the Geode
the Geode

MINSA
Mineralogical Association of South Africa
A division of the GSSA

Minsa gets around

Minsa goes to Mintek

Bruce's Beauties: critical metal minerals

The UP rock garden gains momentum

Meet Keshree Pillay, CGS mineralogist

geology in our indigenous languages

Wager & Brown layered intrusion workshop

14th International Platinum Symposium

Betty's Bay Earth-Age wall

The GEODE

Minsa Newsletter
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NEWSLETTER
Volume 10 No. 3
September 2023

Contents

Next issue theme: Gem and mineral collectors

Are you a member of a gem and/or mineral collecting organisation, or a collector of interesting or attractive minerals or even their images? We would like to hear from you. Let us know what interests you, who you share those interests with and how, and where. See also pg. 20.

The Editor's Site

Greetings from Minsa for the third quarter of 2023. It has recently been brought to our attention, here at the editorial desk, that some of our dear readers were unsure whether they could send us their mineralogical news whenever the mood struck them, or did they have to wait until an appropriately themed issue of the Geode was announced. The answer is that we want to hear your news any time, and we will publish it quarterly regardless of the issue theme. The concept of a theme was introduced just to help people have a focus for submissions to an issue, and perhaps for the issues then to become more pertinent to these selected topics. However, any mineralogical activities that you would like to share with our readership will always be welcome, in addition to, and regardless of, our selected theme. That being said, this particular issue is entirely "themeless".

So in spite of being themeless, we here in the office did not need to resort to A.I. contributions (see Vol. 10 no. 2 to see where that got us) this time. For example, we get to meet a "real" mineralogist this time, Ms Keshree

Pillay of the CGS, and we also have a brand new Minsa Chair to introduce to you (NOT named Igor OR Bertus, for a change).

The Editor in Canada last December. Always working on your behalf: Ice is a mineral too.

Among other things, Lesley Andrews informs us on the use of SEM imaging in the characterisation of slag evolution in our most scientifically relevant contribution, Bjorn von der Heyden addresses the Zen-like question of "how long is a wall", at least in Betty's Bay, and yours truly contributes a photo-heavy account of this year's paired layered intrusion and platinum conferences in Cardiff in July. Our photo essay from Bruce Cairncross, who also has a new gem & minerals of southern Africa book out, features the minerals of critical metals. Our crossword puzzle will also feature 'critical minerals'.

So until next time, I remain, uncritically yours,

Steve Prevec

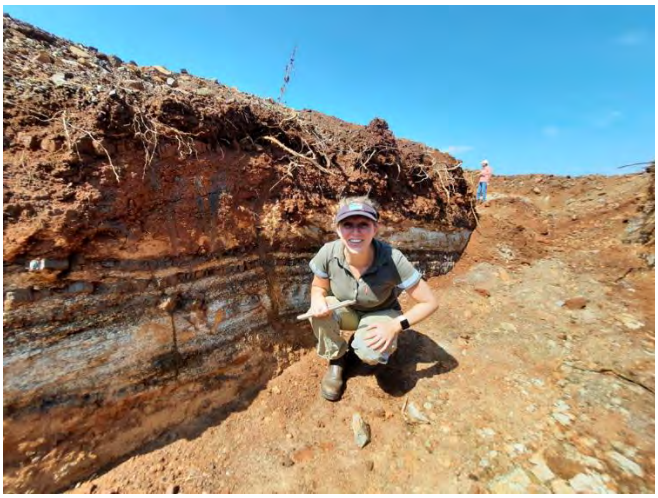
From the Chair

In my role as Minsa's newly appointed Chair for 2023 - 2024, I am excited to bring my expertise as an exploration geologist (not quite a mineralogist) to this distinguished society. I would like to express my sincere gratitude to the past, present and future members of the Executive and Co-opted Committee for accepting the invitation to actively contribute to Minsa's future. These members are all experts in their fields, but more than that, they have a passion and enthusiasm that keeps this society thriving and always exceeding expectations. As the longest serving Minsa Chair, Igor Tonžetić deserves a special thanks for his years of dedicated service. I am very grateful for his willingness to stay on as a co-opted member and look forward to drawing on his experience.

As Chair, I want to foster collaboration between the various scientific branches that contribute to bringing a deposit to life - from geology, metallurgy, mining, processing, to ESG (environmental, social, and governance) and rehabilitation. Together, we can create a more sustainable and efficient mining industry that benefits everyone involved.

Furthermore, I am committed to promoting the importance of mineralogical research and its practical applications in the industry. By showcasing the achievements and advancements made by our members and in the minerals sector, Minsa can raise awareness about the significance of mineralogy in unlocking economic potential. I am excited to embark on this journey and help Minsa grow in the years ahead!

As always, our thanks go to Steve Prevec for compiling and editing the Geode. Thank you all for reading and keeping up with Minsa activities. Feel free to contact us if you have any comments or suggestions regarding the Geode or would like to contribute an article. Like the precious minerals we study, may we continue to shine brightly in the final quarter of 2023. Let our passion for mineralogy fill us with boundless energy and enthusiasm as we enter the final months of the year. Stay happy and energised!



Sara Turnbull (*Chair, 2023-24 Minsa Executive Committee)* mapping magnetite layers in a trench on the Eastern Limb of the Bushveld Complex.

Minsa News

Minsa Executive Committee 2023/2024

Herewith your new Minsa committee for July 2023 until June 2024.

Chairperson Ms Sara Turnbull
Communications Professor Bertus Smith
Youth & Development Dr Bavisha Koovarjee
Secretary-General Mrs Petra Dinham
Treasurer Mrs Jeanette Dykstra
Without Portfolio Mrs Lethu Dubazana

Co-opted committee 2023/2024

Dr Bjorn P. von der Heyden
Professor Stephen A. Prevec
Dr Deshentree Chetty
Professor Frederick Roelofse
Mr M. Ernest Moitsi
Dr Craig Smith
Mr Igor Z. Tonžetić
(continued on next page)

Co-opted committee 2023/2024 (continued)

Dr Sabine Verryn
Dr Sarah Glynn
Ms Shinelka Singh
Mr Richard Harrison

Minsa members on the move

Freddie and Steve go to Wales

In late June through early July, Freddie Roelofse (UFS) and Steve Prevec (Rhodes University) went to Cardiff (U.K.) in their capacities as session convenors and members of the organising committee, as well as participating researchers, to attend the 4th Wager & Brown layered intrusion workshop, and immediately thereafter, the 14th International Platinum Symposium (IPS). A more detailed account of some of the highlights of this paired meeting features later in this issue. For yet more details, the abstracts and conference programmes will appear in a pending (November) issue of The Canadian Journal of Mineralogy and Petrology.

