the Geode

the Geode

MINSA

Mineralogical Association of South Africa

A division of the GSSA

Minsa on Critical Minerals: Li mineral analysis and Pt arsenides.

The GEODE

Minsa Newsletter

Volume 11

No. 2

June 2024

MINSA
Mineralogical Association of South Africa
A division of the GSSA
website: www.gssa.org.za/Minsa
e-mail: Minsa@gssa.org.za

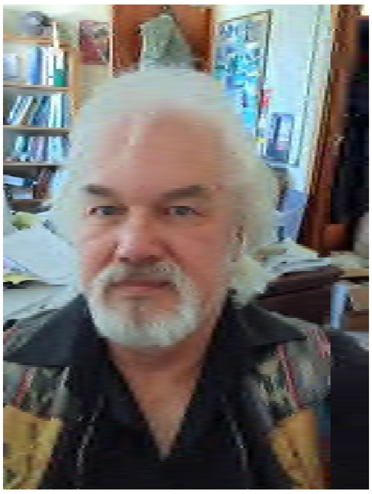
the Geode

NEWSLETTER
Volume 11 No. 2
June 2024

Contents p.

The Editor's Site

Greetings to our membership in mid-2024, from the home of the (currently ongoing) National Arts Festival in Makhanda (previously Grahamstown). In this issue the Editor gets over-invested in some geologically-contextualised Netflix adventures set in Lapland, duly geologically reviewed (one involving Finnish gold, the other Swedish iron). However, prior to that, we review a family night out in Gauteng in the form of Igor Tonžetić's *Night at the Museum* account from November 2023, and we get introduced to South African mineralogist Thelma Boitumelo Chirwa of De Beers, via Mintek.



The Editor. About as pretty as we get.

Continuing the exploration of our theme for 2024 of minerals relevant to energy management, we look at lithium, this time from the perspective of the most appropriate analytical tools for the various lithium ores, courtesy of Yash Thakurdin of Mintek. This is later complemented by a Li-themed crossword puzzle for this month, and Bruce's Beauties give us examples of sperrylite, the platinum arsenide, to fit in with both the critical minerals theme and the 100 years since the discovery of the Merensky Reef. Bjorn von der Heyden also regales us with the semi-precious stone potential of Zimbabwe.

On behalf of Minsa, all the best 'til the next time.

Steve Prevec

Minsa News

Upcoming activities of interest

- 100 years of the Merensky Reef: Minerals, metals and mining. GSSA meeting, Hunter's Rest, Rustenburg. There is a planned session on "Geometallurgical characterisation of Merensky Reef and massive chromitites of the Bushveld Complex". (15-23 Aug.)
- European Mineralogical Conference (EMC 2024: Dublin; 18-23 Aug.)
- 37th IGC, BEXCO (Busan, South Korea, 25-31 Aug.)
- "Meet-A-Mineralogist" Tour to Namibia (14-26 Sept.); see more below.
- Minsa/GSSA Analytical Techniques for Geoscience Symposium. 14-15 Oct., hosted at Mintek.
- MEI - Process Mineralogy '24. 11-13 Nov., Cape Town.
- Mintek@90 conference: Gearing the industry for a sustainable mineral future. 11-12 Nov., Sandton Convention Centre.
- 100 Years of the discovery of the Namaqualand Diamonds, 11-20 March 2025.

Shaping the Future Together: Minsa's Invitation to Tomorrow's Geologists and Mineralogists

In the ever-evolving world of geology and mineralogy, the voices of the young and the emerging professionals are not just valuable; they are essential for shaping the future of these sciences. The Mineralogical Association of South Africa (Minsa) recognizes this imperative need and is actively extending an open invitation to students and young professionals across the country to join its ranks and contribute to the vibrant future of mineralogy. Building on this foundation, Minsa extends an invitation to students and young professionals across the country, aiming to empower the next generation of scientists. By joining Minsa, members are offered various opportunities designed to foster professional growth. These include access to workshops, field trips, and seminars, alongside a platform for sharing research and insights. This initiative is more than a membership; it's an invitation to be part of a community that values collaborative learning, innovation, and the mutual exchange of knowledge.

Minsa's student membership is FREE when accompanied by a short motivation (300-500 words).

A Voice for the Youth

Central to Minsa's mission is the recognition and incorporation of the aspirations and feedback from its younger members. The association is committed to ensuring that the evolving fields of mineralogy and geology remain relevant and responsive to the needs and visions of the upcoming generation. This focus on youth engagement underscores Minsa's dedication to creating a dynamic and inclusive scientific environment.

The Geode: A Platform for Recognition

Through "The Geode", Minsa's newsletter, the association offers students and young scientists a unique opportunity to highlight their work and share their journey with a broader audience. This platform is not just about showcasing research; it's about building a narrative of progress, innovation, and community contribution, offering young professionals and students the visibility and acknowledgment they deserve within the professional community.

Collaboration and Professional Development

Emphasizing the importance of mentorship and professional networking, Minsa actively seeks collaborations with other professional groups, such as the Geological Society of South Africa (GSSA). These partnerships aim to connect young members with established mentorship and graduate development programs, further enriching the professional growth and development of Minsa's youthful contingent.

Join Us in Shaping the Future

Minsa's doors are open to all young enthusiasts from the geosciences, from university students to early-career professionals stepping into the workforce. The

Mineralogists, Scientists, Students, Enthusiasts.

ATTENTION ALL MINERAL PHYSICISTS!

Minsa would like to remind all our members of the forthcoming European Mineralogical Conference EMC 2024, to be held in Dublin from 18th to 23rd August 2024.

Minsa's representative on the IMA Physics of Minerals Commission, Prof. Johan de Villiers, informs us that there will be a session sponsored by the IMA Commission on the Physics of Minerals entitled:

RECENT CHALLENGES AND ADVANCES IN THE THEORETICAL AND EXPERIMENTAL MINERAL PHYSICS.

The session will focus on recent advances in the physical and chemical properties of minerals.

To quote the session aim:

"This session aims to bring together researchers involved in the development of cutting edge methods in geoscience and materials science to exchange interdisciplinary information for the development of new interdisciplinary technologies that can be applied to the study of the mechanisms of the Earth and other planets, as well as the developments of the industrial and technological materials."

To see the full programme, please follow the link:

https://emc-2024.org/programme/

association eagerly anticipates the fresh ideas and feedback from its youngest members, ready to integrate these into the collective effort to advance the fields of mineralogy and geology.

If you're driven by a passion for geosciences and seeking a community that champions your development and contributions, look no further than Minsa. For more information on joining and taking an active role in this exciting journey, please contact us directly at Minsa@gssa.org.za.

Contributed by Bavisha Koovarjee

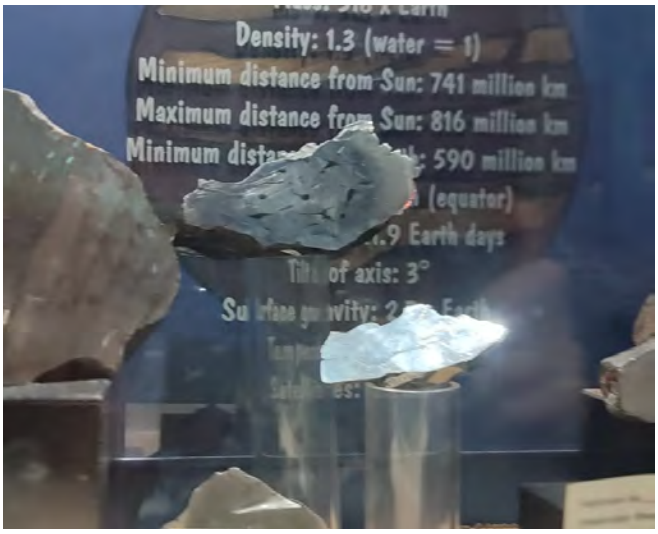
Night at the Museum: November 2023

On Friday the 24th of November 2023 Minsa hosted our 8th annual Night @ The Museum extravaganza at the Ditsong Museum of Natural History deep in the city centre of Pretoria. The evening saw 34 members and their families/friends registering for the event though only 28 people showed up due to unforeseeable circumstances.

The evolution of man…

As usual the festivities began with walkthroughs and discussions in each of the museum's halls and exhibits (Austin Roberts Bird Hall, the Mammalian Hall and the Genesis of Life Hall). Dinner was had and then an exciting treasure hunt/quiz race was run with a box of Ferrero Roche as the prize. Thereafter, the idiosyncratic movie "Night at the Museum" was viewed with snacks galore (and many of the kids falling asleep halfway through the movie due to the previous tiresome *(tiring, but surely not tiresome? Ed.)* activities).

After having slept in one's exhibit hall of choice, the kids were able to get their hands dirty with science in the Discovery Centre. The Council for Geoscience Museum was then opened and the kids were able to view our fantastic world of minerals, rocks and meteorites.

