Website Newsletter of the Cape Town Gem & Mineral Club

APRIL 2023

Side-Tipper Ore Transport Truck, N7

DIARY

April	*1*	*10:00–14:00*	*Open to the Public Day – Rocks, gems, jewellery, mineral specimens to look at, chat about, swap, sell or buy.*
	8		*EASTER WEEKEND - CLUB CLOSED GEMBOREE AT AUGRABIES*
May	*6*	*10:00–14:00*	*Open to the Public Day – Rocks, gems, jewellery, mineral specimens to look at, chat about, swap, sell or buy.*
	13		*To be announced*

Letters to the Editor

Have you ever wanted to comment on an article in the Mineral Chatter? Or have a mineral-related issue that you'd like to share with readers? Well, now you can in this proposed 'Letters to the Editor' section. You can send an email to capetowngemmineralclub@gmail.com preferably short (one or two paragraphs) and to the point and share your thoughts/wisdom with your fellow members. To get things started Peter has submitted the first such 'letter' below. We look forward to hearing from you…

"Duncan's very interesting and thought-provoking article "*Time is an Abyss*" in Minchat 157 of March 2023 reminded me of something I read about decades ago that is vaguely related. The proposition was that although we as humankind (how I hate PC words!) were capable of producing *inter alia* cars, trains, planes, harnessing nuclear power, electricity, microwaves and visiting the moon and sending spacecraft deep into outer space, i.e. Duncan's Technospasm, most people have no idea of how to make or do these things. What would happen to humankind if these technocrats got wiped out through an Earth cataclysm or nuclear holocaust? We'd be back in the Stone Age. So, the wise thing to do according to this proposition would be to have plane loads of suitably-skilled technocrats aloft, aboard special flights to keep them out of harm's way or perhaps in the not-too-distant future have them safely ensconced in a colony/colonies on the moon (Beam me up Scottie!). They could then be deployed to areas of the World where these skills have been lost. In this vein, I read somewhere that underground nuclear bomb-proof bunkers exist in some countries for the purpose of sheltering VIPs, hopefully excluding politicians, from harm from Armageddon or the threat thereof. Mind you, we'd be better off if certain politicians *were* locked up in such bunkers and the only noticeable consequence would be that things would improve for the rest of us.
Duncan kindly provided me with the following pertinent quote:
"*…science is a numerically small and somewhat persecuted international sect… Scientists are necessary to their societies but they are treated like the smiths of classical times (Hephaistos was the mythical archetype) who were social outcasts, but who were lamed to prevent them from running away, since their skills were needed but not understood*." (Mackay, A.L. 1991. Lucretius: atoms and opinions. *Interdisciplinary Science Reviews* **16**:125.)"

Peter Rosewarne
Century City

Minerals and War

By Peter Rosewarne

Introduction

We've had "Minerals in Art" and now, at the other end of the spectrum, we bring you "Minerals and War." This is not a fun topic, and it perhaps illustrates that my rehabilitation from writing wacky articles has gone too far but I'll carry on regardless. So, fun or not, here we go.
The first anniversary of Russia's war on the Ukraine, or as Putin prefers to call it, a special military operation, and the ANC government would no doubt have us believe is a friendly joint military exercise between Russia and Ukraine, using live ammunition with some unfortunate collateral injuries and damage, fell on 24 February 2023. The media is full of discussions about tanks, shells, missiles, ammunition etc. and it got me thinking about which minerals are processed to produce these armaments. The US Department of Defense apparently uses 750 000 t/a of minerals to build the technologies that ensure its national security. I thought it might be of interest therefore to readers to find out more about this topic but, if it isn't, you can skip straight to the ads page.

The Armaments

The list of armament-related items (only including those of metallic origin for this article) that I came up with after a brief brainstorm were:

- Bullet/shell casings
- Bullets/shells
- Armour/tanks
- Firearms/guns
- Mortars
- Missiles
- Fighter jets

The corresponding metallic elements that I thought would be needed to manufacture these items included *copper* and *zinc* (in *brass* alloy), *nickel*, *lead*, *aluminium*, *iron*, *manganese*, *titanium* and *uranium*. However, surfing the internet, I discovered that *antimony* is also a very important component, plus *molybdenum* and *beryllium*. The so-called *rare earths* are also very important which, although they aren't rare *per se*, are usually widely disseminated and only found in concentrations sufficient to exploit in a few places on Earth. There are many more but in the interests of brevity this list will suffice.