Freddie presented a talk and a poster, as well as co-authoring two other presentations, and chairing a session.

Scientific drilling in the Bushveld Complex: A status update on the ICDP-BVDP project, by Roelofse, F., Allwright, A., Ashwal, L.D., Khoza, D., Klemd, R., Trumbull, R. & Webb, S. (talk at IPS).

On the development of bifurcated chromitite in the UG-1 footwall at Impala Platinum Mines, Rustenburg, by Roelofse, F., Magson, J., Nicholson, M. & Nyakane, T. (poster at IPS).

Steve presented two talks, co-authored another couple, and also chaired a session.

Evidence of localized hydromagmatic control on PGE distribution in the Merensky Reef, Bushveld Complex, South Africa, by Prevec, S.A., Largatzis, S.A., Salge, T. & Brownscombe, W. (talk at IPS).

Evidence for temporal shifts in basaltic magma compositions in the Karoo dolerites, South Africa, by Prevec, S.A., Letete, K., Molyneux, D., Nchee, M. & Ntantiso, M.

Lesley and Petra go to Pretoria

Slightly later in July (on the 19th, specifically), two of our members, Lesley Andrews and Petra Dinham, visited the University of Pretoria. The objective was to check out their "Educational Garden Route" with our guide Jeanette Dykstra, another Minsa member who is co-ordinating the 'Rock Garden' at TUKS. The route has twenty two concrete plinths already erected (see page 6, below). These will display information signs and rock specimens in, as far as possible, a "natural environment", to educate passers-by on the botanical, ecological and geological history of each rock.

Whilst Minsa is not officially sanctioning the collection of these specimens, we are helping out in an unofficial capacity. Minsa members have been involved in collecting five of the six specimens already on display, namely (i) Wits conglomerate (ii) the collection of carbonatite from our trip to Phalaborwa (iii) Pretoria Group quartzite (iv) Stromatolitic dolomite from Malmani Group and (v) Gabbro from the BIC. UP's professional planning department is finalising the first plaques that will display the names of the organisations or companies who sponsored the specimens. UP is also considering a unique QR code and landing page for the garden that will enable visitors to undertake a virtual

tour. The landing page will name and fame donors of specimens, as well as serving as a free marketing tool for those who chose to contribute.

Figure 1: Signpost at entrance of UP Geological Display Garden showing the placement of the plinths on a circuitous route. The route numbers are displayed below this map along with a description of the display.

Figure 2: View of one of the exhibits showing space for two information plaques. One of them will have the geological, botanical and ecological information (as above) and the second (here at right, and empty) is for details of the sponsors of the rock.

To this end, we would like to extend our "Chairman's Challenge" to all in industry, and those with available means, to help us reach the goal of a world class educational garden route. We challenge those in industry (and those with available means) to collect a larger sample, either in the form of one large specimen or large fragments that cumulatively weigh no more than 220 kg, or provide drill core of approximately 1m length from the list of outstanding samples below. Obviously, please obtain requisite permissions from authorities where applicable.

Rock Garden samples still outstanding:

Route stop #	Description
1	Komatiite from the Barberton Greenstone Belt, Onverwacht Formation (solidified komatiitic lava)
2	Banded iron formation (BIF) from the Barberton Greenstone Belt, Fig Tree Formation
3	Microbial mats in sandstones from the Barberton Greenstone Belt, Moodies Formation
6	Banded iron formation (BIF) from Thabazimbi/Prieska with Crocidolite
7	Hekpoort lava
9	Rooiberg lava/Ignimbrite/Volcaniclastic breccias
10	Magnetitite from the Bushveld Igneous Complex
13	Conglomerate with intercalated sandstone from the Waterberg Group
14	Tillite from the Dwyka Group
15	Coal seam in quartzite from the Ecca Group, Karoo Basin
16	Dolerite from the Karoo Basin
18	Sand River Gneiss
19	Kimberlite/Griquaite ultramafic nodules
20	Pegmatite (coarse-grained)
21	Jaspilite from the Northern Cape
22	Cape Granite, with large feldspar phenocrysts

Rock Garden samples already received:

To see an illustration of the samples already in place in the rock garden, fully credited, please see the next page of this issue.

Bjorn goes to Betty's Bay

Minsa's very own Dr Bjorn von der Heyden attended the successful launch of the Harold Porter Gardens' (HPG) 4.6 billion year Earth-Age display & local geological succession rock garden (~550 million years) at Betty's Bay on Friday 15th of September 2023.

He was joined on the day by over 100 guests and dignitaries, including SANBI (South African National Biodiversity Institute) personnel from Pretoria, Kirstenbosch and Harold Porter Gardens, Overberg Geoscience Group Geoscientists, local Botanical Society members, zoologists, hydrogeologists, the Overberg Municipality Tourism Department, local press, and others that participated. His detailed report can be found later in this issue.

Many Minsa mineralogists go to Mintek!

Many Minsa "Automated" mineralogists were to be seen at the TESCAN TIMA Automated Mineralogy Workshop held on the 21st September at Mintek. This was presented by TESCAN, Wirsam Scientific and Minsa. There were 54 people at the venue and a further 21 attended virtually, including two of the speakers. We listened to several fascinating presentations including the development of alternative mineral processing indices by our past Chairman, Igor Z Tonžetić, and a detailed sample preparation overview from our member Richard Harrison of SGS. A veteran in the automated mineralogy field, our member Dr Christopher van Alphen delivered a summary of his involvement and developments in this field via his extensive experiences from the early days of QEMSCAN and the A-scan to the present day. He summarised his presentation as follows:

- It starts with sample preparation and understanding of stereology principles
- Development of accurate and robust mineral identification standard classifications:
    - These should include all the minerals in the sample, especially gangue. Reduce the classification of "others" to less than 0.5%.
    - Particularly important for coal and fly ash mineral classifications, because of high proportion of amorphous phases.
- Validate the automated mineral results:
    - Check that predicted grades are in line with measured grades.
    - Develop software to predict minerals based on element properties.
    - It is especially important for coal to calculate ash/CV.
    - Include comparisons to results derived from other techniques, such as XRD, TGA, *etc*.
    - If you cannot validate the results, then there is a problem, which will invariably occur during sample preparation (in case of coal, mineral segregation and over-estimation of ash or over-polishing are common).
- Develop a logical and appropriate particle classification scheme.
- KISS – "Keep It Simple, Stupid". Simplify the data and only include relevant mineralogical information in the reports. This is facilitated by the mineralogist having a good understanding of the mineral characteristics, the problem at hand and the processing process.
- Finally – have fun!