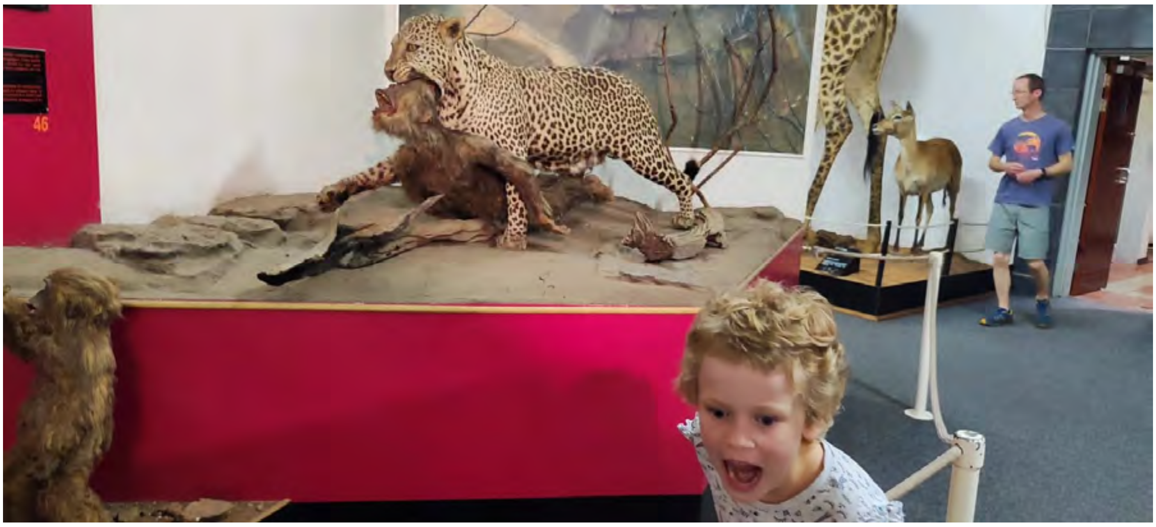


Contributed by Igor Željko Tonžetić

Night at the Museum: a photo montage

Asking questions about mammals (and getting answers).

Walkthrough of Austin Roberts Bird Hall.



Terrifying exhibits (though I maintain still not half as terrifying as the mannequin milking a cow exhibit).

Science: it's exhausting.

Megalon, with Jason Statham for scale: small enough to eat in one bite, but completely unpalatable.

Who's a dimetrodon?

And who's a triceratops (and who's not)?

And finally, trouble in the Hall of Mammals, seemingly populated by mammal-like reptiles. How did they get in?

Articles

Meet a Mineralogist

Name: Thelma Boitumelo Chirwa
Affiliation: De Beers

Thelma Chirwa started her mineralogy journey as an MSc student working on a process mineralogy project with Mintek. Following completion of her studies she joined Mintek where she was exposed to a variety of techniques and had the privilege of operating Automated SEMs (i.e. MLA and QEMSCAN) and worked on various commodities and metallurgical samples as a scientist. She later joined ALS global to explore the business aspect of the commercial labs as a lab manager. Pre-COVID she re-joined Mintek as a commercial co-ordinator where she established the marketing team and co-ordinated the implementation of the MinFOCUS newsletter, later changed into Principal scientist where she had an opportunity to train junior scientists and share her skills with fellow colleagues. With more than a decade of mineralogy experience, she took on the opportunity to apply her skills in the exploration space as an AutoSEM Specialist at De Beers (Indicator Mineral Laboratory).

What is your favourite mineral, and why?

It is not easy to choose one favourite mineral, we come across exciting minerals from various deposits and you fall in love with different minerals for a variety of reasons. I will have to choose based on my anytime gem and it is topaz – beside being my birth month gemstone, it is the hardest silicate -number 8 in the Mohs hardness scale, occurring in a variety of beautiful colours.

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

Although this provokes some emotions, it will have to be a trip to Laingsburg for field mapping (Prince Albert formation)- we were three ladies in our group –"The photographer", "The navigator" and "The motivator". All of us had different characters but we pulled together very well, pushing our outcrop hunting and measuring dip and strikes - taking fun photographs along the way. Until we reached a farm where the three giant dogs, "Boerboels", with the heads bigger than ours enclosed us from three opposite directions, we froze for about 5 minutes until we were assisted by the farm workers.

Editorial illustration. In no way to scale.

What is the most exciting aspect of mineralogy for you?

The mineralogy application and interpretation to solve various problems; of course you need a variety of skill sets to know which aspect/technique to apply in addressing the problems at hand. Having the skill to unlock and bring to life aspects hidden in mineralogy that others may not see, though it holds so much value, brings fulfilment and encouragement.

What motivates you to go to work every day?

A healthy working environment, problem solving and the quest to complete the project.

Being in a space to innovate gives you a goal to look forward to the next day.

What is the most exciting project you have worked on?

In the early stage of my career I had an opportunity to work on samples where metallurgists had to conduct a flotation test work project, and as a mineralogist in the team, I had to characterise and aid with why the desired recoveries were not met. An undesired presence of calcite was discovered in the sample, and senior metallurgists were questioning the identification/classification, but with a simple basic solution

(HCl-acid test) both parties were brought onto the same page and the energy was invested in finding the right solution for the optimisation of the unexpected sample characteristics. About 3-4 years later we read in the news that they have built a plant and today we are buying their product and it is used in many buildings. It is satisfying to know I was part of a product journey that is today regarded as a quality product and used by many. (Unfortunately, I cannot disclose the company or product…but it is for you to work it out).

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

Mineralogy is a mathematical Art, and there is more life/beauty to it than the fundamental basics - the more you understand the art the better you learn to appreciate its value and freestyle with it, no matter what you come across.

Craft your journey, learn as much as you can, and knock on closed doors: someone will open.

What route did you take to become a mineralogist?

I started my mineralogy journey through my M.Sc. research with Mintek on process mineralogy. After my M.Sc. studies I joined Mintek, where I learned a variety of skills, since then it has been an ongoing journey of mineralogy application in various disciplines, from metallurgy via the chemistry lab and back to exploration.

"Interviewed" by Bavisha Koovarjee

Mineralogical Analysis of Lithium Ores

Yash Thakurdin & Susan Brill
Mintek, Mineralogy Division
YashT@mintek.co.za

The Element Li

Lithium is the lightest, least dense metal on the Periodic Table. On Earth, lithium occurs as an elemental component within naturally forming minerals or in saline solution (brines). Lithium-bearing minerals are hosted primarily within pegmatitic rocks (lithium-caesium-tantalum (LCT) granitic pegmatites) and subordinately in clays from volcano-sedimentary deposits. Although pegmatites are currently the major source of Li, brines constitute a significantly larger resource for lithium at the global scale (Kesler et al., 2012).

North and South America (Unites States, Canada, Argentina and Brazil among others) host several major pegmatite and evaporite deposits that contain a large portion of the world's lithium. Australia (pegmatite) and China (pegmatites and evaporites) also possess significant Li reserves (Bowell et al., 2020). In Africa, lithium-bearing pegmatites are found in the Democratic Republic of Congo (Manono), Zimbabwe (Bikitia), Namibia (Rubicon Mine, Cape-Cross-Brandeberg-Uis) and Ghana (Winneba).

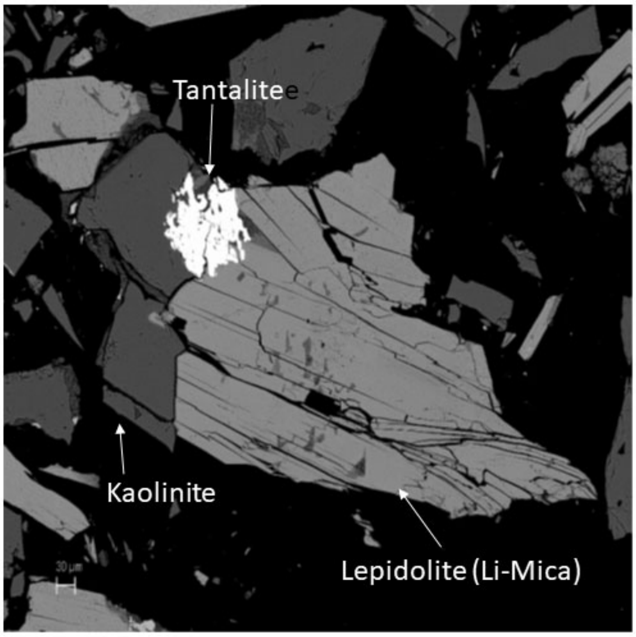
Historically, lithium was utilised in medicines, alloys, glasses and ceramics. The demand over the last few decades, however, has shifted to rechargeable batteries, driven primarily by the automotive and electronic industries (Bibienne et al., 2020).

Table 1. Chemical compositions of selected Li-bearing minerals (after Grew, 2020).

