The Diverse Mineral Deposits of Namibia's Damara Orogenic Belt: Insights from SEGF Ronald E. Seavoy Student Field Trip Excursion



GSZ Summer Symposium_2026, Harare, Zimbabwe

Godfrey S. Chagondah (PhD)
University of Zimbabwe, Department of Chemistry & Earth Sciences, Harare

Talk Format

- Introduction to SEGF Ronald E. Seavoy Student Field Trips.
- Assembly & tectonic evolution of the Damara Belt.
- Metallogeny of the Damara Belt.
- Field excursion on selected sites.
- Take-Aways.

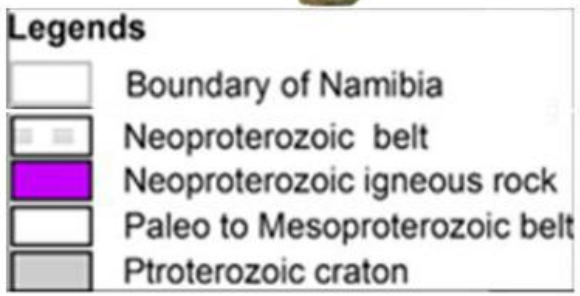
Introduction to SEGF Ronald E. Seavoy Student Field Trips

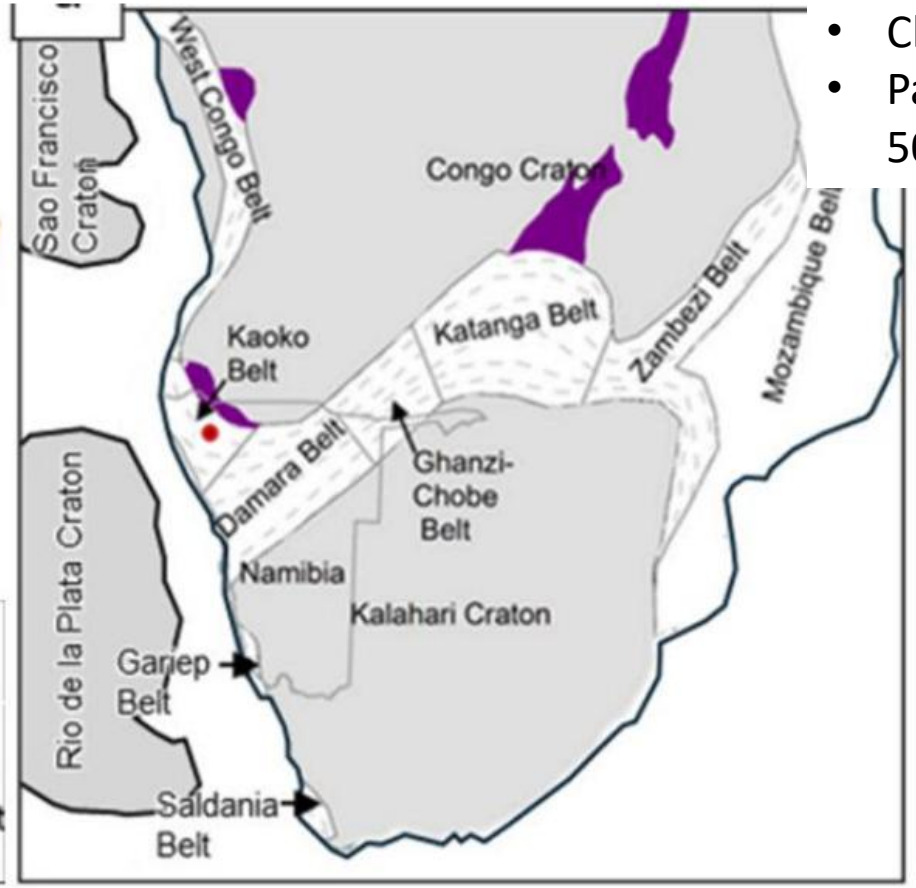
- Ronald E. Seavoy Student 2026 *Field* Trips are organized by the Society of Economic Geologists Foundation (SEGF). SEG was founded on 28 December 1920, by 60 distinguished professionals.
- Ronald E. Seavoy (1931-1920), exceptional, hard working, passionate geologist & long time member of SEG.
- Ronald was attentive in recording key attributes in the field that would benefit the viewer in the future… a key attribute of a good geologist.
- SEGF provides funding & subsidize student participation to impactful field trips to globally important mining districts, started in 2006.
- A global selection of 18 post-graduate students, mentors and trip leaders participated in the Damara trip.
- The program was undertaken from April 7–19, 2026, focusing on the mineral wealth and ore deposits in the Damara Orogenic Belt in Namibia.
- The aim of the trip; to provide students with a first-hand appreciation of the geology, ore formation, mining methods and metal recovery processes in operational, developmental and exploration stage projects.
- This talk shares with you the Damara field excursion experience, with aim of motivating geologists of various generations to be part of the SEG global community and access to SEG Timothy Nutt Funds for Zim geology students in tertiary instructions.

Assembly & Tectonic Evolution of the Damara Belt

Namibian geology is composed of the Proterozoic MC, Neoproterozoic Damara Supergroup (Laukamp, 2006; Miller, 2008; Webb, 2012).



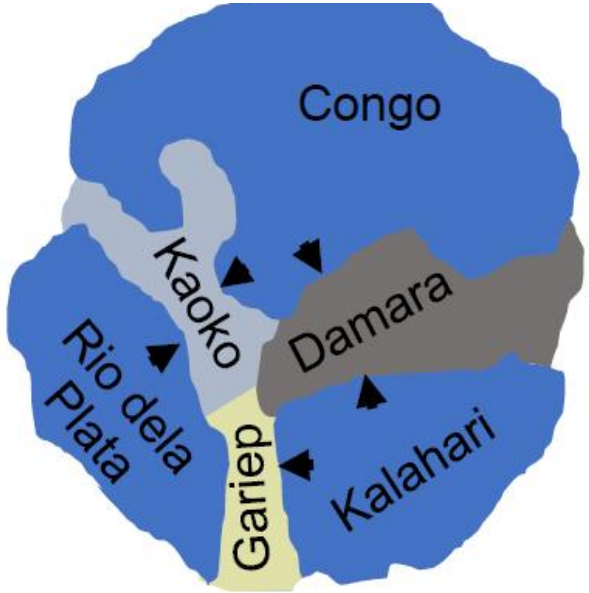




(Hoffmann and Prave, 1996; Gray et al., 2006; Miller, 2008).