Contributed by Petra Dinham

Forthcoming Events & Attractions

Some events are still missing specific dates: Minsa will let you know! Watch for e-mailed announcements. All dates are 2023 unless otherwise stated.

- Night at the Museum, 24 Nov. 2023
- Eskom ERIC visit, 3 November 2023
- "Meet-a-Mineralogist" tour to Namibia (planned for 2024)
- "100 years of the Merensky Reef Minerals, Metals and Mining", 15-23 August 2024, South Africa. GSSA, Rustenburg.

Existing UP rock garden sample installations:

Feb'21
Conglomerate Witwatersrand
MINSA
Igor Tonzetic & Jaco Delport


Sep'21
Gabbro BIC
SIBANYE STILLWATER
Vusani Mathada &
Jeanette Dykstra


Dec'21
Phoscorite & Carbonatites
Phalaborwa
MINSA
Igor Tonzetic & Jaco Delport


Jun'22
Quartzite
MINSA
Igor Tonzetic & Jaco Delport


NOV'22
Coal Seam
EX SOLO
Jaco Delport & JP Nel

NOV'22
Stromatolitic Dolomite
MINSA
Igor Tonzetic

Articles

Meet a Mineralogist

Name: Keshree Pillay

Affiliation: Analytical Services Unit, Council for Geoscience (Pretoria)

Keshree graduated with a B.Sc. (Hons) in geology from the University of Kwazulu-Natal in 2006. In 2007 she joined the Mineralogy Division at Mintek, where she spent nine years. During this time, she completed a M.Sc. in chemical engineering, specialising in process mineralogy, at the Centre for Minerals Research (CMR) at the University of Cape Town. Since then, she has worked in the mineralogy labs at Anglo American Technical Solutions and at the CMR at UCT, and is currently based at the Council for Geoscience (in Pretoria?). Keshree's main areas of expertise are in quantitative X-ray diffraction analysis, automated scanning electron microscopy, and process mineralogy and geometallurgy.

What is your favourite mineral, and why?

I don't know if any mineralogist has just one favourite mineral – because there are so many to love! I can try to narrow it down though. I've worked extensively with copper ores and there's such a variety of copper oxides, carbonates, sulfides and even silicates with an array of remarkably pretty colours and interesting textures and intergrowths. I know it's not the most scientific reason, but prettiness does make the minerals more fun to work with.

What is your most funny or memorable field- or lab-work experience?

My most memorable field experience was going to the area around Prieska to work with small scale Tiger's Eye miners, while I was at Mintek. They had asked for our help with grading their material as they understood very little about the quality of the product and were just selling the raw material to any interested buyer without making any profit. When we arrived, their foreign buyer happened to be there and was lying to them that all their stones were of poor quality, so that he could buy them really cheap. The farm owner then turned up, who was helping the buyer illegally export the Tiger's Eye, and they thought we were some sort of government officials that the mining company called in to try to bust them! We never expected to get caught up in this sort of political drama and didn't want to get stuck in any deeper. Eventually we worked through the Prieska municipality to train all those involved in Tiger's Eye mining on how to characterise and grade Tiger's Eye based on its mineralogical features so that they could better grade and price their own material and won't be so easily cheated in future.

I think one of my funniest lab experiences was when a former colleague of mine called me to the SEM lab to show me a grain of the uranium mineral schröckingerite on the screen. She excitedly asked, "What does this look like?" and I immediately shouted, "Mozart!" It looked exactly like Wolfgang Amadeus Mozart.

What is the most exciting aspect of mineralogy for you?

As a mineralogist, people are always coming to you to help them look for answers to interesting problems, whether they are geological, metallurgical or even medical, archaeological or agricultural issues sometimes. The exciting part is using whatever tools we have to try and solve their mysteries and the satisfaction you get when you actually figure out the answer!

What motivates you to go to work every day?

I enjoy being in an environment where I'm always learning new things, working with fascinating samples and there's a lot of variety in the work, so you never know what new challenge is going to come up next.

What is the most exciting project you have worked on?

When I was at Anglo, I got to be part of a furnace dig out at one of the smelters. It was a wondrous and exciting experience to actually walk inside a furnace and take samples from the different levels of the hearth to understand what was going on inside. We often worked on smelter samples in the lab, but I never thought I would actually get to have the opportunity of being inside the furnace and seeing everything in situ.

What advice would you give your younger self, when you were just starting out in the industry?

Everyone you will work with knows something you don't. Always be open to learning as much as you can from those around you, and sharing what you learn with others also helps you become more confident in your skills.

What route did you take to become a mineralogist?

I did a B.Sc. (Honours) in geology and when I graduated, I got my first job in the Mineralogy Division at Mintek. That's where I was trained in process and applied mineralogy and learnt many different analytical techniques. Whilst working I also did my M.Sc. in process mineralogy at the Centre for Minerals Research at UCT, which also helped me learn to apply the different techniques I was learning to mineralogical research.

"Interviewed" by Bavisha Koovarjee

MINSA
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ATTENTION

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POSTGRADS, PROFESSIONALS, ACADEMICS AND FRIENDS OF THE EARTH SCIENCE

MINSA IS LEADING AN IMPORTANT ENDEAVOR TO COMPILE A COMPREHENSIVE DATABASE OF WORDS RELATED TO MINERALS, GEOLOGY, AND LANDFORMS IN ALL OF THE COUNTRY'S NATIONAL LANGUAGES. THE ULTIMATE GOAL IS TO UPLOAD THIS VALUABLE COLLECTION OF TERMS INTO A NATIONAL REPOSITORY, WHICH SERVES AS A CENTRALIZED RESOURCE FOR LINGUISTIC INFORMATION. BY UNDERTAKING THIS INITIATIVE, WE AIM TO BROADEN THE SCOPE AND ACCESSIBILITY OF OUR SCIENTIFIC FIELD, ALLOWING A LARGER SEGMENT OF THE POPULATION TO ENGAGE WITH MINERALOGY, GEOLOGY, AND GEOMORPHOLOGY.
THIS EFFORT REPRESENTS A CRUCIAL INITIAL STEP TOWARDS FOSTERING INCLUSIVITY AND EMPOWERING A WIDER RANGE OF INDIVIDUALS IN SOUTH AFRICA TO ACTIVELY PARTICIPATE IN THE EARTH SCIENCES

FOR MORE INFORMATION CONTACT: MINSA@GSSA.ORG.ZA

USE OF LOW VACUUM SEM TO STUDY SLAG WEATHERING AND SECONDARY PHASE FORMATION

Lesley Andrews
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Slag is a low-grade product of metallurgical smelting, the discard after the higher-grade matte has been concentrated by melting and converting then removed for refining and sale. This has resulted over time in the dumping or abandonment of slag waste at many sites worldwide.