Mineral	Ideal Formula	Li Grade (wt. %)
Spodumene	$LiAlSi_2O_6$	3.7
Elbaite	$Na(Li_{1.5}Al_{1.5})Al_6Si_6B_3O_{27}(OH)_4$	1.1
Triphylite	$LiFePO_4$	4.4
Amblygonite	$(Li,Na)Al(PO_4)(F,OH)$	3.4
Lithiophorite	$(Al,Li)Mn^{4+}O2(OH)_2$	3.2
Montebrasite	$LiAl(PO_4)(OH)$	1-4
Cookeite	$(Al,Li)_3Al_2(Si,Al)_4O_{10}(OH)_8$	2.9
Lithiophilite	$LiMnPO_4$	4.4
Petalite	$LiAlSi_4O_{10}$	2.1
Polylithionite	$KLi_{1.7}Na_{0.3}AlSi_4O_{10}F(OH)$	3.0
Eucryptite	$LiAlSiO_4$	5.5
Bikitaite	$LiAlSi_2O_6.H_2O$	3.4
Lepidolite	$K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$	3.6
Zinnwaldite	$KLiFeAl(AlSi_3)O_{10}(F,OH)_2$	1.6
Trilithionite	$KLi_{1.5}Al_{1.5}AlSi_3O_{10}F_2$	2.6
Hectorite	$Na_{0.3}(Mg,Li)_3Si_4O_{10}(OH)_2$	1.9
Jadarite	$LiNaAlSiB_2O_7(OH)$	2.9
Zabuyelite	Li_2CO_3	18.8

Lithium is currently observed as an elemental component in approximately 120 mineral structures. The vast majority of Li-bearing minerals are either silicates or aluminosilicates, with spodumene (~3.7 wt. % Li) being the most common. Phosphates are less common but can contain significant Li (e.g. triphylite –

4.4 wt. % Li). A variety of lithium borates, carbonates, oxides and hydroxides (Table 1) have also been classified from deposits around the world.



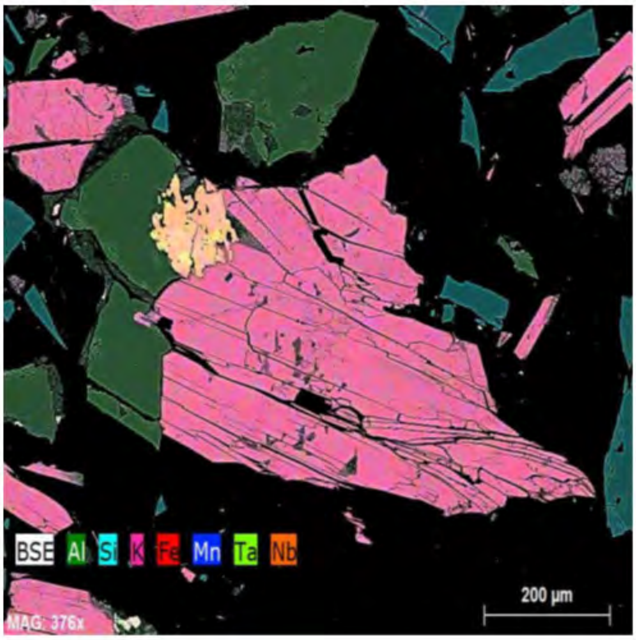


Figure 1: Back-scattered electron (BSE) image (above, top) and accompanying energy-dispersive (EDS) elemental map (above, bottom) showing the association of an Li-bearing mica (lepidolite) with other minerals in a clay-rich deposit.

Lithium Detection and Quantification

Conventional mineralogical analytical instruments such as the scanning electron microscope (SEM), automated SEM (AutoSEM), X-ray diffractometer (XRD), micro-X-ray fluorescence spectrometer (µXRF) and the electron probe micro-analyser (EPMA) operate on the principle of X-ray fluorescence or X-ray diffraction. The fluorescent yield of lithium is extremely low, making it difficult to directly detect and quantify Li using these techniques. This does not preclude the usefulness of these instruments in lithium studies, however (see below). Laser techniques such as laser-ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and laser induced breakdown spectroscopy (LIBS) do not possess the same limitations as X-ray instruments, and can directly measure Li.

Bulk Lithium Studies: X-Ray Diffraction (XRD) and Automated SEM (AutoSEM)

X-ray powder diffraction is a fast, reliable method for obtaining bulk mineral and/or phase compositions. While XRD cannot directly quantify the Li-content in minerals, the proportion of Li-bearing phases present (e.g. percent spodumene or lepidolite in a sample) can be obtained along with the amount of gangue (non-lithium) phases. An estimation of lithium content in certain ores can be calculated using XRD when combined with rigorous statistical treatment (e.g. Pöllman and König, 2021).

XRD detection limits may hinder the characterisation of low grade ore (e.g. <3 % Li-bearing minerals). Additionally, XRD provides no information about the Li-mineral particle properties. A more comprehensive bulk mineralogical dataset can be obtained using QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscopy) or MLA (Mineral Liberation Analyser) which can constrain Li-mineral grain size, texture, association and liberation (Figure 1). This type of data is critical for determining the optimal route for extracting and processing Li to create pure lithium metal.

In-Situ Lithium Ore Characterisation: Micro-XRF (µXRF)

Micro-XRF is a versatile analytical technique that uses an X-ray source to obtain the elemental composition and texture of solid materials. It is particularly suited to large specimens (up to 20 cm), therefore is an ideal technique for investigating in-situ rock/particle textures. This is especially applicable to pegmatites, which often contain centimetre-sized megacrysts of spodumene that can be assessed for chemical homogeneity and impurities using µXRF (e.g. Sirbescu *et al.*, 2023). While µXRF cannot measure lithium contents, the ability to rapidly identify the presence of lithium minerals and associated gangue in large samples (e.g. drill cores – see Potter and Brand, 2019) is very useful in exploration geology and mineral processing.

Estimating Lithium Content in Minerals: Electron Probe Microanalysis (EPMA)

EPMA is a micro-analytical technique utilised for obtaining accurate elemental compositions of solids at the micron scale. Whilst EPMA also cannot directly measure Li, indirect methods can be used to estimate Li based on the concentration of other major elements in lithium-bearing minerals. For trioctahedral micas (zinnwaldite, lepidolite, siderophyllite), the concentration of Li can be estimated based on the amount of silica (SiO_2) present in the mineral (Tindle and Webb, 1990; Tischendorf *et al*., 1997). This method can lead to over/underestimation of Li by EPMA as explained by Thiergärtner (2010) and Guimarães et al. (2021). However, the speed and cost of EPMA relative to other expensive, destructive techniques (wet chemistry, LA-ICP-MS) nonetheless lend viability to this method.

Recent innovations in EPMA such as soft x-ray emission spectroscopy (SXES) have allowed for detection of lithium emission spectra (Takahashi *et al*., 2016). Instrumental modifications (e.g. reflection zone plates) have also shown encouraging results for Li detection with EPMA (Hassebi *et al*., 2023).

Direct Lithium Measurement: LA-ICP-MS and LIBS

LA-ICP-MS involves the ablation of solid surfaces using a laser to create a small volume of ionized material that is differentiated into its elemental components using a mass spectrometer. Detection and quantification of Li is made possible by employing a number of external and internal calibration standards. A method was previously developed at Mintek using LA-ICP-MS to detect and quantify lithium in various reference materials. In a study on pure spodumene, direct Li analysis by LA-ICP-MS yielded an average concentration within error of the reference value of 3.7 wt. % Li.

Laser-induced breakdown spectroscopy (LIBS) is a relatively new technique that involves ionisation of a small volume of surface material (plasma) by a laser-beam. Photons emitted by the plasma are spectrally differentiated and recorded at the detector to provide elemental compositions (Harmon *et al.*, 2009). The technique is especially sensitive to light elements, allowing for direct measurement of lithium. Most instrumental setups involve handheld devices (handheld LIBS) but fixed standing setups have also been manufactured. LIBS is undergoing rapid development and is expected to become increasingly utilised in lithium exploration and beneficiation.

Integrated Workflows for Lithium Ore Studies

In practice, the above described techniques are rarely used in isolation for lithium investigations. For the analysis of a typical Li-ore, XRD is used as the initial step to identify and estimate the proportion of minerals present. This initial data assists in configuring the parameters for more detailed bulk mineralogical assessment by QEMSCAN or MLA (AutoSEM). Once AutoSEM data has been obtained, mineral chemistries from EPMA (including Li-estimation) may be used to reconcile the data and ensure data quality. The EPMA information is then additionally used for LA-ICP-MS calibration (internal standards) to accurately measure lithium content.

References

Bibienne, T., Magnan, J. F., Rupp, A., & Laroche, N. (2020). From mine to mind and mobiles: Society's increasing dependence on lithium. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 16(4), 265-270.

Bowell, R. J., Lagos, L., de los Hoyos, C. R., & Declercq, J. (2020). Classification and characteristics of natural lithium resources. Elements, 16(4), 259-264.