The corresponding minerals that are of strategic importance include, but are not limited to, *chalcopyrite* (Cu), *sphalerite* (Zn), *pentlandite* (Ni), *galena* (Pb), *bauxite* (Al), *hematite* (Fe), *braunite* (Mn), *ilmenite/rutile* (Ti), *uraninite* (U), *stibnite* (Sb), *molybdenite* (Mo), *beryl* (Be) and *allanite-monazite-xenotime* (rare earths – e.g. Ce). Some of these are discussed and illustrated in the next section.

The Minerals

Brass, an alloy of copper (70%) and zinc (30%), is used to make cartridge cases for bullets and shells. Two principal ores of these elements are chalcopyrite, a copper-iron *sulfide*, and sphalerite, a zinc *sulfide*, respectively. Examples are shown in **Figure 1**.

Figure 1: Chalcopyrite and Sphalerite (Dan Weinrich images, ex Rosey Collection specimens)

The largest copper deposits are found in the USA, Chile and Peru while the largest zinc deposits are found in Australia, Canada and the USA. In South Africa, the Okiep copper deposits, hosted in *noritoids* of the Koperberg Suite, are once again being exploited as the original mining apparently only extracted the richest copper ore and that left behind is now economic to mine. Evidence of this new activity is in the large number of huge side-tipper ore transport trucks seen by the author on the N7 between Klawer and Cape Town recently. An example on the N7 near Malmesbury is shown in **Figure 2**. They could also contain heavy mineral sands concentrate (e.g. *zircon*, ilmenite, rutile, *garnet*) from the West Coast, e.g. Tronox's Brand-se-baai operation or zinc ore from the Gamsberg or even Rosh Pinah, Namibia. Either way, they are a pain for other road users and are contributing to the premature erosion of our road network. The Gamsberg and Black Mountain polymetallic deposits in the Northern Cape produce zinc and copper ores.

Figure 2: Side-Tipper Ore Transport Truck, N7

Figure 3 below shows copper ingots that I saw in transit in the Caprivi area (I think the official name is now Zambezi Region) of Namibia in November 2022, presumably from a mine/refinery in Zambia.

Figure 3: Copper Ingots in Transit, Caprivi, Namibia.

Nickel is mostly found in uninteresting looking minerals such as pentlandite, an iron-nickel sulfide, and some limonites[1]. Canada has large deposits of the former. An example is shown in **Figure 4** (I did warn you!).

Figure 4: Pentlandite, Canada (internet image)

Lead was the traditional element that bullets were made from. Galena, a lead sulfide, is the main ore of lead (**Figure 5**) and is found in large deposits in the USA in the so-called Tri-state area of Oklahoma-Kansas-Missouri, China, the USA and Australia. Modern-day bullets include nickel-jacketed and depleted uranium (DU) types (**Figure 6**), the latter containing only about 0.3% of $U^{238}$and is mainly composed of non-fissile U^{235}. DU is also used for armour-plating. Uraninite, a uranium *oxide*, is the main ore of uranium and usually occurs as uninteresting disseminated grains but a superb crystal group is shown in **Figure 7** further below.

[1] A broad term for iron hydroxides and not a valid mineral species

Figure 5: Galena – Bulgaria and USA (ex Rosey Collection specimens)

Figure 6: 30 mm DU Slug (Wikipedia)

Figure 7: Uraninite, Shinkolobwe Mine, DRC (Michael Bainbridge image)

When I was being interviewed in London in 1974 for a position in the South African Geological Survey, I was asked which base metal South Africa had the World's largest reserves of. Nerves got the better of me and I gave the stupid answer of *platinum* when, as you all no doubt know, it is manganese. They must have been desperate because despite flunking the interview, I still got the job. My first task was geological mapping in the Great Karoo near Beaufort West coinciding with a boom in exploration for uranium and US Steel, Esso, Union Carbide and others were all staking claims in the area. This hasn't got much to do with minerals and war, apart from mentioning manganese and uranium, but it's taken up a paragraph that I might otherwise have had to think more about.