Slag mineralogy

The mineralogy of recently produced slag is normally studied for process loss prevention or with slag cleaning in mind. This involves the characterisation of slag sampled directly from the furnaces or stockpiles. The sampling campaign is (or should be) thorough, followed up by bulk chemical analysis, and auto-particle search for enclosed matte using image analysis or auto-SEM instrumentation.

As slag ages, and is exposed to the elements, the signs of weathering and disintegration appear. The rate at which a slag alters depends not only on its age, but also on the original composition, the slag texture, and the prevailing climatic and drainage conditions (Vitkova et al., 2010, Piatak et al., 2015, Potysz, 2016). Alteration processes can lead to environmental issues if metal transport pollutes waterways, and particularly if heavy metals are involved. Another important application of slag mineralogy is therefore in environmental studies, and the most interesting slag studies attempt to catch slag alteration “in action”. This is best seen in surface slag samples which have not been cut, polished or coated for SEM work, and the ideal instrument for this type of work is a low vacuum SEM.

Low vacuum Scanning Electron Microscopy

The Field Emission SEM shown in Fig. 1 can be run either in high vacuum mode (normal) or in low vacuum mode where the microscope column is kept at a lower pressure than the specimen chamber.

A fine spray of water enters around the pole piece, and this effects charge neutralisation, improving both backscattered electron (BSE) and secondary electron (SE) imaging. It prevents charging of uncoated non-conducting surfaces.

In similar instruments, gases such as nitrogen, helium, air, argon, carbon dioxide or gas mixtures can be used instead of water, depending on the application.

Figure 1: The Nova NanoSEM at the University of Cape Town.

The advantages of this technique for slag mineralogy are as follows: Secondary/altered slag samples are frequently friable, and phases may be lost during cutting and polishing. Sulphate and chloride phases may be partially soluble, and fine crystal structures are also at risk. The use of uncoated sections allows surface carbon enrichment to be estimated, and low vacuum operation prevents charging. Far more crystallographic information can be recorded.

Detractors argue that low vacuum SEM operation leads to loss of image resolution, but this did not apply in this study, possibly because back scattered electron (BSE) images were acquired. The EDS results are not as reproducible as on a polished section - this is due to

sample topography and the resultant angle to the detector. These effects appear to far outweigh any caused by gas scattering, except, possibly, in light element quantification – in some cases longer acquisition times can used to prevent spurious peak identification.

Application: Low vacuum SEM investigation of Northern Cape copper slags

Samples were taken from three Northern Cape slag heaps during 2020 and 2022. The slags derived from previous copper smelting and converting operations, now no longer active. They consist of silicate slags with varying Fe/Si ratios. Most samples had been exposed to a degree of rainfall, although the region is relatively arid, and one site experience perennial waterflow and occasional groundwater contact.

The altered samples were neither cut nor polished but were run uncoated at low vacuum on the Nova NanoSEM 230 at the University of Cape Town. The instrument, equipped with an Oxford Instruments X-Max 20 mm^2 detector, was run at 20 kV, and EDS spectra were processed using INCA software. When crystal groups were examined, area scans, or multiple points were analysed when possible, to reduce the effect of topography.

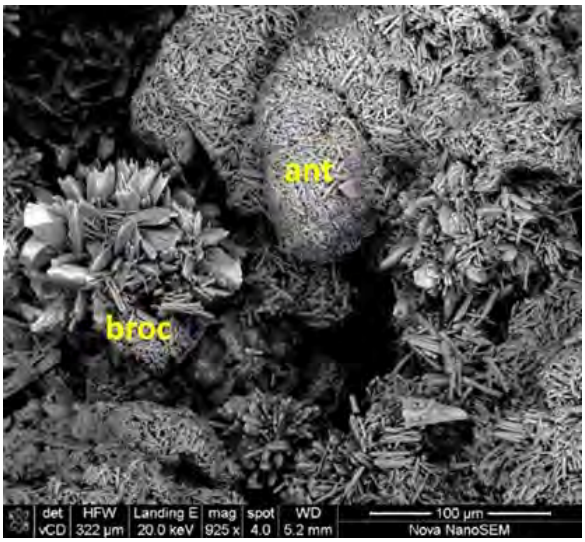


Figure 2: This area of weathered slag contains multiple copper sulphate species, mainly antlerite (ant) and brochantite (broc). BSE image.

Over one hundred secondary phases were analysed by SEM-EDS and those identified on the slag surfaces included antlerite ($Cu_3SO_4(OH)_4$) and brochantite ($Cu_4SO_4(OH)_6$), as well as other, possibly hydrated, copper sulphates, atacamite ($Cu_2Cl(OH)_3$), hydrated iron oxides and jarosite ($KFe_3(SO_4)_2(OH)_6$). Copper sulphate and chloride examples are shown in Figures 2 and 3.

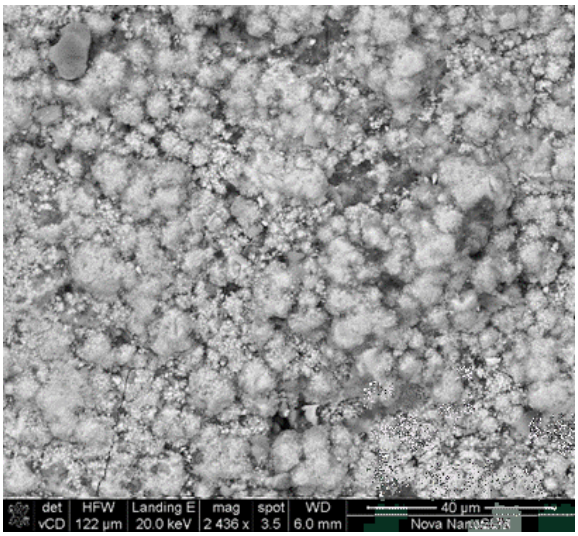


Figure 3: BSE image showing amorphous copper chloride, probably atacamite, or a partially hydrated form. This forms as crusts when there is groundwater contact.

Antlerite and brochantite are occasionally present in sufficient thicknesses to be confirmed by XRD. Although malachite ($Cu_2CO_3(OH)_2$) has been reported in Northern Cape slag, none was identified in this study, and the pH conditions during weathering make it an unlikely product (Potysz, 2016).