Grew, E. S. (2020). The minerals of lithium. Elements: An International Magazine of Mineralogy, Geochemistry, and Petrology, 16(4), 235-240.

Guimarães, F. S., de Oliveira, A. L. R., Amorim, L. E. D., Rios, F. J., Lehmann, B., Hernández, C. R., & Moraes, R. (2021). Lithium-mica composition as pathfinder and recorder of Grenvillian-age greisenization, Rondonia Tin Province, Brazil. Geochemistry, 125737.

Harmon, R. S., Remus, J., McMillan, N. J., McManus, C., Collins, L., Gottfried Jr, J. L., ... & Miziolek, A. W. (2009). LIBS analysis of geomaterials: Geochemical fingerprinting for the rapid analysis and discrimination of minerals. Applied Geochemistry, 24(6), 1125-1141.

Hassebi, K., Rividi, N., Verlaguet, A., Erko, A., Probst, J., Loechel, H., ... & Jonnard, P. (2023, June). Reflection Zone Plate Spectrometer For Li K Emission Detection In Lithium Compounds. In International Workshop on the Characterisation and quantification of lithium.

Kesler, S. E., Gruber, P. W., Medina, P. A., Keoleian, G. A., Everson, M. P., & Wallington, T. J. (2012). Global lithium resources: Relative importance of pegmatite, brine and other deposits. Ore geology reviews, 48, 55-69.

Pöllmann, H., & König, U. (2021). Monitoring of Lithium Contents in Lithium Ores and Concentrate-Assessment Using X-ray Diffraction (XRD). Minerals, 11(10), 1058.

Potter, N., & Brand, N. (2019). Application of micro-XRF to characterise diamond drill-core from lithium-caesium-tantalum pegmatites. ASEG Extended Abstracts, 2019(1), 1-4.

Sirbescu, M. L. C., Doran, K., Konieczka, V. A., Brennan, C. J., Kelly, N. M., Hill, T., ... & Student, J. J. (2023). Trace element geochemistry of spodumene megacrystals: A combined portable-XRF and micro-XRF study. Chemical Geology, 621, 121371.

Takahashi, H., Murano, T., Takakura, M., Asahina, S., Terauchi, M., Koike, M., ... & Nagano, T. (2016). Development of soft X-ray emission spectrometer for EPMA/SEM and its application. In IOP Conference Series: Materials Science and Engineering (Vol. 109, No. 1, p. 012017). IOP Publishing.

Thiergärtner, H. (2010). Can the Li2O content of mica really be calculated from its main chemical components? Zeitschrift fur geologische Wissenschaften, 38, 195-205.

Tindle, A. G., & Webb, P. C. (1990). Estimation of lithium contents in trioctahedral micas using microprobe data: application to micas from granitic rocks. European Journal of Mineralogy, 595-610.

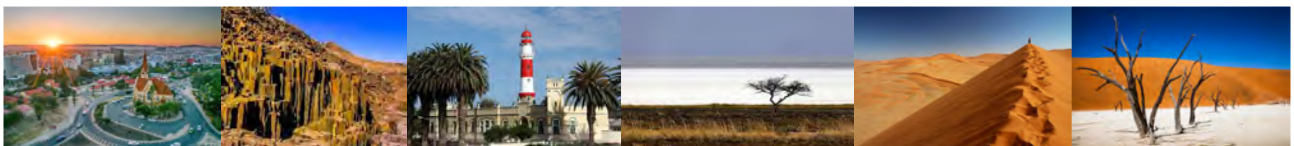
Tischendorf, G., Gottesmann, B., Foerster, H. J., & Trumbull, R. B. (1997). On Li-bearing micas: estimating Li from electron microprobe analyses and an improved diagram for graphical representation. Mineralogical Magazine, 61 (409), 809-834.

MEET-A-MINERALOGIST NAMIBIA TOUR 2024

MINSA is delighted to bring you the "Meet-A-Mineralogist" Tour! We will be doing a circular route (beginning and concluding in Windhoek) that will incorporate mineral collecting (self and bought), mine tours, museum excursions, some natural history, some cultural history and some palaeontology.

Mineralogists, Scientists, Students, Enthusiasts.

MINSA
Mineralogical Association of South Africa



ITINERARY

Highlights include:

Meet-A-Mineralogist Dinner at Joe's Beer House to catch up with Prof. Sybrand de Waal.

Mineral collecting/buying: Tourmalines at the Okajo Safari Lodge; the Uiba crystal market; Topaz fossicking at Klein Spitzkoppe; Aris phonolite quarry.

Mineral museum & heritage site visits: Swakopmund crystal museum; Twyfelfontein World Heritage Site.

Mine visits: Rubikon Lithium Mine; Navachab Gold Mine; Rossing and/or Khan U Mines; Uis Tin Mine.

TO SUMMARISE

WHAT	MINSA Meet-A-Mineralogist Namibia Tour
WHEN	Tuesday 17th September – Friday 27th September 2024
WHO	Members of MINSA including friends and family
WHY	Visit mines, museums, collect/buy mineral specimens

FINANCIAL ARRANGEMENTS

COST
R7000/PERSON

- (Includes all accommodation and most food). Some meals may have to be self-catered, but this will be communicated in due course and kept to a bare minimum.
- This fee does NOT include petrol. It is estimated that petrol costs will amount to approximately R3000/vehicle (Calculated @ 10km to the litre/R23 per litre_95 unleaded…we will be travelling approximately 110km/day). MINSA is happy to provide a provisional cost breakdown to those who request it.
- Most accommodation will be campsites, so tents are essential (2 nights will be spent in guesthouses). You are welcome to do the tour in a camper van or similar vehicle.
- It is recommended that you have some Namibian dollars on your person.

RSVP
To secure your place on the tour please pay ½ of the total fee (R3500) by 9th of July 2024 into:

ACCOUNT NAME	**Mineralogical Association of South Africa (MINSA)**
BANK	**ABSA**
BRANCH	Clearwater Mall, Roodepoort
BRANCH CODE	632005
ACCOUNT NUMBER	21095311
ACCOUNT TYPE	Savings
POP	minsa@gssa.org.za
REFERENCE	MAM_Surname

INTERESTED?

Please complete the form on the next page, and along with your proof of payment send both documents to minsa@gssa.org.za.

REGISTRATION DOCUMENT

	YES / NO / NUMBER
Surname	
First Name(s)	
Number of persons accompanying?	
Will you be using your own vehicle for the excursion?	
Do you have space in your vehicle to accommodate a car-pooler (who would share costs)?	
If yes to the above question, please specify how many car-poolers you can accommodate.	
Would you like us to book accommodation for you on the1st night of 17th September (Urban Camp, Windhoek)?	
Would you like us to book accommodation for you on the last night of 27th September (Urban Camp, Windhoek)?	
Please specify any particular food allergies or requirements.	

PLEASE NOTE: SPACE IS LIMITED.

MINSA
Mineralogical Association of South Africa

ATTENTION

MINSA
Mineralogical Association of South Africa

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

35 IGC LEGACY FUND
PROJECT FUNDING

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

Zimbabwe's under-exploited semi-precious stone endowment

Bjorn von der Heyden
Stellenbosch University
bvon@sun.ac.za

Zimbabwe is well-endowed with a number of diverse precious and semi-precious stone occurrences, the best known of which are its diamonds, its exquisite green Sandawana emeralds, along with some of its aquamarine and alexandrite. Despite this acclaim, the gem mining sector in Zimbabwe has not been fully developed, and there remains vast opportunity for further expansion, which in turn, would have positive impact on the local economy. Recently published work by Mamuse *et al.* (2024) suggests that several key ingredients are required in order for this sector to expand. These include, firstly, a need to enhance geological understanding of the known endowments, and to use this understanding to advise future exploration endevours. Secondly, there is need to build capacity within the local communities such that they can effectively mine the gemstones in an efficient, safe, and environmentally sound manner, and so that they have the business and marketing skills to ensure that they can maximise the saleability of their product. Thirdly, there is also a strong need to increase capacity in the downstream beneficiation of locally mined stones, since polished stones carry a many-fold increase in value relative to raw or unpolished stones.

Towards satisfying the first of these 'ingredients', the work by Mamuse and coworkers presents an overview of Zimbabwe's gemstone endowment in a context of the country's metallogenic evolution (Fig. 1). This work highlighted that the regions most prospective for precious stone mineralisation include the extensive pegmatite belts found within the country, where various gemstones are found in miarolitic cavities, and where emerald formation is promoted by the association of Be (from pegmatites) with surrounding Cr-rich mafic and ultramafic country rock. Another prospective setting is those areas that have experienced elevated pressure and temperature conditions on account of orogenesis, particularly those that comprise aluminous protolith rocks (e.g., metapelites). In this regard, discussion focused on case studies of the Pfungwe gemstone cluster (eight deposits of garnet, kyanite, quartz, ruby, sapphire or aquamarine) and the Mwami gemstone cluster (21 gemstone occurrences; Fig. 2).

