Updated stratigraphic framework for magnetite deposits in the Gawler Craton

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Matthew Peacock, Ed Lynch (OneSteel)
Dwayne Povey (Peak Iron Mines)
Jonathon Trewartha, Shane O'Connell (Lincoln Minerals)

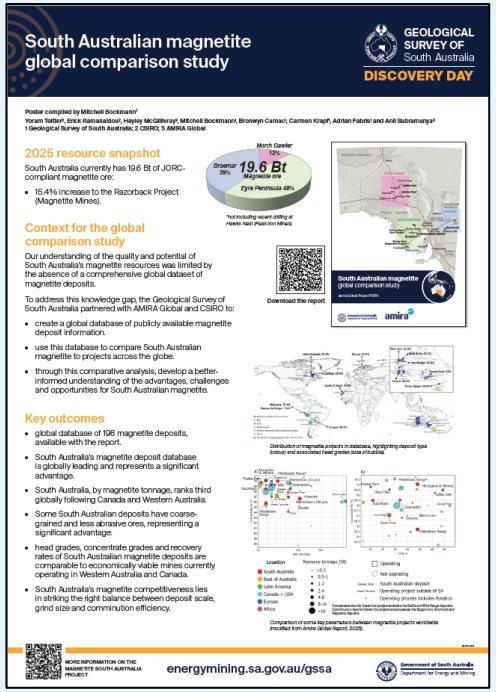
GEOLOGICAL SURVEY OF South Australia

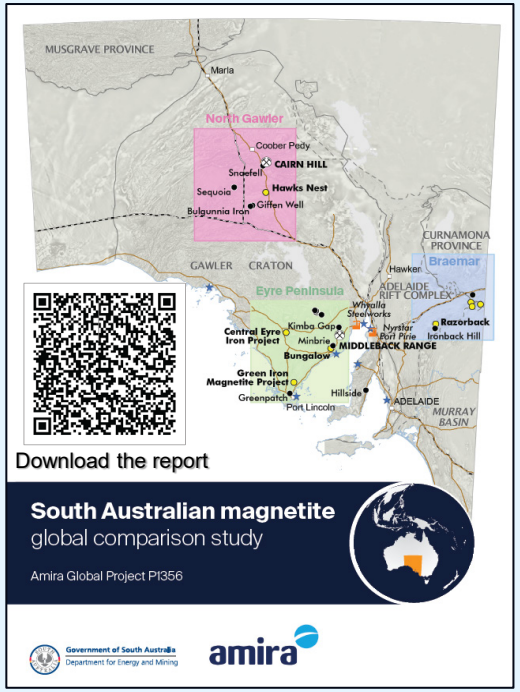
DISCOVERY DAY

Magnetite South Australia Project

Magnetite global comparison study

Comparison of South Australian magnetite resources to global projects to understand our advantages, challenges and opportunities for SA