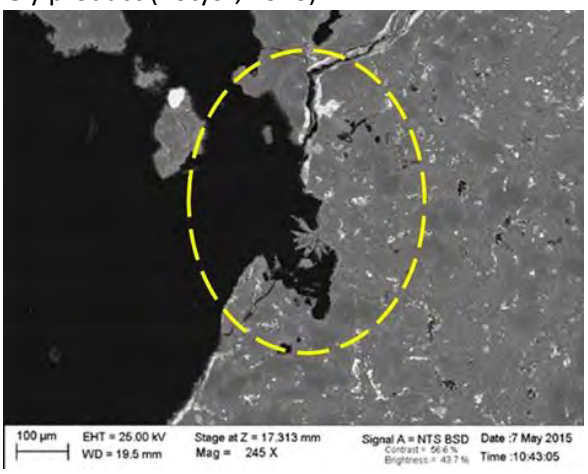


Figure 4: A BSE image of copper sulphate crystals forming inside a slag cavity. This section of Argent slag required special polishing conditions and many attempts to avoid losing the crystals.

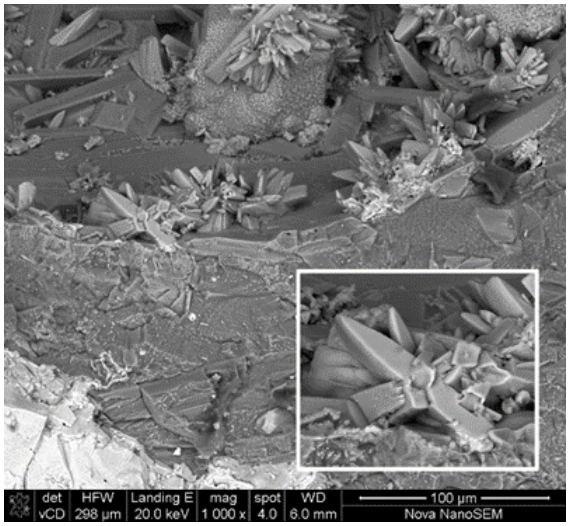
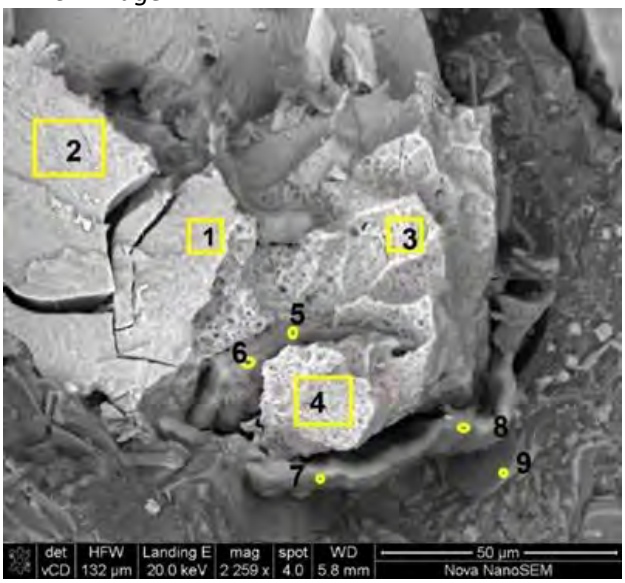


Figure 5: The same phenomenon captured easily using low vacuum SEM on the Northern Cape slags. Here the curved-faced crystals may be a sign of cyclical erosion and deposition. BSE image.



SEM-EDS analysis (norm. wt %)

	O	S	Fe	Cu
1	8.3	32.5	8.6	50.6
2	6.6	32.4	8.9	52.1
3	7.2	29.7	8.9	54.1
4	17.8	17.8	10.6	53.8
5	54.5	6.9	21.3	17.3
6	60.3	3.6	22.0	14.1
7	62.1	3.1	20.4	14.3
8	63.9	3.1	19.7	13.3
9	66.0	0.5	31.4	2.1

Figure 6: Phase analysis of a partially altered matte prill run on the low-vacuum SEM.

Many of the copper sulphates seen in the slag samples are very small, but recognisable as green clusters. On the SEM, there is evidence of how these formed (Figures 4 and 5).

The copper sulphates originate from copper and copper-iron sulphide matte prills or veinlets entrained in the slag. The matte inclusion exposed in Figure 6 provides an insight as to the alteration history. A comparison of the compositions of the alteration shell with the original (but already partially altered) matte suggests that copper has leached out leaving an iron-enriched residue.

Images such as those above are invaluable in that they provide such a clear record of the dissolution/ recrystallisation and metal transport mechanisms. Use of the NanoSEM provided a great deal of information that the examination of cut and polished sections would not have elucidated, including crystallographic insights and the effects of crystal growth in cavities.

Funding for the collection and analysis of the Northern Cape copper slags was received from the Andrew Geddes Bain Fund of the Geological Society of South Africa. This is gratefully acknowledged.

The assistance of Miranda Waldron and the staff of the Electron Microscope Unit at UCT, as well as permission to operate the NanoSEM, is much appreciated.

All photographs/images were taken by the author.

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Wager & Brown Layered Intrusion Workshop and the 14th International Platinum Symposium

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In late June and early July 2023, Cardiff University hosted the paired scientific meetings of the Fourth Wager and Brown Layered Intrusion Workshop, followed almost immediately (one rest day) by the 14th International Platinum Symposium. The Wager & Brown Workshop was organized by Christian Tegner (University of Aarhus, Denmark), while the Platinum Symposium was coordinated by Wolf Maier (Cardiff University, U.K.).

The Wager & Brown workshops, named for the pioneering contributions of Lawrence Wager and George Brown in the 1950s and 60s for their description, characterization and interpretation of layered mafic igneous rocks from around the world, are designed to facilitate the sharing of research on the evolution of these geological bodies. These are often associated with so-called large igneous provinces (LIPs) along with volcanic eruptive sequences and dyke swarms, typically mostly tholeiitic basaltic in composition. Similarly, many important metal ore deposits including those of nickel, copper, and the platinum group metals are also hosted in layered mafic intrusions. The international platinum symposia, which occur approximately every four years, global pandemics permitting, convene to share ideas and discoveries relating to the platinum group metals (the PGE: Pt, Pd, Ir, Ru, Rh, and Os), so a large amount of research on the two areas overlaps, although they are also distinct. Note that many important deposits of these metals can also be hosted in other rock types entirely, and that the behaviour of the PGE in environments such as in environmentally-sensitive low-temperature waters is also an active area of study, for example. So in this case, the pairing of the two meetings meant that around twenty-five researchers arrived in Cardiff on June 28 to head off to the southwesternmost point in Wales, the St Davids (which appears to be acceptable with or without an apostrophe, so I'm keeping it simple) peninsula, home to the St Davids layered intrusion and the neighboring city of St Davids.