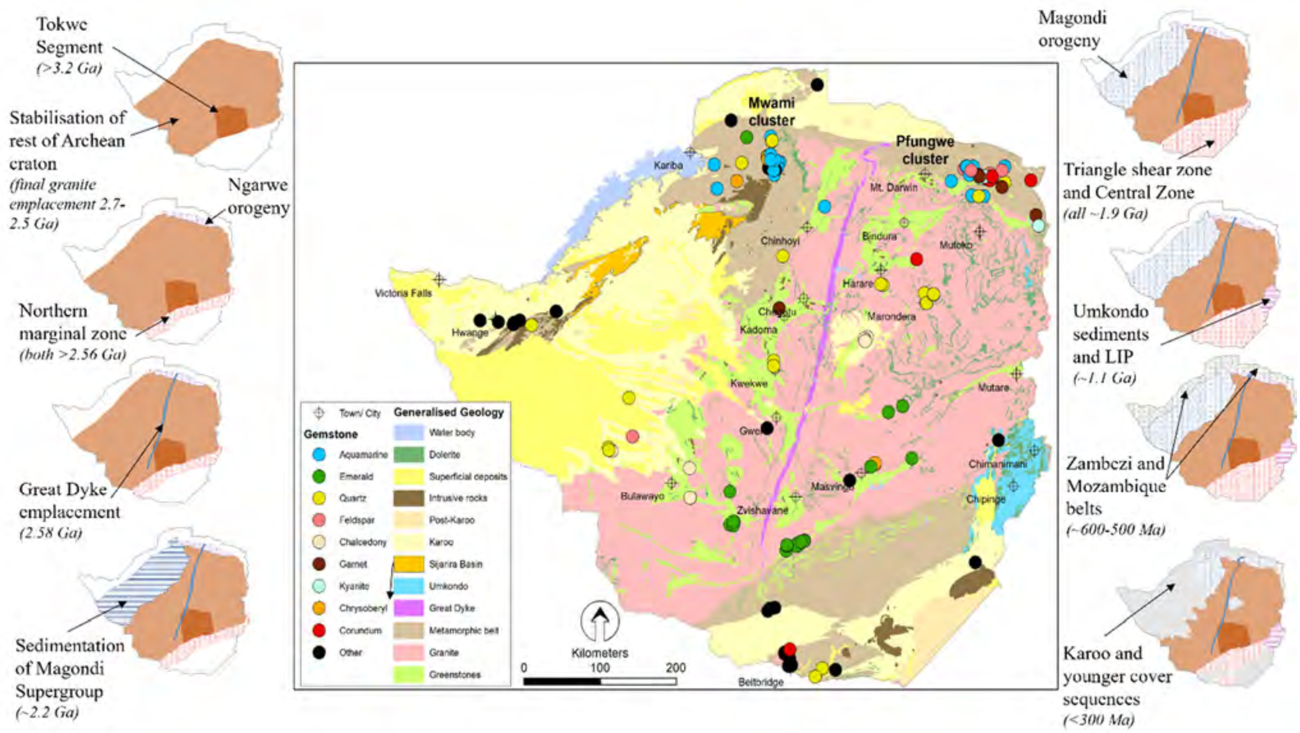


Figure 1: Distribution of precious stone occurrences within the Zimbabwean land borders, supported by a pictorial summary of its regional geological history (adapted from Mamuse et al. 2024).

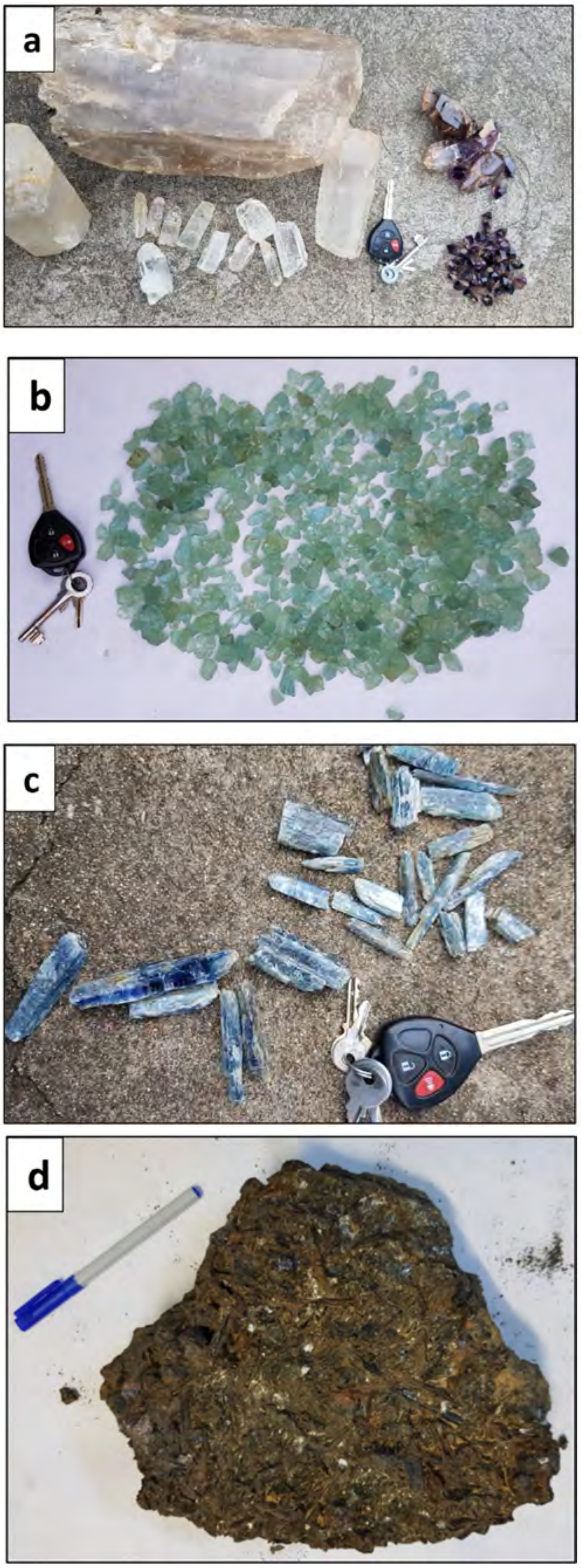


Figure 2: A variety of Zimbabwean semi-precious stones collected during a sampling campaign funded by the HEPSA grant program.

For further information, the full article is available through the Journal of the Southern African Institute of Mining and Metallurgy (at https://www.saimm.co.za/Journal/v124n1p33.pdf) The work resulted from a very successful funding initiative that aimed at strengthening intra-Africa collaboration and collaboration with UK-based tertiary institutes (the Higher Education Partnerships for sub-Saharan Africa (HEPSA) programme (Royal Academy of Engineering)).

Reference:

Mamuse, A., von der Heyden, B.P. & Blenkinsop, T. (2024) Zimbabwe's coloured gemstone endowments – a regional geological overview. Journal of the Southern African Institute of Mining and Metallurgy, v. 124, no. 1. pp. 33–42.

MINSA
Mineralogical Association of South Africa
A division of the GSSA

Who we are

Minsa was established in 1979 to foster interaction within the mineralogical community of South Africa. We are a specialist division of the Geological Society of South Africa (GSSA) and are affiliated with the International Mineralogical Association (IMA).

Minsa organises various events of interest to both professional and amateur mineralogists, geochemists and petrologists. We promote access to cutting edge developments in the field through meetings, symposia and workshops, the largest of which was the IMA2014 international conference.

Membership benefits

- Opportunity to interact with peers in the mineralogy, petrology and geochemistry fields

- Reduced fees for attendance of symposia and workshops organised by Minsa
- Free attendance of quarterly topical talks by eminent scientists
- Participation in field trips to exciting and interesting sites, laboratories and factories of mineralogical interest, typically free of charge
- Events at which family participation is encouraged, in stimulating the interest of a new generation of mineralogists
- Quarterly newsletter of MINSA activities (The Geode) and upcoming events of interest to the community. Special themed editions are now a common occurrence
- Opportunity to address issues relating to the mineralogical community

Becoming a member is easy

Scan the QR code below, or click the link on the Minsa membership page earlier in this magazine.

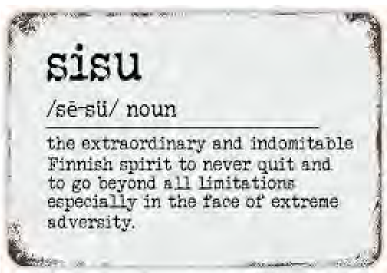
Mineralogists, Scientists, Students, Enthusiasts.

Other Gems

Great moments in Geology: Lapland on Netflix.