- Rifting of KC & Congo Craton, breaking up of the Rodinia continent: 870-700 Ma
- Damara Supergroup deposition of thick sediments: 700-555 Ma.
- Closure of the Khomas Ocean: 555-550 Ma
- Pan African Orogeny & peak metamorphism (580-500 Ma): assembly of Gondwana Supercontinent.

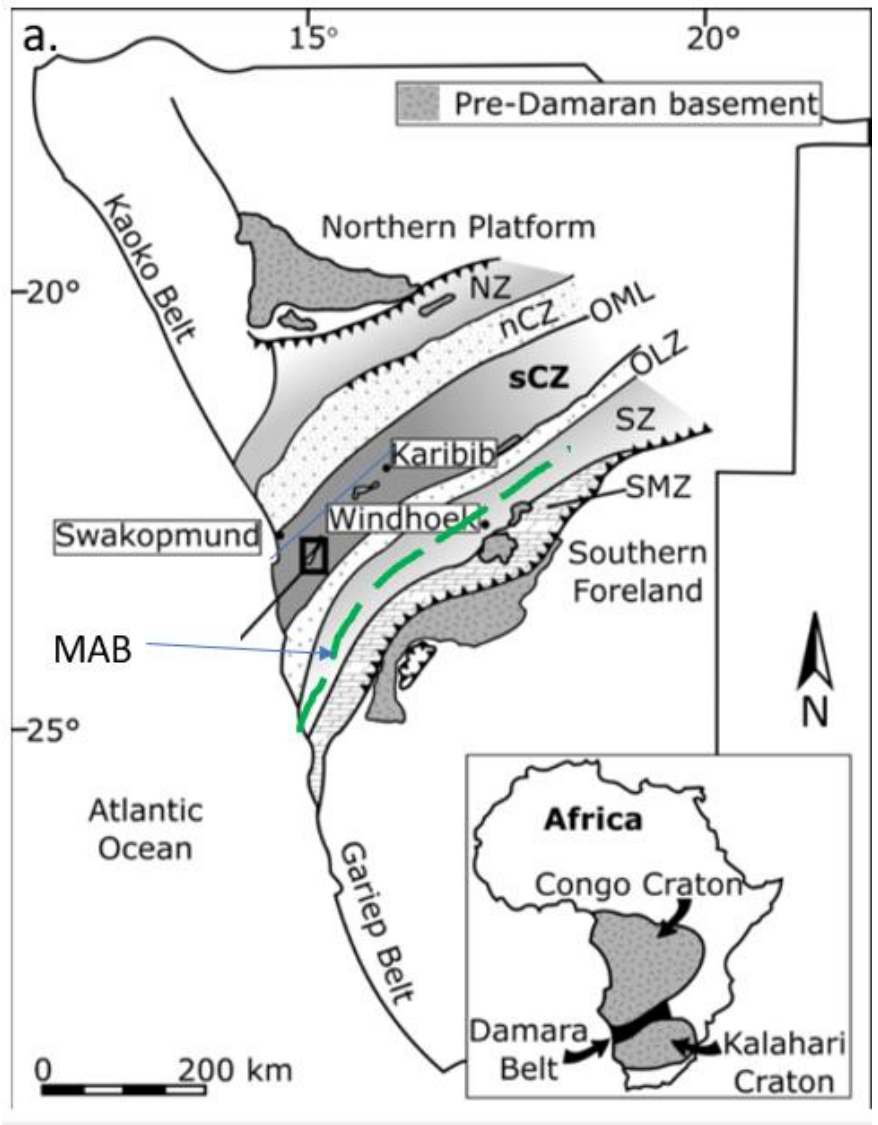
- D1: 645- 580 Ma
- D2 - D3: 580- 540 Ma
- D4: 535-505 Ma



- **Collisional Tripple Junction:**

2 coastal belts & an inland belt.

