***(Mary to ask)***
September Club night	***Lake sediments***	***Peter Ingram***
September FT	***?***	
October Club night	***?***	
October Labour Weekend	***Away Trip to?***	
November Club AGM	***AGM and talk from Patron***	***Mike Johnston***
November FT	?Champion	
December Club EOY		

STOP PRESS!!!!!!

Tim Saunderson as many members know, is a valued member of our club who has shifted to Auckland.

He is still very active with his interest, and if you would like to see what he is up to you may subscribe to his newsletter which he publishes on an ad-hoc basis.

This is free, all you need to do is email Tim and he will send you a copy whenever he publishes. His email is saphesia@gmail.com and the first issue is out now.