Sisu (2022)

Sisu is defined at the start of the movie as follows:



So now (most of) you have a new word to throw around next time you're at the sauna. In this film, the noun is applied to the fictional character of Aatami Korpi, former soldier turned gold prospector, who basically wants to be left alone. With his dog and his horse, he prospects for gold in Finnish Lapland, before encountering a German platoon, whom he deals with in the current fashion of brutally efficient, effectively unkillable thoroughness that characterises the John Wick / Jack Reacher / Robert McCall (the Equalizer) models of competent self-sufficiency from recent films. In this context, for our protagonist, faced with a similar assemblage of mostly nameless antagonists with seemingly very high blood-pressure (based on the volume and energy by which this fluid escapes their bodies given the opportunity), any "do-gooding" benefit to other occupants of the story is largely incidental to his primary motivation.

For our purposes here, we will stick to the geological aspects of the story, set in the vicinity of the town of Rovaniemi, in northern Finland, just below the Arctic Circle. Rovaniemi, now the northernmost outpost of the Finnish Geological Survey (GTK, for geologian tutkimuskeskus), was indeed burned to the ground in 1944, as illustrated in the movie, likely (in real life) a consequence of the explosion of an ammunition train (either by the retreating Germans or by Finnish commandos).

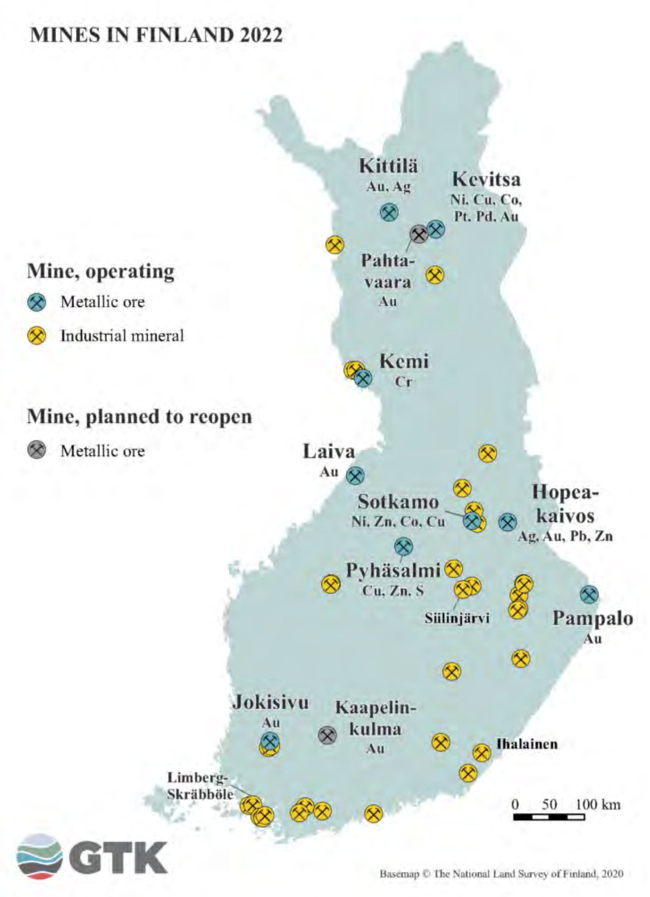
Our main geological interest, though, relates to Korpi's gold exploration. His approach is fundamentally sensible, using gold panning in local small streams in the tundra to access gravels and soils to prospect for gold flakes and nuggets, and on that basis following the vectors towards likely gold sources, which he explores by trenching using his (very) trusty pick-axe (you should see what else he uses it for). The exploration method applied is even more thoroughly presented on film in the Coen Brothers 2018 Western anthology "The Ballad of Buster Scruggs" in the vignette entitled "All Gold Canyon", based faithfully on the 1904 Jack London story of the same name, which provides an even more detailed account. Finnish geologists have a long and proud tradition of gold panning, as exemplified here (below) by Dr Timo Huhtelin (then of Outukumpu) pictured in 2005 in the Penikat Intrusion (only about 100 km southwest of our story setting), wearing his lucky gold-panning hat, under which he had won the prestigious international annual gold panning competition (held near Nelspruit (Mbombela)) the previous year.

But I digress.

In the film, Korpi comes across the find of a lifetime. The initial exposure he discovers is a planar surface of solid gold about two metres long, tens of centimetres wide, and evidently thick, as it produces two saddlebags full of solid gold chunks, with no quartz or other silicate or carbonate gangue minerals visible in his ores. His discovery is overlain by tundra (fortunately not under permafrost), and outcrop is poor here; unlike Canada, for example, Finland was not scraped clear of its surface sediments by Pleistocene glaciation, so a lot of Finland is boggy and loamy, making surface geological exploration difficult.

The geometry of the ore requires that this is a stratiform deposit of some kind, which would allow for a vein in a fracture, or a vertically tilted placer bed. In both cases we would expect impurities. Placer gold would be associated with coarse clastic sedimentary rocks, such as conglomerates, dominated by quartz pebbles. Vein- (fracture and/or shear-zone) hosted gold would be expected to be associated with quartz and/or carbonates, with associated iron-staining (hematisation), pyrite or arsenopyrite. The fact that the rocks immediately adjacent to the ore surface were amenable to being trenched suggests that this planar, near-vertical surface was less geologically coherent, consistent with faulting and perhaps shearing.

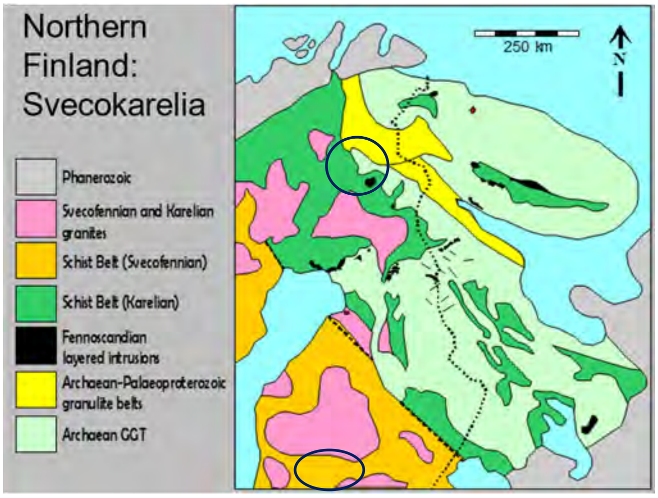
In fact, Finland now hosts four active gold mines, two in schist belts in the far south and two hosted in greenstone belts in northern Lapland. So we need look no further than the latter.



Above, mining in Finland as of 2022 (GTK, 2022).

It is noteworthy that the Finnish gold deposits are not hosted in Archaean greenstone belts, as is typically the case on other cratons (Abitibi, Canada; Barberton, South Africa; Kambalda-Kalgoorlie in western Australia), but rather in Neoarchaean and Mesoproterozoic schist belts. The map above (Prevec, unpublished) places the gold districts from above onto a regional geological map of northern Finland.

An image of shear zone-hosted gold from the Consort Mine north of Barberton (South Africa) looks pleasingly similar to the exposure unearthed in the movie. In addition, an online picture of the gold from the Kittalä mine (also referred to as the Suurikuusikko gold deposit), which looks identical to that depicted in the movie (although there’s no scale provided, apart from wood grain in the table). The somewhat porous nature of the gold could be consistent with removal of gangue quartz by post-depositional hydrothermal activity, upgrading the gold concentration.



Above, simplified geology of Finland with blue ellipses indicating Au prospective zones (after Firefox Gold, n.d.).

Above, fracture-hosted gold from Pan African Resources' Consort Mine, Barberton Greenstone Belt, RSA (Pan African Resources, 2020).

Above, a stock image of gold used to illustrate an article on gold prospects in Finnish Lapland (Yle News, 2016). Below, Korpi's gold, preparing his bank transaction.

Activity at the Agnico-Eagle Mines' Kittalä mine commenced in 2004, about two decades after its discovery and exploration drilling. It is currently the largest gold mine in Europe (Wikipedia). The gold there is mostly hosted in sulphides, specifically arsenopyrite and arsenic-rich pyrite (Barradas, 2015), rather than as giant 24-carat layers, as implied in the film.

So in summary, the geological premise is broadly plausible, with a few grains of salt, and hence, willing suspension of disbelief permits total acceptance of the rest of the movie (and there's a lot of willing suspension required). I'm very suspicious of the ore purity and thickness; any geologist with an opinion on this is invited to please share it! The online images of gold look like post-refinery, pre-gold bar materials to me, as a guess.

References:

Barradas, S. (2015) Kittala Mine, Finland. Mining Weekly, August 14 2015.

Fixefox Gold (n.d.) Exploring Finland. Firefox Gold website, accessed 20 June 2024.

GTK (2022) Mining and ore deposit maps. GTK website, accessed 25 June 2024.

Pan African Resources (2020) Consort Gold Mine. Pan African Resources website, accessed 21 June 2024.

Yle News (2016) Prospecting for gold in Finnish Lapland. Radio Canada International website, accessed 21 June 2024.