Tectonostratigraphic Zones of the Damara Belt

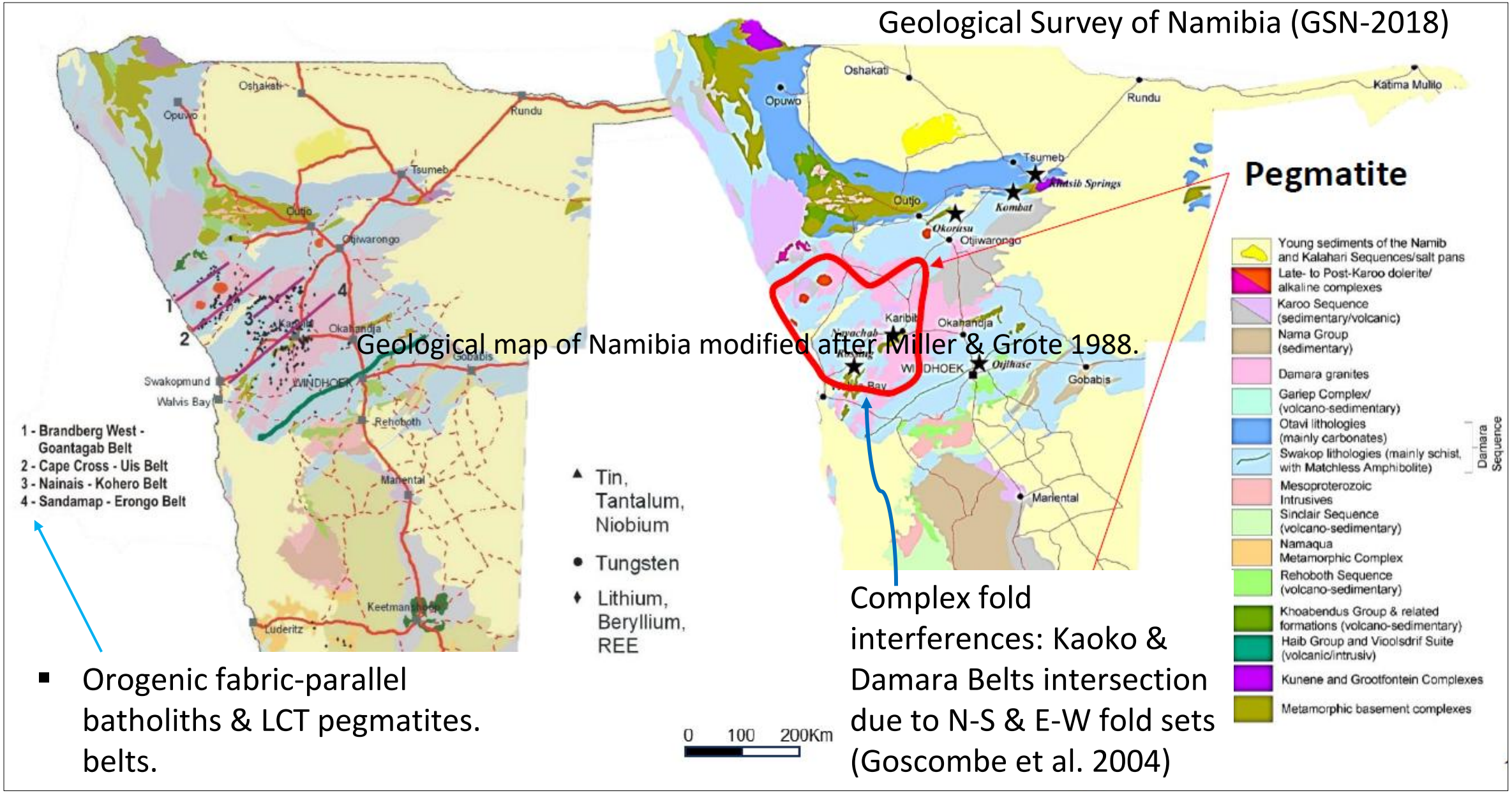


MAB = Matchless Amphibolite Belt.

- Pronounced structural zonation & metamorphic grade variations.
- NMZ = marks transition between the CC & Damara Supergroup sediments. Greenschist-lower amphibolite facies). Hosts significant stratabound **Cu-Pb-Zn** deposits hosted within the Otavi Group carbonates.
- NZ = Northern Zone, low-grade meta., greenschist facies. Base metals & graphite mineralization.
- CZ = Central Zone, granite intrusions dominated, elongated NW trending basement cored domes & basins, amphibolite-granulite migmatites (Maberg, 2000).
- SZ- Southern Zone; intermediate P-T conditions, ca. 600 °C at ~10 kbar: Amphibolite facies. Less granitoid intrusions compared to CZ.
- SMZ = Southern Marginal Zone, southernmost collisional, interface above the KC; greenschist-amphibolite grade.
- High-grade meta. & a complex deformation history (Gray et al. 2006).
- Widespread syn-late kinematic S-type granitoids: 534 – 513 Ma (Foster et al., 2015).

Metallogeny of the Damara Belt

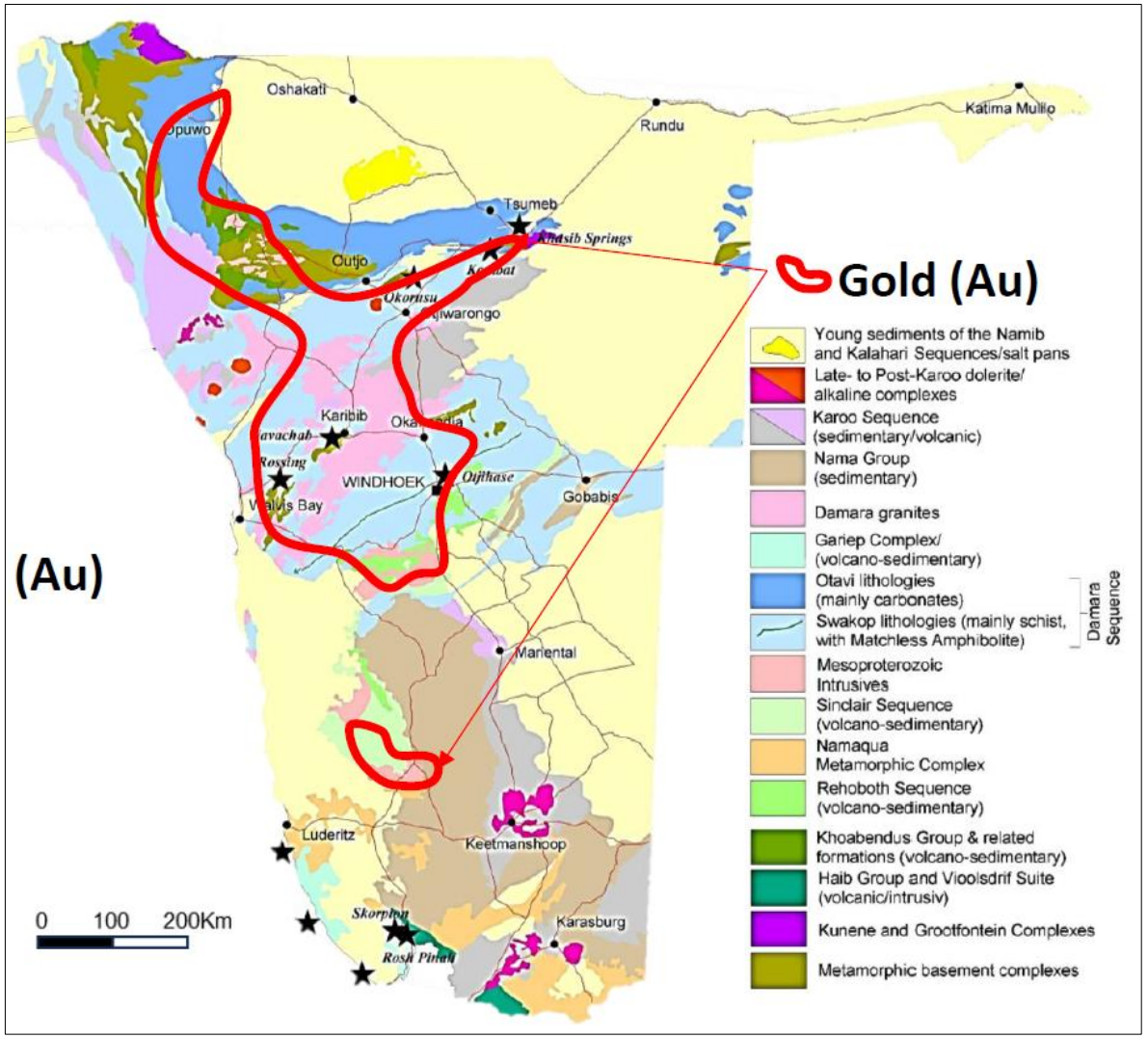
Pegmatite Belts endowment : Sn, Ta, Nb, Li, Rb, W