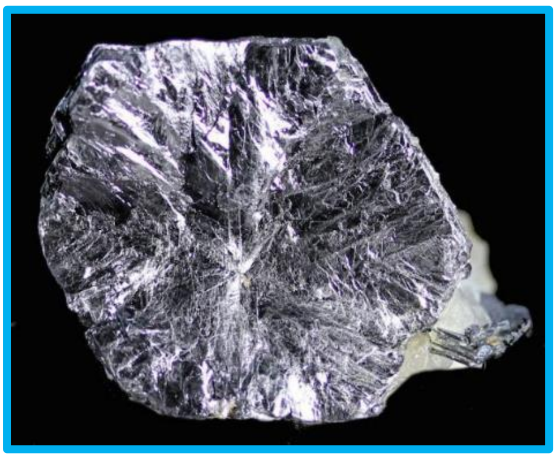
Massive iron ore deposits are found in e.g. South Africa (Sishen), Brazil and Australia. Part of the Sishen Mine open cast operations as in 2016 is shown in **Figure 8** and it is quite awesome to watch an iron ore train crossing a bridge on the Sishen-Saldanha railway, rumbling along, truck after truck, for about seven minutes. Hematite, an iron oxide, is one of the main ores containing iron and an example of one of its habits, so-called *kidney ore*, is shown in **Figure 9**.

Figure 8: Sishen Open Pit, 2016

Figure 9: Hematite, UK (ex Rosey Collection specimen)

Antimony is used to produce armour-piercing bullets/shells amongst other military applications, with between 2–5% by weight being mixed with lead. China produces 80% of World production and the main ore is stibnite, an antimony sulfide, an example of which is shown in **Figure 10**. The Murchison Antimony Mine near Gravelotte in Limpopo Province produces antimony and a specimen of native antimony and stibnite from there is shown in **Figure 11**.

Figure 10: Stibnite, China (Dan Weinrich image, ex Rosey Collection specimen)
Figure 11: Native Antimony with Stibnite, Monarch Antimony Mine, Gravelotte. (Weinrich Minerals image and specimen)



Molybdenum is used to make high strength steel alloys and it only needs <1% content to do this. If the Ryst Kuil uranium deposits near Beaufort West ever get exploited, molybdenum will be an important by-product. A large molybdenite, a molybdenum sulfide, crystal is shown in **Figure 12**.

Figure 12: Molybdenite Crystal, Canada (Hummingbird Minerals specimen and image)

Titanium is the fourth most abundant metal in the Earth's crust, a statistic that surprised me. It is found in minerals such as *brookite*, *anatase*, ilmenite, rutile, *titanite* (*sphene*) and *perovskite*. Ilmenite and rutile are the two chief ores, being simple oxides and relatively common. Titanium minerals are shown in **Figure 13** (no clues, except that I think anatase is top left, then ilmenite, rutile, and bottom right is titanite?). It has a high heat tolerance, strength and is corrosion-resistant and is used as an alloy in fighter jet construction and the hulls of submarines. Major producers include South Africa and Australia, both from heavy mineral sands. **Figure 14** shows rutile crystals (reddish) on hematite. Lovely large rutile crystals come from Graves Mountain, Georgia, USA and the twinned crystals in **Figure 13** could well be from that source.

Figure 13: Titanium Ores (Internet)

Figure 14: Rutile on Hematite, Zambia (ex Rosey Collection)

China has the largest deposits of rare-earths (minerals containing e.g. *cerium* and *yttrium*), which is a bit worrying for the West, but recent discoveries in Japan might shift the balance. Namibia has deposits of *monazite*, cerium-*lanthanum-thorium phosphate*, at the Eureka deposit near Usakos, where large orange-brown crystals are embedded in a *carbonatite* matrix (**Figure 15**) and South Africa has a relatively small fracture-hosted rare earth deposit at Steenkampskraal in the Northern Cape. Other countries with significant deposits include India and Madagascar.

Figure 15: Monazite in Carbonatite, Namibia (Dakota Matrix image)

Figure 16 shows the amount in pounds (1 pound = 2.2 kg [if only 1 pound = 2.2 Rand!]) of rare-earths required to manufacture a fighter jet, destroyer and submarine – quite a lot!