Contributed by Steve Prevec

Avgrunden (The Abyss) (2023)

This Swedish film is set in the mining town of Kiruna, in Swedish Lapland, about 300 km to the northwest of our previous feature. The plot of this movie is a family drama (but not too “Hallmarky”) set in the context of the ongoing relocation of the town of Kiruna from its historic location, subsequently identified as overlying economic resources (in the form of the Kiirunavaara mine) and now destabilised by underground mining, to a new location a few kilometres away.

In fact, the relocation of the town of Kiruna began in around 2007 and is now well underway, as presented in the film. Relocation of the town centre is basically complete as of now, with final relocations scheduled for completion by 2040. The story is centred around the person of Frigga Vibenius, who is separated from her husband (who also happens to be the mine operations manager), and has a doting new love interest (a fireman), and two alienated teenaged children to balance with her job, which is head of mine safety (translated in the film as ‘head of mine security’, but seemingly more mining engineering manager). She is occupied with monitoring of the regular seismic activity that accompanies the mining through the use of a network of geophones, linked to cell-phone readouts of spatially-contextualised seismic readouts, all very plausible (to me). It is my understanding that rockbursts represent the single largest source of down-time (injuries, loss of life, loss of mine access) in underground operations (I once attended a fracture propagation conference in Johannesburg). Dangerous areas are explored with the use of drones, sensibly. The underground mine faces are appropriately festooned with shotcrete and rock bolts (although no metal mesh webbing that I could see). One scene involving the use of the rescue chamber during a rock fall seemed realistic, including access to oxygen and other resources, except for the lack of any communication system to the surface; there was no cell phone signal (perhaps unsurprisingly), and no hard-line phone or bell system available.

She describes the mine aptly as “Sweden’s womb”; the Kiruna iron mine is described (in Wikipedia, various pages of which comprise the source for the rest of this article) as the world’s largest and most modern underground iron mine, and has been active since 1898, producing nearly a billion tons of ore in that time (that sounds like a lot, but in terms of iron mining, it’s not; read on for more). The mine is owned by the Swedish government through the Luossavaara-Kiirunavaara Aktiebolag (LKAB) mining company, state-owned since the 1950s. Much of the ore is sent to the Norwegian port town of Narvik for smelting, which provides the setting for yet another WWII-based recent (2022) Netflix film (“Narvik”), which will not be addressed here (not much geology involved, beyond the town’s immense strategic value as an iron smelting and export site). That town is also twinned with Rovaniemi, thus linking these two articles a little bit further.

Petrogenetically, I had assumed that this famous iron deposit was a stratiform banded iron formation, like the vast majority of other famous, volumetrically large economic iron deposits, such as the Algoman-type iron ores in northern Michigan and Minnesota, U.S.A., as well as in Australia and Liberia, and the Lake Superior-type banded iron formations such as those found in northwestern Ontario, Canada, and the Kalahari banded iron formations in South Africa, using the classification scheme of Gross (1980). In fact, the Kiruna deposit is volumetrically small, consisting of an inclined sheet of about 4 km length by 80 x 120 120 m thickness, extending down to about 1500 m; mining is currently primarily taking place between 1300 and 1400 m depth at the moment, but is very high grade, consisting of mainly magnetite (locally hydrothermally hematised), with accessory disseminated interstitial apatite, mainly (another consequence of which is that it has been recently identified as a viable REE ore deposit as well). Proposed genetic models for the deposit include a magmatic igneous origin (possibly involving immiscible iron-rich magmas as postulated for the El Laco volcanic iron deposit in Chile), or alternatively a volcanogenic sedimentary deposit.

By contrast, BIF-hosted iron ore deposits measure in the hundreds of thousands of square kilometres in area, hundreds of metres in thickness, and produce on the order of trillions to hundreds of trillions of tons of iron ore *per year,* from giant open-pit (or open-cast, as you prefer) mines.

So this film gets top marks for geological veracity, and hence, is deemed worthy.

Reference:

Gross, G.A. (1980) A classification of iron formations based on depositional environments. *The Canadian Mineralogist* **18**, 215–222.

Contributed by Steve Prevec

Bruce's Beauties: Sperrylite

The Editor-in-Chief pointed out that with the centenary of the discovery of the Merensky Reef this year, something related to this might be suitable for this issue's Geode feature. For that reason, sperrylite has been selected, even though the historic black and white photo is not one of mine.

Sperrylite, $PtAs_2$, was named in 1889 after Francis Louis Sperry, chemist at Sudbury, Ontario, who discovered it (Wells, 1889). The type-locality is the Vermilion mine in Ontario, Canada. At the time, only tiny fragments less than a millimetre were known. Notwithstanding the Canadian discovery, it was the Bushveld Complex in South Africa that produced the first noteworthy macro-sized sperrylite crystals. These historical specimens are commented on by Wagner in his 1929 'Platinum Deposits and Mines of South Africa' book as ". . . crystals of sperrylite of a size previously undreamt of . . ." Figure 1 is from his book. The crystals were discovered in a gossan on the farm Tweefontein 1033 and at the time were the largest known. It should be stated here that larger crystals and crystal clusters have subsequently been found in other Canadian deposits and famously from the Talnakh copper-nickel deposit in Noril'sk, Russia. However, these contemporary crystals seldom match the brilliant silver lustre of the Tweefontein crystals. It appears that the large sperrylites from the early 20th Century Bushveld discovery have never been equaled. The Tweefontein crystals have recently been featured in a contemporary mineral related publication (Wilson, 2010).

References

Wagner, P.A. (1929). *The platinum deposits and mines of South Africa*. Oliver & Boyd, London, 326 pages.

Wells, H.L. (1889). Sperrylite, a new mineral. *American Journal of Science*, 3rd Series, XXXVII(217-222), 67-70.

Wilson, W.E. (2010). Sperrylite from the Tweefontein farm, Limpopo Province, South Africa. *Mineralogical Record*, 41(2), 147-155.

Big crystals of sperrylite from Tweefontein, No. 1033, north-north-west of Potgietersrust. The crystal on the left is now in the British Museum; that in the matrix at the back is in the Geological Survey Museum, Pretoria.

The black and white photograph in Wagner (1929), with his caption reproduced verbatim. It is worth noting that the front left crystal is still in the "British Museum", not the Natural History Museum in London. It rests loosely on the soft brown gossanous matrix. Sadly, the other two specimens referred to as being in the Council for Geoscience collection in the now-Ditsong Museum (Geological Survey) were stolen during the 1970s.

A 4 mm sperrylite crystal in gossan matrix. This is an historic specimen collected during the 1920s from the outcrop at Tweefontein. The specimen measures 2.5 cm.

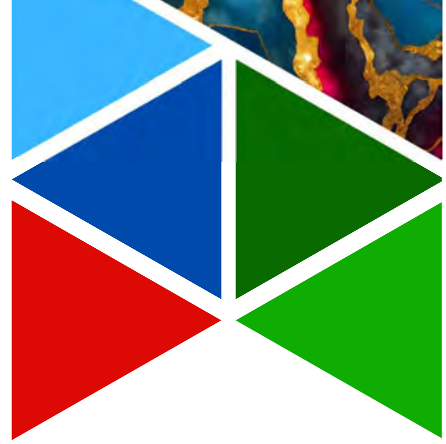
A fragmented 13 mm silver sperrylite crystal imbedded in limonite-malachite matrix.

Minsa invites its members (and their friends) to contribute submissions for our next issue of the Geode, for September 2024.

Submissions can be sent to minsa@gssa.org.za or to s.prevec@ru.ac.za and should reach us by August 31st 2024

For more info: minsa@gssa.org.za

INVITATION FOR SUBMISSIONS TO THE NEXT ISSUE OF THE GEODE



5th SOUTHERN AFRICAN MINERAL SYMPOSIUM 2024

SECOND CIRCULAR

A one-day symposium highlighting the minerals and mineral/gemstone deposits of southern Africa, hosted by the Mineralogical Association of South Africa.

Mineralogists, Scientists, Students, Enthusiasts.

MINSA
Mineralogical Association of South Africa
A division of the GSSA

IMPORTANT INFORMATION

Date:	Saturday 7th September 2024
Venue:	Origins Centre, University of the Witwatersrand, Johannesburg
Cost:	Early Bird rate: R200.00 payable on or before 30th June 2024. Thereafter R300.00
Dealer table:	R300.00 (see Dealer information)

PAYMENT OF REGISTRATION FEE

Payment should be made via electronic fund transfer (EFT) to the following account:

Account name:	Mineralogical Association of South Africa
Bank:	ABSA
Branch:	Clearwater Mall, Roodepoort
Account number:	21095311

IMPORTANT:

- All delegates attending the symposium are required to pay the registration fee.
- Use **MIN SYMP followed by your surname and initials as the reference** for the deposit.
- **PLEASE email proof of payment to minsa@gssa.org.za**
- Unfortunately, credit card payment facilities are not available.
- Cancellation policy: Full refunds of the registration fee will be made if cancellation is made before 9 August 2024. Any cancellations after this date receive no refund.
- Delegate's registration fee covers arrival coffee, morning and afternoon teas, lunch and symposium documents.