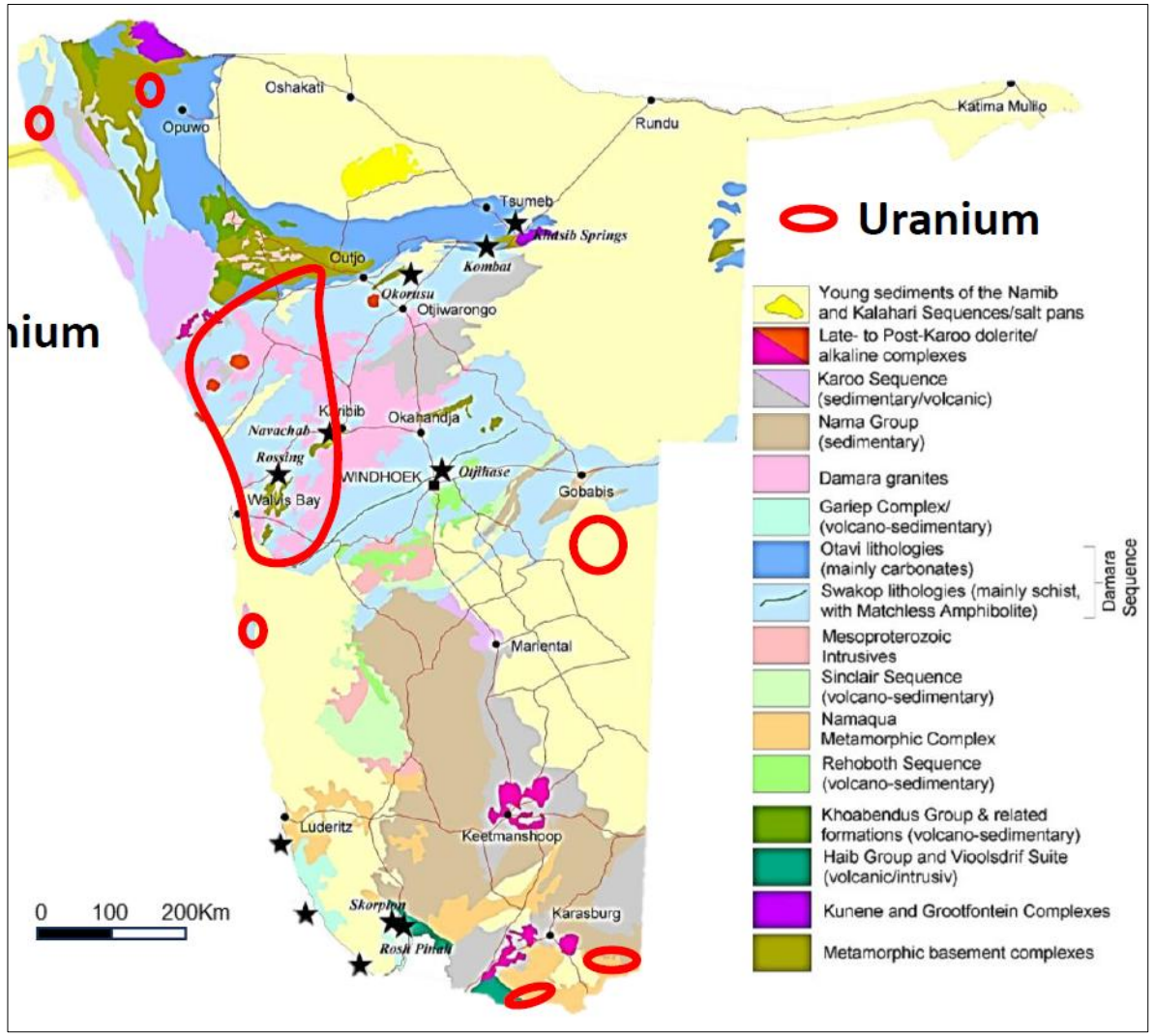


- Orogenic fabric-parallel batholiths & LCT pegmatites. belts.

Complex fold interferences: Kaoko & Damara Belts intersection due to N-S & E-W fold sets (Goscombe et al. 2004)

Metallogeny of the Damara Belt…cont.