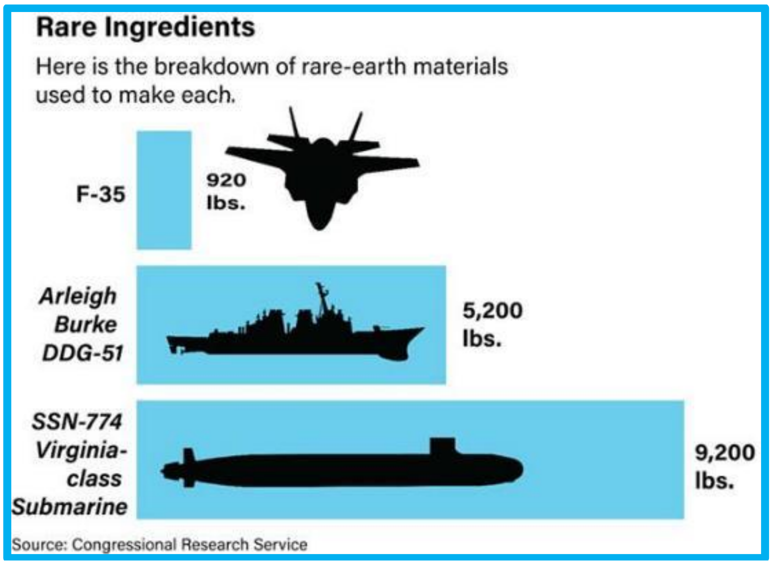


Figure 16: Rare Earths Used to Make a Fighter Jet, Destroyer and Submarine

Figure 17 gives an indication of the countries with the most reserves of strategic minerals, the leading two being Canada and China. The USA would no doubt be up there too, but this diagram is based on US imports. South Africa is in the premier league along with Brazil, Russia, Mexico and Australia. However, the fact that the percentage of World-spend on mineral exploration in South Africa is apparently only about 1% is an indictment on the poor state of local governance in this sphere. I wonder when Antarctica will start being included on these sorts of maps? South Africa recently assisted a Russian exploration ship on its journey to Antarctica to prospect for minerals and begs the question, if Rosatom instead of Shell had come to South Africa looking to start fracking, would the outcome have been different?

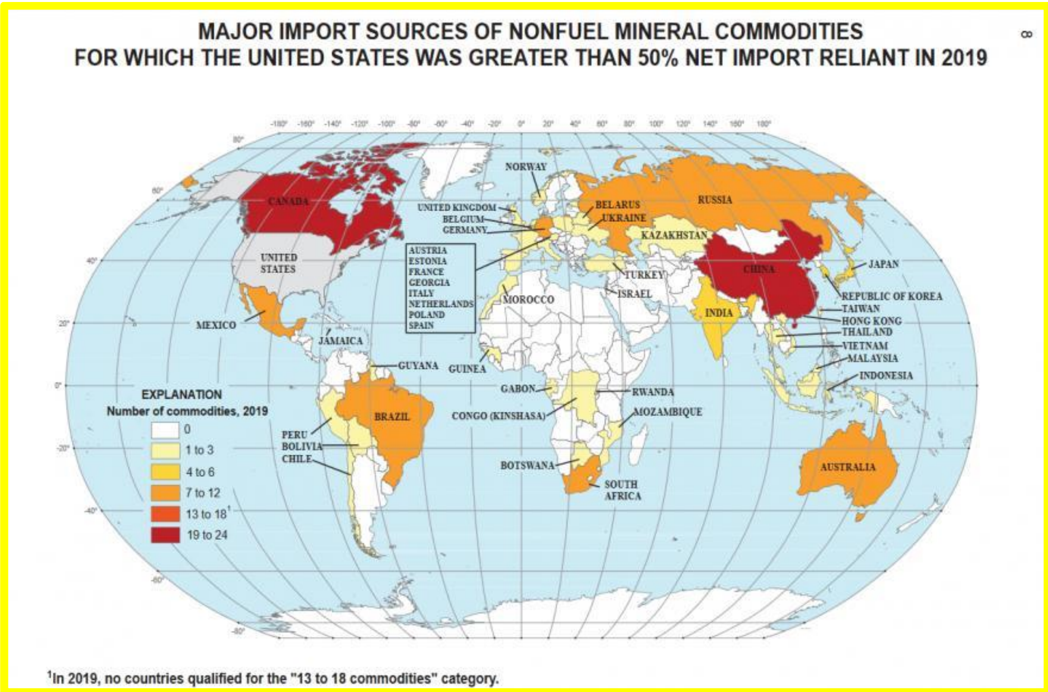


Figure 17: Major Commodity Producing Countries (US Geological Survey)

Conclusions

South Africa is blessed with large reserves of many strategic minerals that the World needs in order to manufacture weapons of war. If it wasn't, *inter alia*, for Transnet's demise and inability to transport the full production from our mines for export, and the Department of Minerals and Energy's dysfunctional cadastral 'system' and sometimes dodgy allocation of mining rights, South Africa would be able to better optimise the fruits of its favourable geological endowment. There is perhaps some light at the end of the tunnel (or the mine shaft) as a tender is being prepared for supply of an industry-standard cadastral system and the private sector is being invited to partner with Transnet on certain key export rail routes. However, don't hold your breath, or stockpile your minerals, as this will probably still be being announced in succeeding year's SONA *ad nauseam*.