SPONSORS

SEDMIN C.C.

SYMPOSIUM VENUE

The symposium is being held at the Origins Centre, University of the Witwatersrand, Johannesburg. Please use Yale Road North or South entrance to gain access to East Campus. Ample secure and free parking is available in the Origins parking lot. https://www.wits.ac.za/maps/braamfontein-campus-east-/

The venue contains modern conference facilities with an auditorium equipped with screens, public address system, PowerPoint facilities and comfortable seating. Dealers will set up in the auditorium. Adjacent spaces will also serve as the venue for refreshments throughout the day.

FINAL CALL FOR PAPERS

Topics will cover minerals, mineral collectors & collections, aspects of mineralogy, micro mounts, travelogues to interesting mineral localities, and related topics. **Anyone still interested in presenting a talk must submit the title and brief description (one paragraph) to Bruce Cairncross by 5 July 2024.** Should the proposed presentation be accepted, the speaker will be notified and the extended abstract (template attached) must be completed and submitted before 31 July 2024. All proposed presentations will be reviewed by the organising committee regarding their suitability for the symposium theme.

INSTRUCTION TO SPEAKERS

SPEAKER ARE ALLOCATED 20 MINUTES FOR THE PRESENTATION AND 5 MINUTES FOR QUESTIONS
(Time slots still to be determined)

ABSTRACT SUBMISSION

Each presenter is required to submit an abstract of their presentation. Speakers must please adhere to the specifications listed below for the formatting of the abstract. Abstracts submitted in formats and/ or styles other than that prescribed will be returned to the speaker to be corrected.

REGISTRATION FORM FOR SPEAKERS & DEALERS

(If you have already registered via the First Circular, you do not have to repeat the registration form again. Payment will be due as per instructions in this Second Circular)

I will attend the 5th Southern African Mineral Symposium, 7th September 2024.

Surname	
First Name(s)	
Postal Address 1	
Postal Code	
Email	
Tel. Landline	
Tel. Cell	

Please mark that which is applicable:

	I am a dealer (no assistant)
	I am a dealer and will bring an assistant/s
	I will be presenting a talk

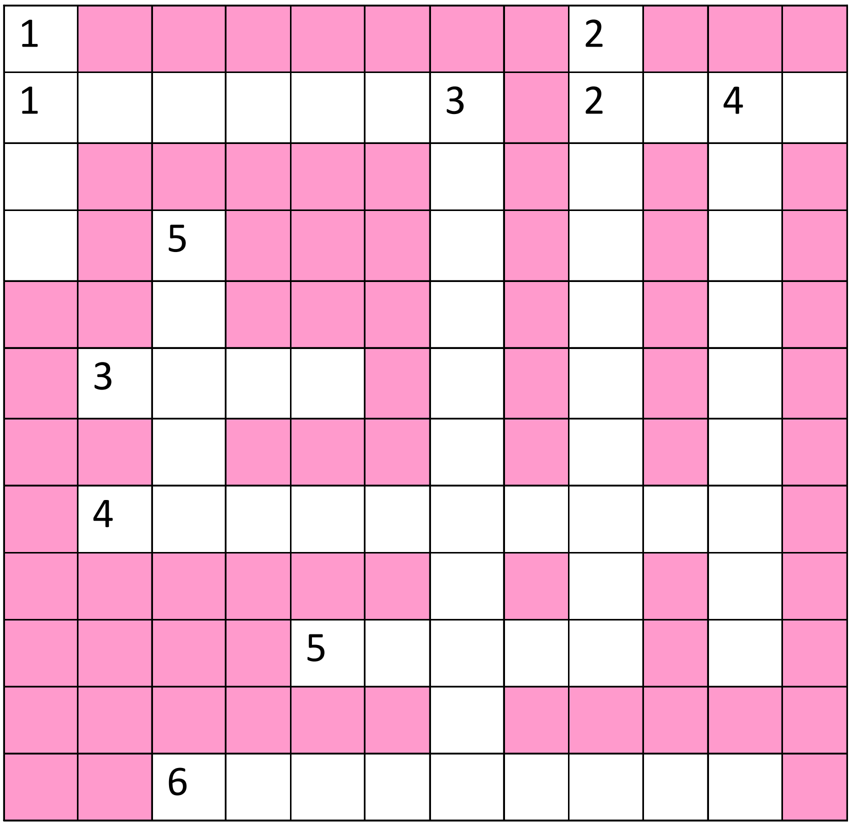
For those presenting a talk please provide the following:

1. Title of Presentation	
2. Please attach a summary of the proposed talk	

*** Email this form to brucec@uj.ac.za ***

Minsa Crossword for June 2024

The theme for this crossword is minerals containing lithium, and the mining thereof. In keeping with the annual theme of the society relating to 'minerals and energy', lithium is an important critical element in today's world.



ACROSS:

1. The name of the South American desert which hosts the world's largest reserves of Li, in the form of giant evaporite deposits.
2. The colour and/or variety of quartz often found associated with Li-rich pegmatites, although the colour in this case is evidently the result of Ti, Fe or Mn impurities (or possible dumortierite fibres).
3. The colour most commonly associated with Li-rich minerals, although by no means universally so.
4. The main Li-bearing phyllosilicate mineral, found in granitic pegmatites associated with 4 Down, it is also the primary source for rubidium.
5. The nation which produces more than a quarter of the world's current Li production, 80-90% of which resides in the deposits from 1 Across. (Most of the rest of current production comes from Australia and China).
6. Arguably the main current industrial application of Li as a Critical Element, its invention and commercialisation for this purpose (beloved of many current South Africans in particular) resulted in a Nobel Prize in Chemistry in 2019.

DOWN:

1. The ionic compound forming in evaporitic flats which comprise most of the world's economic deposits of Li, as found in Australia and 5 Across, in particular.
2. A Li-Fe phosphate mineral with an olivine structure, it is found as crystalline masses in phosphatic pegmatites. It is reported from deposits in southern Namibia and Madagascar (but surprisingly not from Phalaborwa, it seems).
3. A Li-fluorophosphate mineral found in granitic pegmatites and resembles alkali feldspar, containing up to 10 wt.% Li, making it a prospective ore mineral. It is mined from deposits in California (U.S.A.) and from south central France in particular.
4. The primary ore mineral of Li, this pyroxene is mined from Li-Ce-Ta (LCT) pegmatites, mainly from Western Australia. The largest known reserve of such deposits is from the southeastern DRC, at the Manono-Kitolo Mine, formerly extracting Sn-Co-Ta (coltan) from 1915-1980s, and Li since 2018.
5. The name for concentrated (up to 26 wt.% salinity) aqueous solutions, such as those into which Li and alkali metals may be dissolved and economically extracted, hosted in closed basins.

Minsa Crossword solutions for March 2024

The theme for this crossword was pseudomorphic minerals.

1 O										
1 S	E	R	P	E	N	2 T	I	N	E	
U						R				3 C
2 M	A	R	4 C	A	S	I	T	E		O
I			H			D				V
L			L		3 P	Y	R	I	T	E
I			O			M				L
T			R			I				L
E			I			T				I
	4 R	U	T	I	L	E				T
			E							E

ACROSS:

1. The phyllosilicate mineral group that replaces olivine at high temperatures. In fact, this mineral group is sufficiently stable to carry water 200 km deep into the mantle (in subducted slabs).
2. This iron sulphide mineral is the much rarer polymorph of 3-across, and crystallises from acidic solutions (pH<5). It is then typically replaced by more stable 3-across later on.
3. This mineral is the most abundant sulphide mineral on Earth, and often pseudomorphs earlier sulphides such as pyrrhotite. It can itself be pseudomorphed by lower temperature phases such as limonite.
4. The stable titanium oxide, it commonly replaces its less stable polymorph, brookite.

DOWN:

1. This rare member of the milarite group of cyclosilicate mineral equilibrates to a mixture of alkali feldspar, cordierite and orthopyroxene in granulite facies metapelites, including those found in western Namaqualand.
2. This triclinic silica polymorph exists only as a hexagonal pseudomorph, either prograde after alpha-quartz, or retrograde after its own beta version.
3. This rare copper sulphide mineral forms as both paramorphic replacements and as epimorphic coatings of higher temperature (primary?) sulphide minerals in supergene settings.
4. This phyllosilicate mineral group often pseudomorphically replaces garnet as a result of decompression metamorphism in the greenschist facies.

Cover images: Upper right: nodular 'anorthosite' (leucogabbronite), East Bull Lake intrusion, Canada. Lower left background: spinel rods exsolved from plagioclase feldspar in coronitic gabbros, Labrador, Canada. All images c/o S. Prevec.

Contributions for the next issue of the Minsa Geode invited for submission before August 31, 2024 (see also pg. 20).