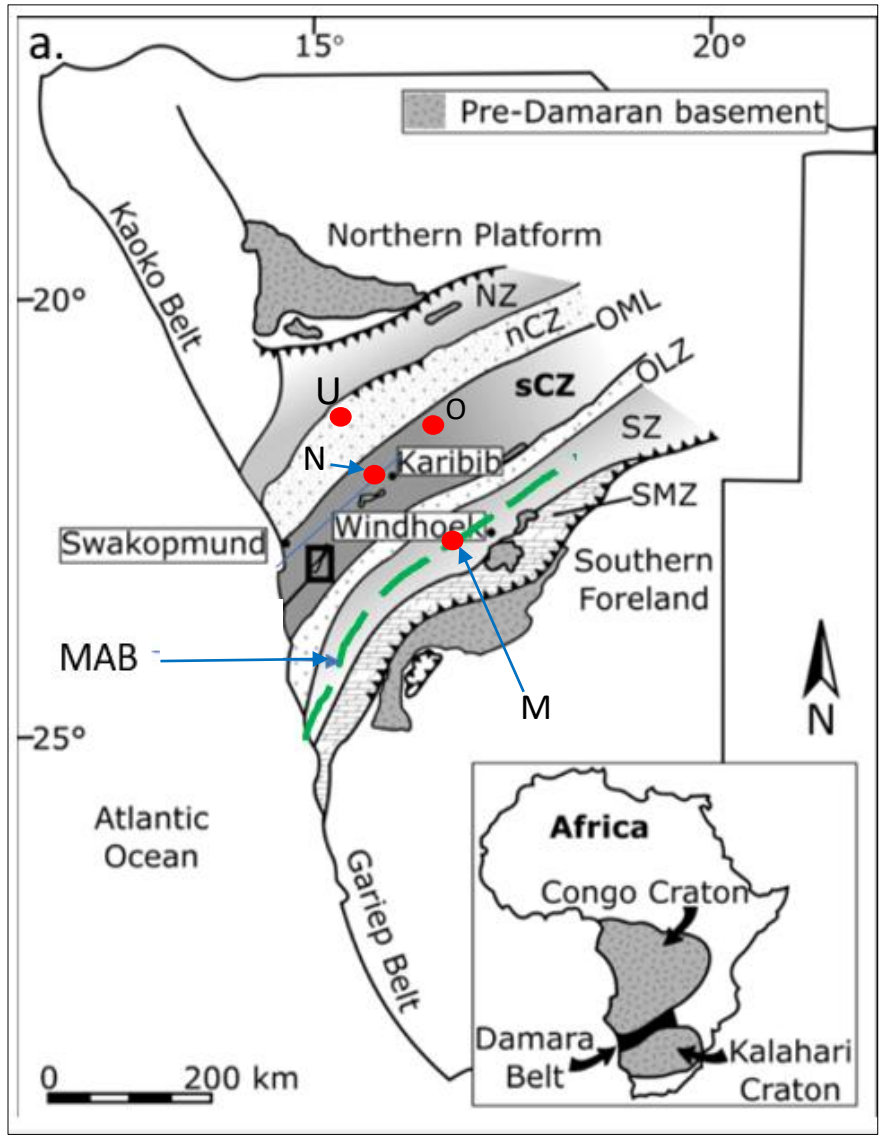




Geological Survey of Namibia (GSN-2018)

Is granite magmatism, Au, U & Rare metals mineralization linked to the Triple junction?

VMS Deposit: Matchless mine



(Gray et al., 2006).

- MAB: deposit related rifting (700-650 Ma)
- MAB is ca. .5 to 3 km wide body of Amphibolite Belt
- Located in the SZ sequence contains the MORB affinity rocks (Matchless Amphibolite Belt, MAB) Cu-Zn-Au mineralization (Foster & Goscombe, 2013).
- Cu-Zn-Au mineralization massive sulphide deposits (e.g., Matcless & Otjihase mines).

Projects:
M: Matchless Mine
N: Navachab
O: Ondundu
U: Uis

VMS Project: Matchless mine



- Mineralization, structurally controlled: follows lineament (Amphibolite Belt) , with evident folding.
- In Core: sulphides enrichment associated with carbon/graphitic zones.

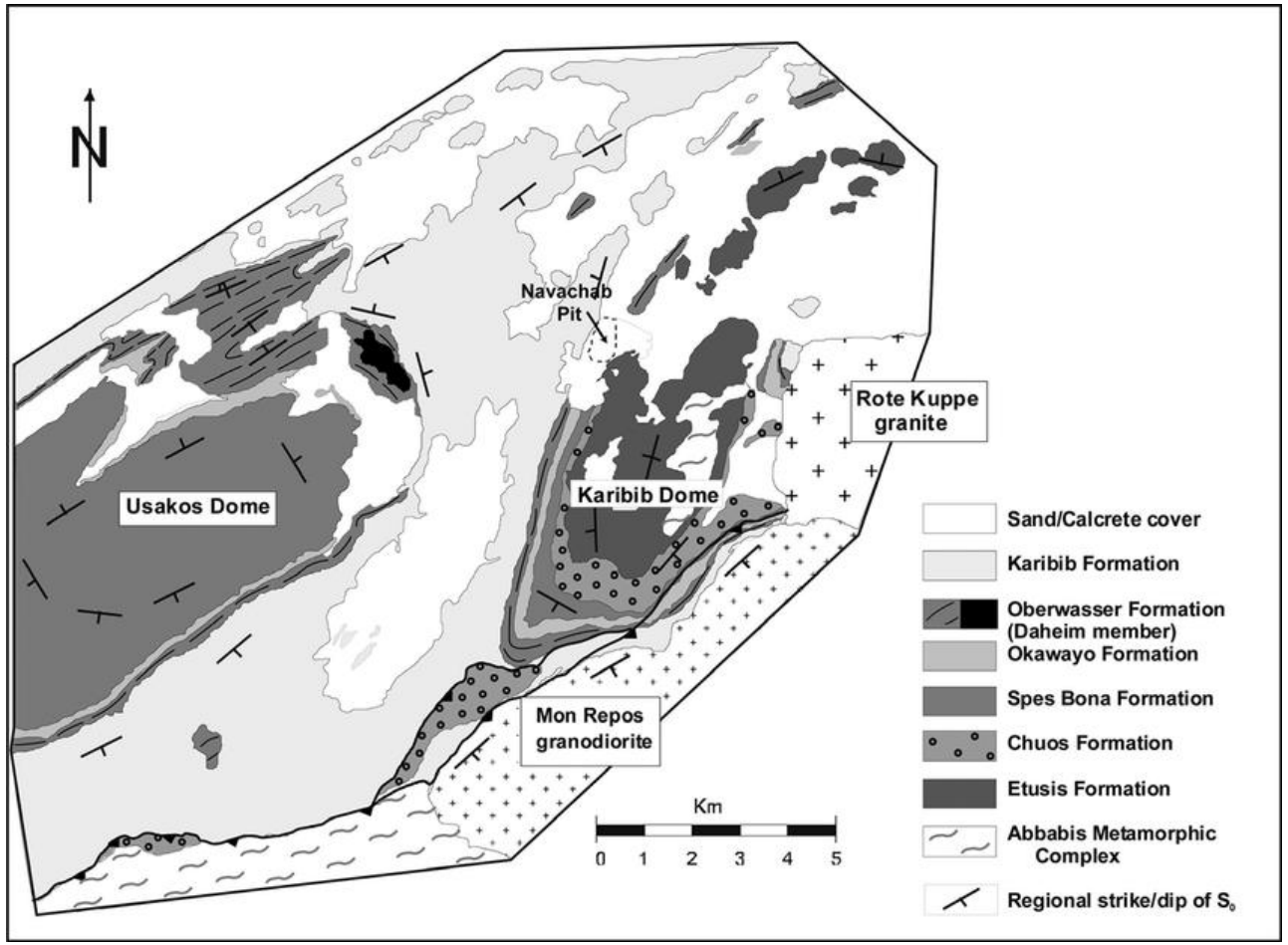


- Source of carbon: Igneous or sedimentary origin?