The location of St Davids, intrusion and city, in the county of Pembrokeshire, whose location in south-western Wales is shown in the inset. Image nicked from Wikipedia.

The distance from Cardiff to St Davids is just under 100 miles (yes folks, miles, we're back in the U.K. now), so it was about a five-hour bus ride up. Many of the participants had met up the previous evening in a backyard hotel bar to get reacquainted in advance, but all were ready to go by 8 AM the next day. After a rejuvenating coffee in the windswept drizzle off St Davids beach, where surf rescue training was underway, we set out on the invigorating half hour or so walk along the hillside to the St Davids Head Intrusion, the focus of the trip. The intrusion is so-called, presumably, because there are a series of disjointed exposures across the hillside horizon, reminiscent of a recumbent giant, for which the southernmost exposure represents the head. Since the nearby town and associated cathedral (more on them later) are named for St David, as the patron saint of Wales and a prominent sixth century bastion of early Christianity, it is sensible that the intrusion followed suit.

Over the following afternoon and subsequent morning (in decidedly better weather), our international group was treated to extraordinarily well-developed igneous cumulate bedform structures, considering the apparent dimensions of the intrusion (<600 m thick and a few kilometres long). Comparable intrusions occurring as sills in South Africa show no such features, and any modal layering is limited and scarce. Some

examples from St Davids Head are shown here. There was some inspired debate about whether this intrusion really is a sill at all, in light of these textural anomalies, or rather a tectonically dismembered, more equant plutonic intrusion, instead. Food for thought.

We are having some fun now. Christian Tegner, at left, eyes the photographer; everyone else is imagining a) some cumulate-textured autoliths near the margins of the intrusion, and b) a warmer place to discuss it.

From left to right, Christian Tegner, Rais Latypov, and Wolf Maier. Irish Sea in background. All in agreement that there's probably something more interesting over that way.

A warmer place to discuss it. Our cozy hostel common room in Trefin, about 10 km (6 miles) northeast of St Davids, for the night. Hot chocolates all 'round.

The nearby village hall. All signs were posted in Welsh (Cymraeg), and most (but not all) also in English. Welsh, a Celtic language and formally recognized as an official language in Wales since 2011, is currently spoken by 20-30% of the Welsh population.

Plagioclase-phyric chilled marginal rocks, much the same as you'd find in dolerites anywhere, except here there are tens of metres of it.

A block of modally-layered, cross-bedded plagioclase-pyroxene (gabbroic) rock.

Examples of metre-scale (or yard-scale, but I won't belabour that any further) cross-bedded gabbroic rocks. The white patches obscuring the geology are lichens, often hundreds of years old.

Finns: at home in any weather.

The dinner bell has rung.

This author (centre foreground, with emerging bald spot, facing sea) makes a point of interest, evidently, recorded for posterity in a photo. Photo S. Chistyakova (courtesy R. Latypov). Note to self: wear a hat.

St Davids Cathedral, founded in the early 12th century. This photo shows the tower and south transept; the church remains a popular tourist destination and needs your support: there is now a 4 metre height difference in the floor from one end to the other! St Davids is the smallest (least-populated) city in the U.K., with just under 2000 residents at last count. (Note that city status does not automatically come with the presence of a cathedral, a common misconception based on long-past practice. In fact, it lost its city status in 1886, but the late Queen Elizabeth II gave it back in 1994).

The two day field excursion was then followed by a lively one-day presentation and discussion session held in the Chemistry Department on the campus of Cardiff University, in downtown Wales, where the field trip participants were joined by another dozen or two colleagues from near and far (more than 40 eventually all together).

At left, a highlight of the conferences: Welsh cakes. You can't eat just one. At right, inside the grounds of Cardiff Castle (also below), established by William the Conqueror on the grounds of a thousand-year-older Roman fort, the memorial for St Gareth of Bale, mighty Welsh warrior of a bye-gone era (2005-2022).

Canadian culture in Cardiff. The cities where I spent most of my life in Canada (Hamilton, Edmonton, Sudbury) have about one Tim Hortons per each 5000 people. Now also available in Cardiff! They gave me a free coffee mug for Canada Day (July 1). I was thrilled.

Cardiff Castle. Inside, Sting was performing. Later in July was Tom Jones (three shows), famously one of William the Conqueror's favourite performers.

The Wager and Brown workshop was followed, after a one-day gap, by four very full days of the 14th Platinum Symposium, held in the same venue (in a different, larger, lecture room). The Platinum Symposium featured around 180 registrants from 20 countries, which was very rewarding for the organisers and participants. There were concerns that hosting this meeting in the U.K. (where there are no platinum deposits to speak of, but plenty of researchers) after a four year gap since the last meeting, prior to the global

COVID pandemic, as well as the effects of other ongoing global strife, some of which involves countries who have a long history of PGE research, on top of elevated post-pandemic travel and accommodation costs, might result in seriously diminished attendance. We needn't have worried; apparently we were all keen to get out of the house. Although a number of participants were obliged, for various reasons, to present remotely using our collectively newly acquired virtual presentation technology skills, the vast majority appeared in person.

Here are some images of the many South African-based, and some formerly South African-based, participants at the meeting, photographed at the evening poster sessions and/or at tea breaks.

Numerous other "South Africans" present but not pictured here include Martin Klausen (Stellenbosch), Rais Latypov and Sofya Chistyakova (Wits), Judith Kinnaird and Paul Nex (both formerly of Wits, now recently 'retired' to Scotland). Among others. Such as myself.

South African geoscience past, present and future was well-represented.

If some of the photos look distorted or out of focus, well maybe you need to stop drinking before noon. Just saying.

L-R: Wolf Maier (Ph.D. Rhodes Univ., subsequently lectured at UPE & UP), now at Cardiff Univ. and the primary coordinator for this meeting, with Ben Hayes (Ph.D. Cardiff, now Snr Lecturer at Wits U.).

L-R: John Hancox (Ph.D. Wits, then Wits Geology, now Caracle Creek Int'l Consulting); Freddie Roelofse (Ph.D. Wits & staff at UFS), Justine Magson (Ph.D. and staff at UFS), and Eva Hancox (or Schneiderhan; Ph.D. UJ, now also CCIC).

Alan Butcher: post-doc at Rhodes Geology ca. 1990; now with the Geological Survey of Finland (GTK).

L-R: Willem Kruger (Ph.D. Wits U., now a post-doc there) and Tahnee Otto (Ph.D. Stellenbosch, now a post-doc there).