I guess the main conclusion that can be deduced from this subject is that the only beneficiaries of war are countries with large reserves of strategic minerals, countries and companies that beneficiate these minerals and make and export armaments, middlemen and shady politicians who get bribed to buy certain products. Luckily, South Africa has legislation prohibiting the sale of armaments to dodgy regimes, although most of our friends these days seem to be dodgy regimes, and the Arms Deal was found to be squeaky clean, so no worries there, right? 😊 But one wonders what that Russian freighter was secretly unloading/loading under cover of darkness at the Simonstown naval base last year? I also wonder which side of history South Africa will be judged to have been on when these tumultuous times are written up? One positive is that, with the World probably at the highest risk of nuclear war since the Cuban missile crisis of 1962, the fact that Putin's poodle is sitting in the Union Buildings might save us from direct annihilation. He'll probably proudly announce to the country that Putin took his call and has given us 30 minutes to take cover…

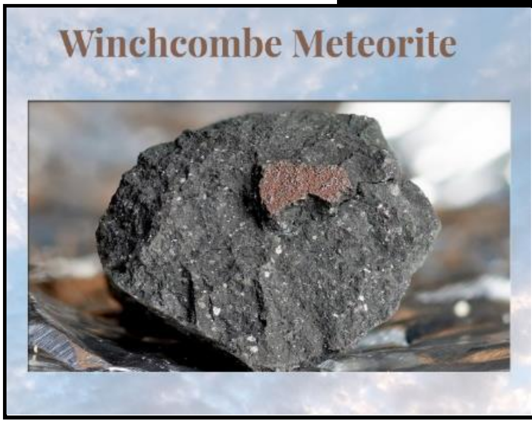
Disclaimer: The opinions/inferences expressed herein are the writer's and do not necessarily reflect those of the Cape Town Gem & Mineral Club.

References

Various Wikipedia entries and mineral dealer websites.

Cairncross, B. and Dixon, R. (1995), *Minerals of South Africa*. Geological Society of South Africa. Linden.

From the Cabinet of Curiosities



This month's curiosity is a Carbonaceous chondrite meteorite found on a driveway in Winchcombe, Gloucestershire in March 2021. It contains 11% water and 2% carbon and experts say these findings show that asteroids played a key role in delivering the ingredients needed to kickstart oceans and life on the early Earth. These types of meteorites are thought to contain unaltered chemicals from the formation of the solar system over 4.5 billion years ago. **PR**

Figure 1: Winchcombe Meteorite (Natural History Museum, London)

LAPIDARY

Last Open Day we received a wonderful donation of cabochons and other items from the daughter of the late Billy Millen. (Hopefully there will be more about him in the next newsletter). Malcolm was so inspired by one of his cabochons that he set to with his stash of tigers-eye the following week, and produced both an article and this cabochon, seen at right>

Tigers-eye

More information on tigers-eye can be found in Mineral Resources of RSA page 36.

The picture above shows five varieties of silicified crocidolite.

The following list of names was given to the stone to help the local small miners to sell various colours in the market place, namely:

Silicified Crocidolite varieties

Tigers-eye	Yellow and Brown
Hawks eye	Grey-Green
Cats eye	Blue
Bulls eye	Red
Zebra	Yellow and Green or Yellow and Blue

The various colours are caused when crocidolite undergoes weathering before silicification.

The red colour occurred when miners built large bonfires on the top of the piles of tigers-eye. The yellow and brown changes to red when the heat causes a reducing action driving off the oxygen - heating in a kiln at 400 degrees would have the same result.

In the late 1960s to 1970s a number of enterprises employed local labour to process varieties of tigers-eye from Niekerkshoop, Pofadder, and Griquastad. At the same time, in an effort to protect the local markets, a law was passed that only "worked" tigers-eye could be exported. This law stands to this day.

FACETIPS

"FACETIPS – A Gem Cutter's Notebook" by Duncan Miller. The faceting articles published over the past few years in the Mineral Chatter have now been compiled into a single 128-page document. The pdf file is available for download from http://ctminsoc.org.za/articles.php for those interested in having all the articles together.

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