- Gossans notable with malachite staining.

Navachab Gold Mine

Controlled by dome-and-basin folding patterns.



(after Kisters et al., 2014).

- **Karibib Dome & Usakos Dome/anticlines:** Major NE-trending regional domal structures separated by the Karibib Syncline.

- The Navachab deposit, on the steep- to subvertical NW limb of the doubly-plunging anticline: the **Karibib Dome**.

- Au mineralization hosted in metasediments (marbles, biotite schist & Calc silicates).
- Quartz veins form during the lock-up phase of folding events.

- Au mineralization elevated along anticlines; transfer of auriferous fluids & locked in domal structures.

Ore reserves as at 31 December, 2011 (Anglogold Ashanti, 2012)
Proved reserve - 6.31 Mt @ 1.09 g/t Au,
Probable reserve - 44.18 Mt @ 1.29 g/t Au,
Total reserve - 50.49 Mt @ 1.26 g/t Au, for 63.76 t of Au

Gold Projects

Navachab Gold Mine, Karibib: hosted in the CZ.



- Fold & thrust Damara Belt: hosts orogenic gold deposits.



- Osimo, Ondandind: Twin Hills Expl oration Project: 3.1 Moz @1.1g/t

Osmio Gold Exploration Project, NW of Ondundu



Historical workings

- Orogenic gold mineralization
- Gold mineralization associated with shear zones.
- Folded domains: thickened fold hinges, tension gashes exploited by hydrothermal fluids.
- Along strike: flexures (fold & inflexition zones) associated with high gold tenor: are extensively worked.

- Across the Damara Belt: hydrothermal Au mineralization was emplaced during the extensional & compressional-collision phases of the orogenic evolution (Pirajno & Jacob, 1991).

Zim analogy

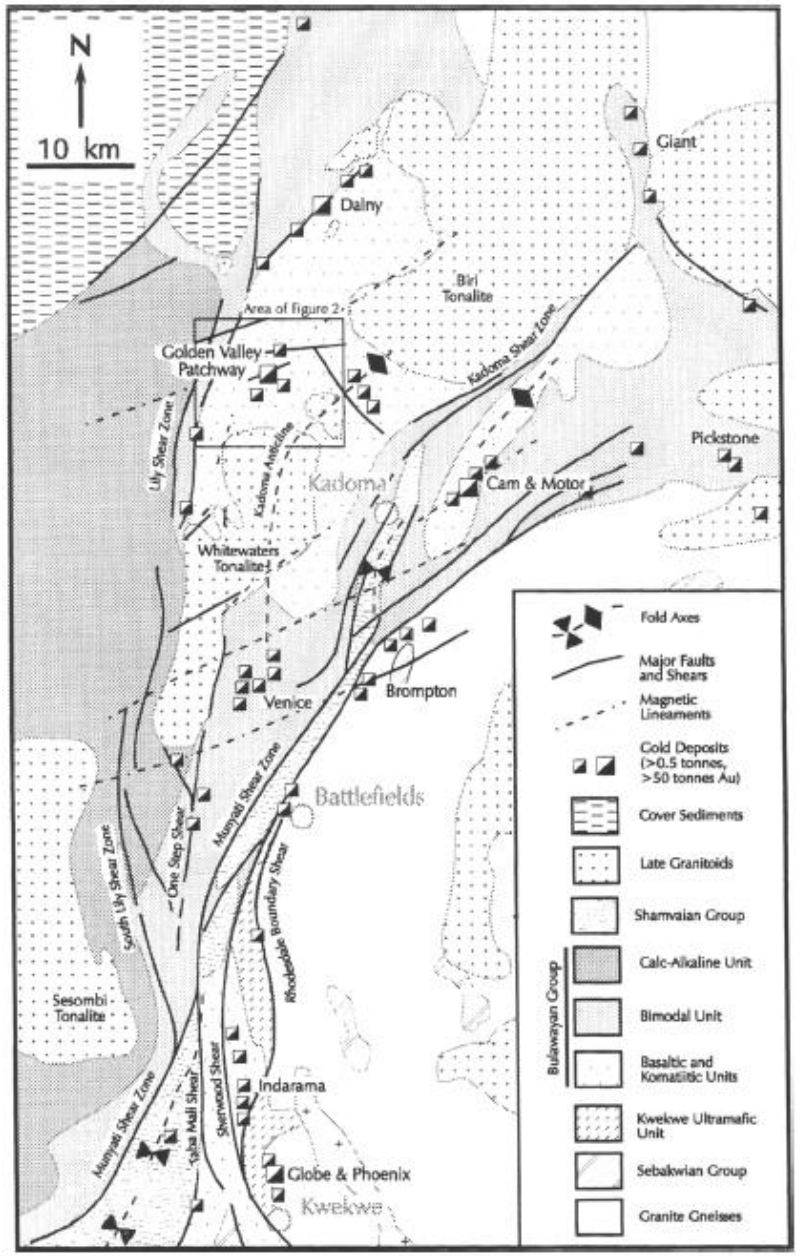
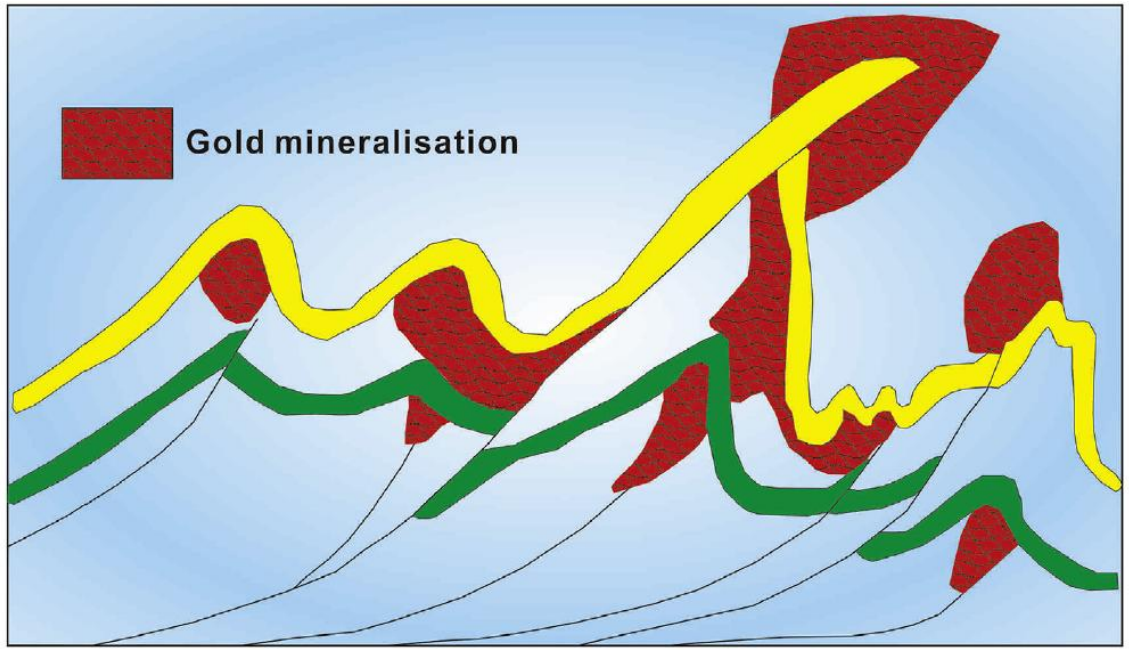