L-R: Mabatho Mapiloko (formerly UFS, now a Ph.D. student at Wits U.) and Jarlen Keet (UFS Lecturer).

L-R: Johan "Moose" Kruger (Ph.D. Rhodes, then a career at Wits at BPI Geophysics / EGRU, now an independent consultant); Di Kruger; Carole Finn (USGS) at centre right; at right, Sue Webb (Wits U.).

Libby Sharman (B.Sc. to M.Sc. at Wits, Ph.D. McGill Univ., now with BHP Xplor).

L-R: Bruce Eglington (B.Sc.-Ph.D. at U. Natal, then Council for Geoscience, now U. Saskatoon) with Mabatho Mapiloko (Wits U.).

Other Gems

String theory or wall theory? Age of the Earth explained in Betty's Bay

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If ever you are in the Betty's Bay area, and you happen upon geologist Dave Mourant, ask him the age-old riddle: "How long is a piece of string?"

You might anticipate the standard answer: "Twice as long as half its length"; or perhaps: "one string-length long"; or maybe even the anagram: "eight cow foals or nine pigs".

However, he will probably turn around and say, "String is old news, we've now got a wall."

And so you may rephrase your question and ask, "How long is a wall?"

And the answer to that is nuanced, for the brand-new Earth Age Display Wall is nominally 46 m long but, through a series of informative and highly-visual educational boards, stands to represent 4.6 billion years of Earth history.

The Earth Age Display is incredibly well thought-out and well presented, and offers interested persons the opportunity to explore Earth history at their leisure and in exquisite surroundings.

This exceptional educational intervention is located at the mouth of the Disa Kloof in the picturesque Harold Porter botanical gardens in Betty's Bay. It seeks to inform the general public, school learners, tourists, and in fact, any interested parties, about deep geological time and the age and evolution of the planet on which we all live (albeit only in the last ~6 cm of wall time).

The walls (there are actually two of them, the second one 'zooming in' on the more recent Earth history) exist thanks to the efforts of a dedicated team comprising the Overberg Geoscience Group, South African National Biodiversity Institute, the Harold Porter Botanical Gardens and a host of local volunteers and financial donors. Despite grey overcast conditions, the "4.6 Billion Year Earth-Age Display & Local Geological Succession Rock Garden (~550 million years)" was formally launched on 15 September 2023 to an audience of well over 100 people.

So, if ever you are in the Betty's Bay area, and whether or not you happen upon any retired geologists to ask questions about rocks or string pieces, do yourself a favour and go check out the new wall. It is well worth the visit.

Jean Malan explaining the Early Earth to interested delegates at the formal launch.

Do you have an analytical service relating to sample preparation, mineral analysis, mineral extraction, or mineral identification?
Do you have capacity to conduct additional services and to get paid for it?

If your answer to any of these questions is "yes, I guess so", then you could be advertising in this space at very reasonable rates, making some revenue, and contributing to the geoscience economy of the nation. What are you waiting for? Right now, someone else is making the profits you could be making, stealing your business!
So get busy!

Minsa invites its members to contribute submissions for our next issue of the Geode, for December 2023. Next issue theme is Gem and mineral collectors: Are you a member of a gem and/or mineral collecting organisation, or a collector of interesting or attractive minerals or even their images? We would like to hear from you. Let us know what interests you, who you share those interests with and how, where, and when. As long as it's legal, we're interested. (If it's not, then the police will be, too.)

Submissions can be sent to minsa@gssa.org.za or to s.prevec@ru.ac.za and should reach us by 30th November 2023.

THE CANADIAN JOURNAL OF MINERALOGY AND PETROLOGY

formerly known as THE CANADIAN MINERALOGIST

Got a short geological study with a mineralogical focus?

Have you identified:

- A new occurrence or a compositional variant of a known mineral?
- A novel mineral assemblage or mineral composition diagnostic of its petrogenesis, and/or of associated minerals of interest (including ore mineralization)?
- A new mineral?
  - The Canadian Journal of Mineralogy and Petrology has a new fast-stream publication process specific to new mineral announcements to get this information out ASAP.
  - We are also introducing a new Short Communications format.

Then look no further: from pegmatites to platinum group minerals, ***The Canadian Journal of Mineralogy and Petrology*** has been providing a timeous research outlet for quality mineralogical and petrological studies since 1957.

Why publish in *The Canadian Journal of Mineralogy and Petrology*?

What do southern Africa and Canada have in common?

Granite-greenstone terranes, a *ca.* billion-year old high grade metamorphic belt (Grenville-Namaqua-Natal), a Proterozoic anorthosite belt, a major impact structure, kimberlites, a variety of major ore deposit types, pegmatites, and lots of research geoscientists, to name a few aspects. Help reunite Pangaea; ideas make the best bridges!

Our editorial staff are experienced and accommodating, and we have over twenty international research-active Associate Editors in a wide range of fields, from crystallography through crustal and mantle mineralogical environments to magmatic and non-magmatic ore deposits, to facilitate rapid expert reviews and quality publications.

Regular thematic issues feature and promote specific mineralization environments and honour researchers from the mineral geoscience community. Recent examples include issues for Anthony Naldrett (2021), Critical Minerals (2022), and Ron Peterson: Mars and Beyond (2023).

The Canadian Journal of Mineralogy and Petrology is a hybrid journal offering both subscription and **GOLD OPEN ACCESS** options, and can be accessed on Geoscience World, as well as through membership in the Mineralogical Association of Canada. We also feature accommodating page charge policies and relatively research-friendly rates.

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Bruce's Beauties: Critical Metals

On a theme of critical metals and their minerals, here are some photos of minerals containing lithium and nickel.

Above: Hexagonal lepidolite crystals, partly imbedded in quartz, with an elongate pink elbaite crystal. Field of view is 2.6 cm. Namibia. Bruce Cairncross specimen and © photo.

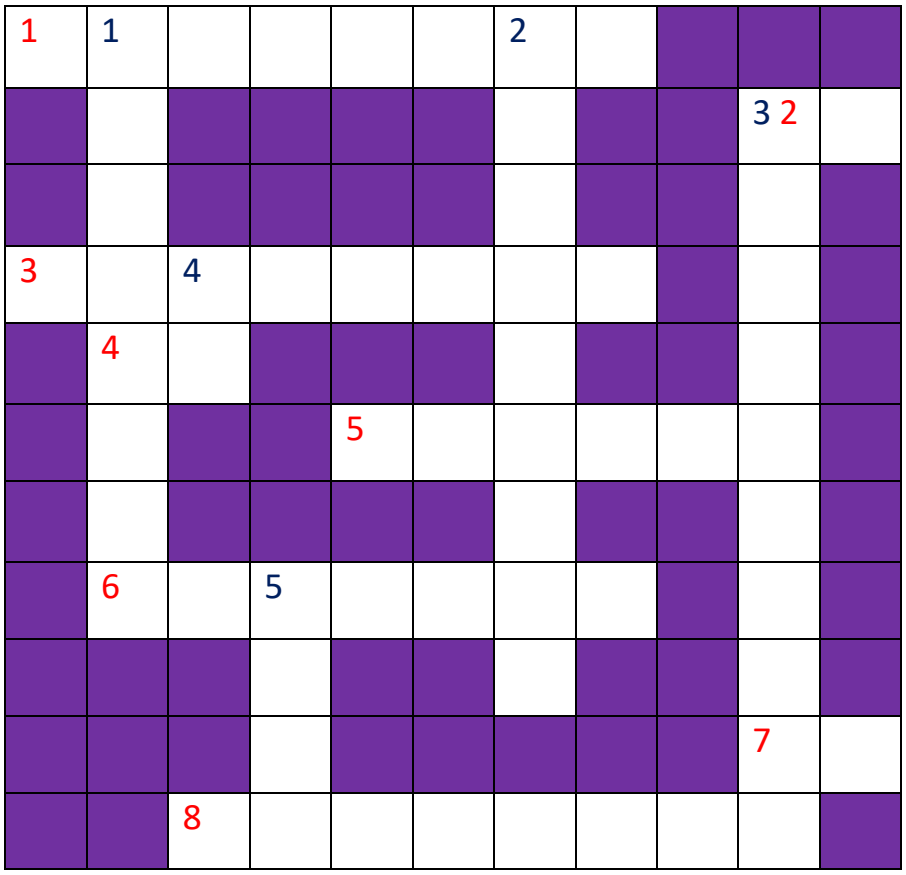
Spodumene crystal, 8 cm, from the Blesberg mine, Northern Cape, South Africa. Bruce Cairncross specimen and © photo.

At right: Two radiating sprays of brassy millerite in hard calc-silicate matrix, 21.6 cm. Pafuri, Limpopo Province, South Africa. Bruce Cairncross specimen and © photo.

Below: Another spodumene crystal, but this time the gemstone variety kunzite, from California, 12 cm. Private collection, Bruce Cairncross © photo.

Minsa Crossword for September 2023

The theme for this crossword, and the preceding photo display, is critical metals and their minerals, just because.



ACROSS:

1. A Ta oxide ore mineral found in granitic pegmatites, named for an individual in Greek mythology who murdered his father-in-law after first reneging on the bride price.
2. The two letter acronym for the 4th lightest element, it is essential in X-ray analytical equipment, modern aircraft, missiles, and the James Webb Space telescope.
3. A light rare earth and thorium phosphate mineral, it is also useful as a geochronometer in granitic rocks.
4. A heavy rare earth metal, one of the many named after the village of Ytterby in Sweden, it is used to create the green colour in cathode ray tubes.
5. The informal name for niobium-tantalum ores of columbite, it is mined most extensively in the DRC and Rwanda.
6. The mineral group into which allanite belongs, into which light rare earth elements (such as Ce) in particular substitute for Ca2+. As a critical metal ore mineral, it is most prominent in carbonatitic deposits in China and Brazil.
7. The two letter abbreviation for the refractory high field strength element below niobium in the periodic table, it is a “technology-critical” element, valuable as a capacitor.
8. A Li phyllosilicate, it decomposes to spodumene and quartz in upper greenschist facies conditions, and is found in pegmatites.

DOWN:

1. The Y-phosphate mineral which is a significant ore of heavy rare earth metals, along with accessory U and Th. It forms as an authigenic mineral during diagenesis and is mined in heavy mineral sands.
2. The primary ore mineral for Ta, this oxide is the Ta-end member of columbite (the Nb oxide ore), and is thus the source of half of the portmanteau (look it up, like I had to) from 5 across.
3. A rare earth metal (REM) fluor-carbonate, this vein mineral has become the preferred light rare earth metal ore mineral because it is REM-rich but poor in radioactive elements such as Th, simplifying its mine waste management.
4. The high field strength element best known to geochemists as the prominent negative spidergram anomaly characteristic of subduction-generated magmas, it’s use as an additive for high-temperature steel makes it an essential critical metal.
5. The acronym for the three chemical members of the platinum group metals who are geochemically affiliated with iridium.

Minsa Crossword solution for June 2023

The theme was mineraloids; glasses and otherwise amorphous and/or disordered solids.

1 S	I	D	E	R	1 O	M	E	L	2 A	N	3 E
					B				N		B
4 A					S		5 J		T		O
2 L	I	M	O	N	I	T	E		H		N
L					D		T		R		I
O			6 O		I				A		T
P			3 P	E	A	R	L		C		E
H			A		N				I		
A			L						T		
N						4 A	M	B	E	R	
E											

ACROSS:

1. An iron-rich, silica-poor vitreous high temperature basaltic glass formed by rapid cooling during eruption in water.
2. A hydroxide, oxide and hydrated iron ore mineral (or agglomerate of minerals, more correctly), it is found in laterites and in mine runoff.
3. The hard, round, most popularly white (but not always, in nature) aragonitic layered concretions found in bivalves (from whose shape its name derives, from the Latin, via the French).
4. Fossilized tree resin (see also Bruce's beauties, above). Can they contain dinosaur DNA? You bet (modern birds now qualify, so don't get your hopes up). Also known as elektron, from the Greek, it can hold a static electrical charge.

DOWN:

1. A highly siliceous volcanic glass associated with rhyolite flows, its earliest usage as a tool by early (pre-Homo sapiens) hominids occurred in what is now Kenya.
2. The variant of coal with the highest density and carbon content. Used for power generation and in metallurgical applications, the largest known deposits are found in Pennsylvania (U.S.A.).
3. Technically a brand name, this 'hard rubber' is produced by vulcanisation (heating in the presence of S) of natural rubber. Its economic heyday was in the early 20th century when it was used to make bowling balls, among other things.
4. An amorphous hydrous aluminium sheet silicate, similar in chemistry and occurrence to kaolinite, evidently made up of aggregates of hollow nanometre-scale spherules.
5. A variant of lignite (the lowest rank of coal, but still above peat), this mineraloid can be carved as a gemstone. Its name is often used as the simile to describe things that are "extremely black".
6. Hydrated amorphous silica, it can contain up to 20 wt.% water, and displays iridescence produced by its internal structure, consisting of nanometre-scale silica spheres packed together.

Note: The recommended deadline for submissions for the next issue of the Geode is November 30, 2023.