Fig. 2. Regional geological map & distribution of orogenic gold deposits in the Midlands Greenstone Belt (Herrington, 1995).

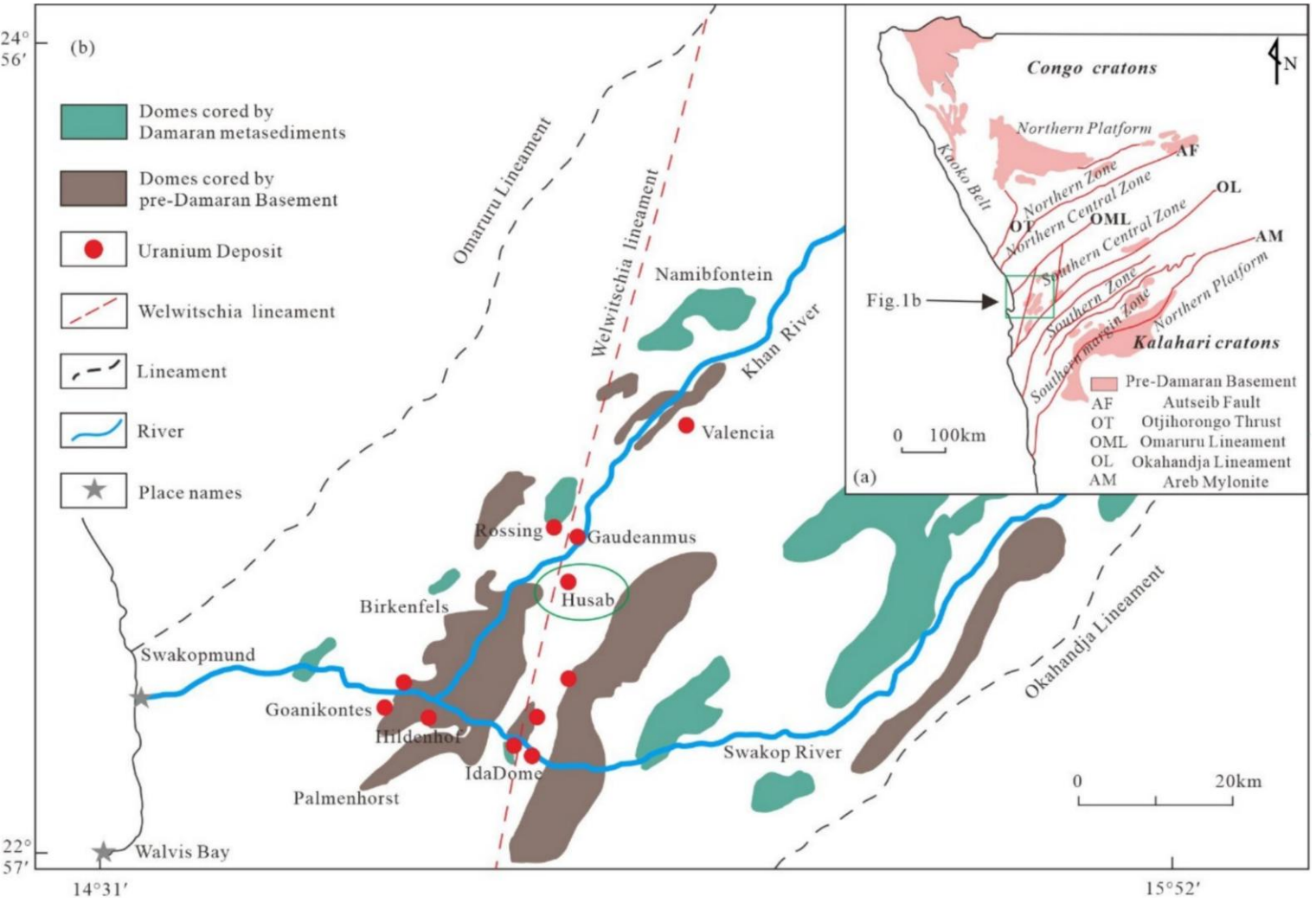
- 1st order crustal- to lithospheric-scale faults and shear zones such as Munyati & Sherwood generally lack economic gold deposits.
- Au mineralization is structurally controlled & occurs in higher order structures.

✓ mineralised anticlinorium (Schematic diagram: Groves et al., 2018).



✓ Au mineralization is predicted to be along fold hinges e.g., in the Kadoma Anticline @ Venice Mine and the Eiffel Flats anticline.

Uranium



- Rossing-type uranium deposits e.g., Rossing, Husab (U-Th-Pb LA-ICP-Ms age of 500 Ma: Xu et al. 2025).
- Hosted in alaskite granites intruded into meta-sedimentary rocks.
- Formed during the late –tectonic to post-orogenic magmatic events. (Ashworth et al., 2020).
- U enrichment via magmatic, hydrothermal & leaching processes (Xu et al., 2025).

Fig. Domes of the sCZ of Damara Belt and their associated primary uranium deposit.
(a) Zonation of the Damara orogen Belt (modified after Goscombe et al., 2005;
(b) Locations of significant uranium deposits in the sCZ (Kinnaird et al., 2007).

Uranium Projects

Bannerman advanced Uraniium Exploration Project, last visit





- S-type granitic magmas intrusive concordantly & disconcordantly into the metasedimentary sequences.

- Uranium mineralization hosted in sheeted granite intrusions (alaskites).
- Grey quartz zones contain elevated grades of uranium.

Rare metals Projects: Karibib & Uis fields

Overview lecture on LCT pegmatites



LCT pegmatites of Cerny & Ercit, 2005

- Residual melts of late- to post tectonic S-type granites (Chappell & White, 2001) or products of direct anatexis of meta-sedimentary rocks.
- Enrichment in volatile components: Li, Rb, F, P, B, H2O (London & Morgan, 2012)
- For efficient fractionation & concentration of incompatible trace elements: Sn-Ta-Li-Rb-Ti-Be to form deposits at upper crustal levels.
- Trace elements sourced from breakdown of weathered micas, hornblende & ilmenite in metapelites (e.g., Romer & Kroner, 2016; Ashworth et al. 2020).

- Note: LCT pegmatites also form from extended fractional crystallization of I-type granites (Chagondah, 2022; Chagondah et al, 2023; Cerny & Ercit, 2005).

Source of melts:

1.Fractional crystallization of model.

2. Anatectic melting model.

Uis: Sn-Ta-W-Li Pegmatites



- Rare-metal & REE pegmatites in the CZ (Ashworth et al., 2020).
- LCT type pegmatites of Cerny & Ercit, 2005.
- Exhibit mineralogical & textural zonation.
- Enriched in Sn (cassiterite) and Li (spodumene & lepidolite).

- Granite related Sn-W deposits e.g., Uis, Bransberg West (Pirajno & Jacob, 1987).





Geo-tourism: Swakopmund



- Ca. 500 – 2 ,000 years old, *Welwitschia mirabilis plant species,* east of Swakopmund, National heritage.



- **Moon Valley**….popular film shooting site near Husab Mine.
- Deeply eroded valleys of the Swakop River.
- Shoot films: Mad Max: Fury Road (2015), The Mummy (2017), string Tom Cruise.



- Swakopmund beaches, off Atlantic Ocean.

Let the comrades eat ...





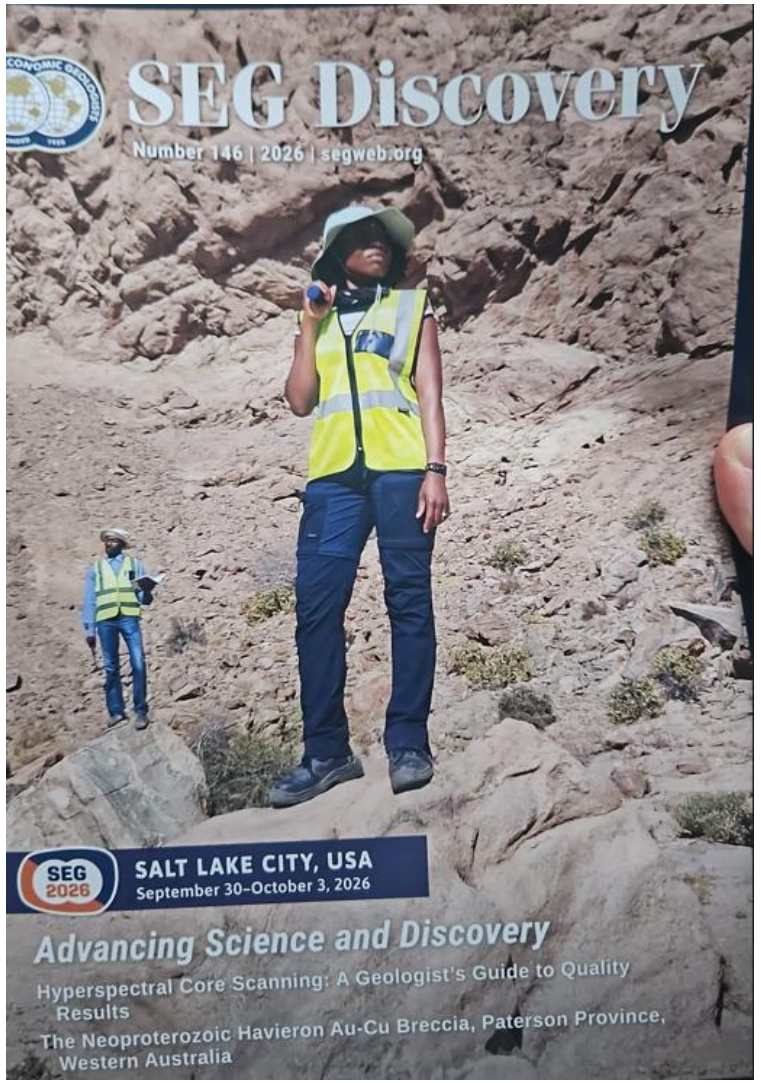
Please pay for your drinks

19:33

Tomorrow morning, we will take breakfast in Uis before we go to the mine. We will leave here at 6 am. So loading at 5:45 am. Please be on time

Presentation of participation certificates





From the SFT organizing committee….

Thank you all for your interest and enthusiasm for this program. When it started in 2006, we had a dream - your experience makes it come true.

Please report back to us with your appraisal, suggestions and feedback.

And please keep supporting SEG!

Take-Aways

- First-hand appreciation of large-scale geological processes: sedimentation, tectono-magmatic events in continental crust assembly & ore formation processes in the Damara Orogenic Belt.
- Appreciation of best practice in safety protocols, mining methods & metal recovery processes.
- Geology, metal budget of source (enriched Archean basements?) & structure are important controls in mineralization.
- SEG trips & conferences are important for networking & cross pollination of ideas within the global geology community.
- For optimal performance, geologists should be good time-keepers; combine work & fun AND should not forget to pay for their drinks!

Acknowledgements