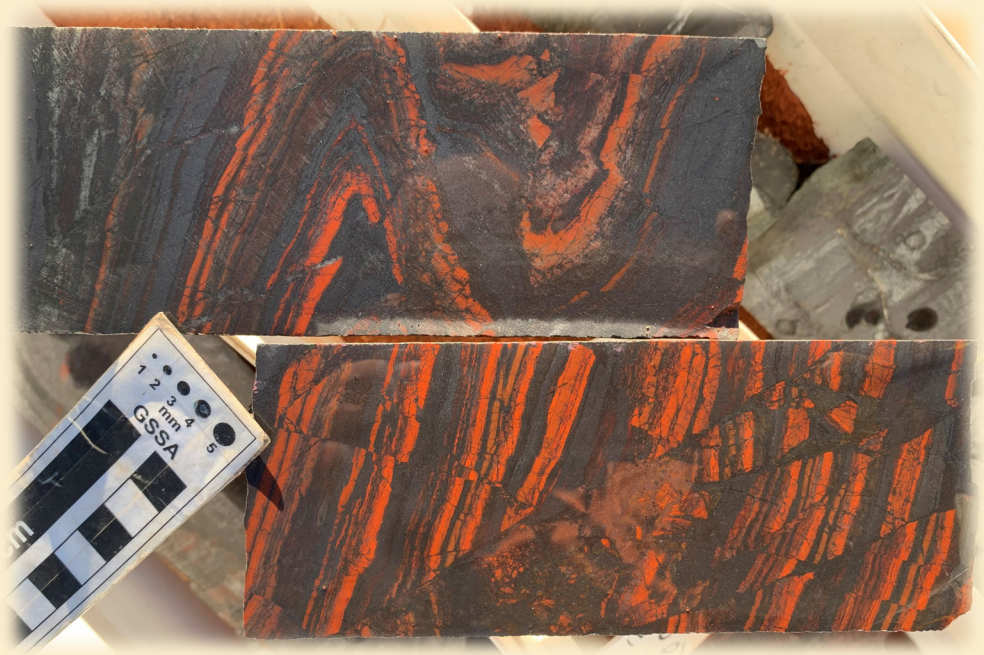




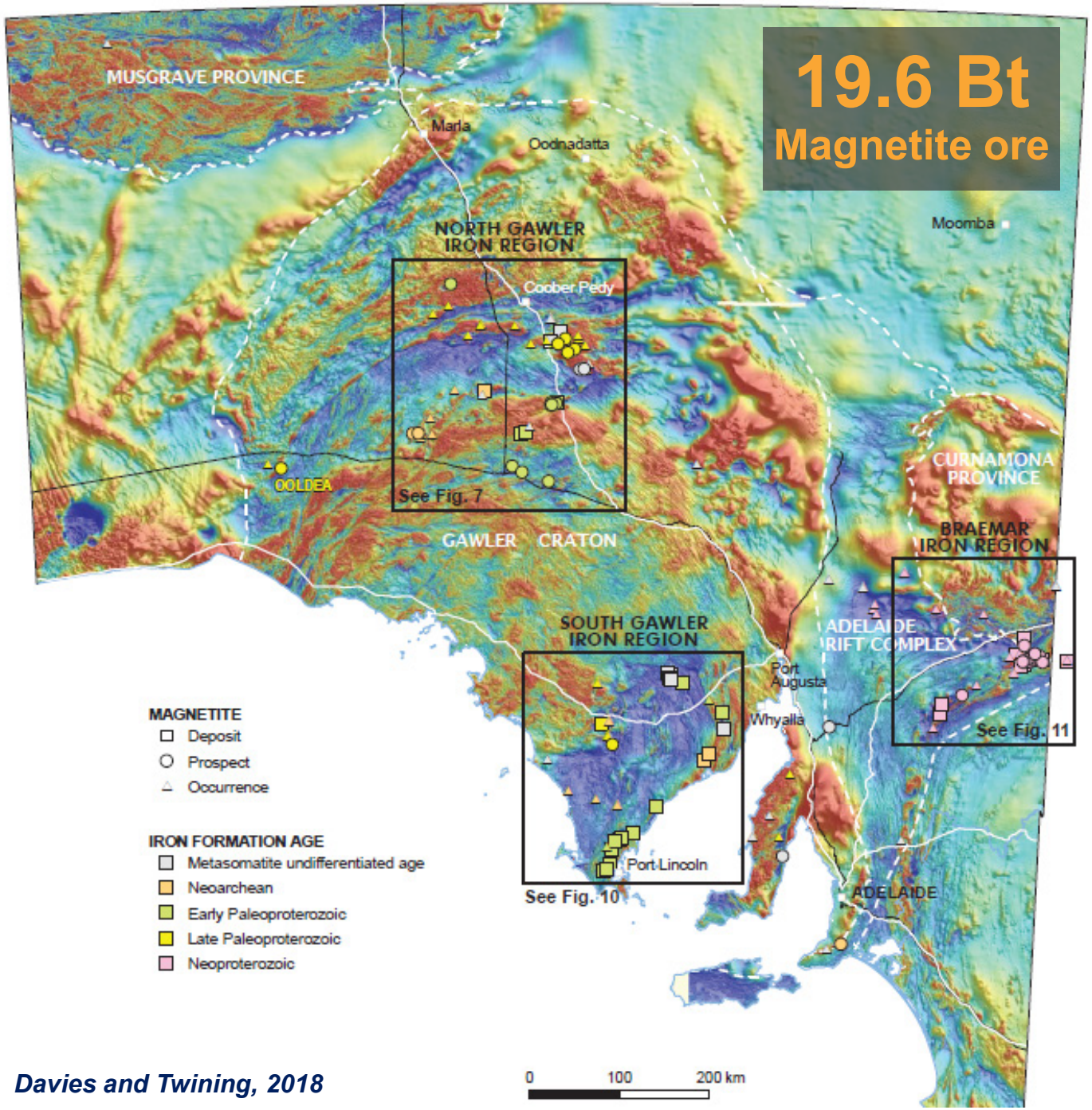
See poster in foyer

Follow-up geological studies

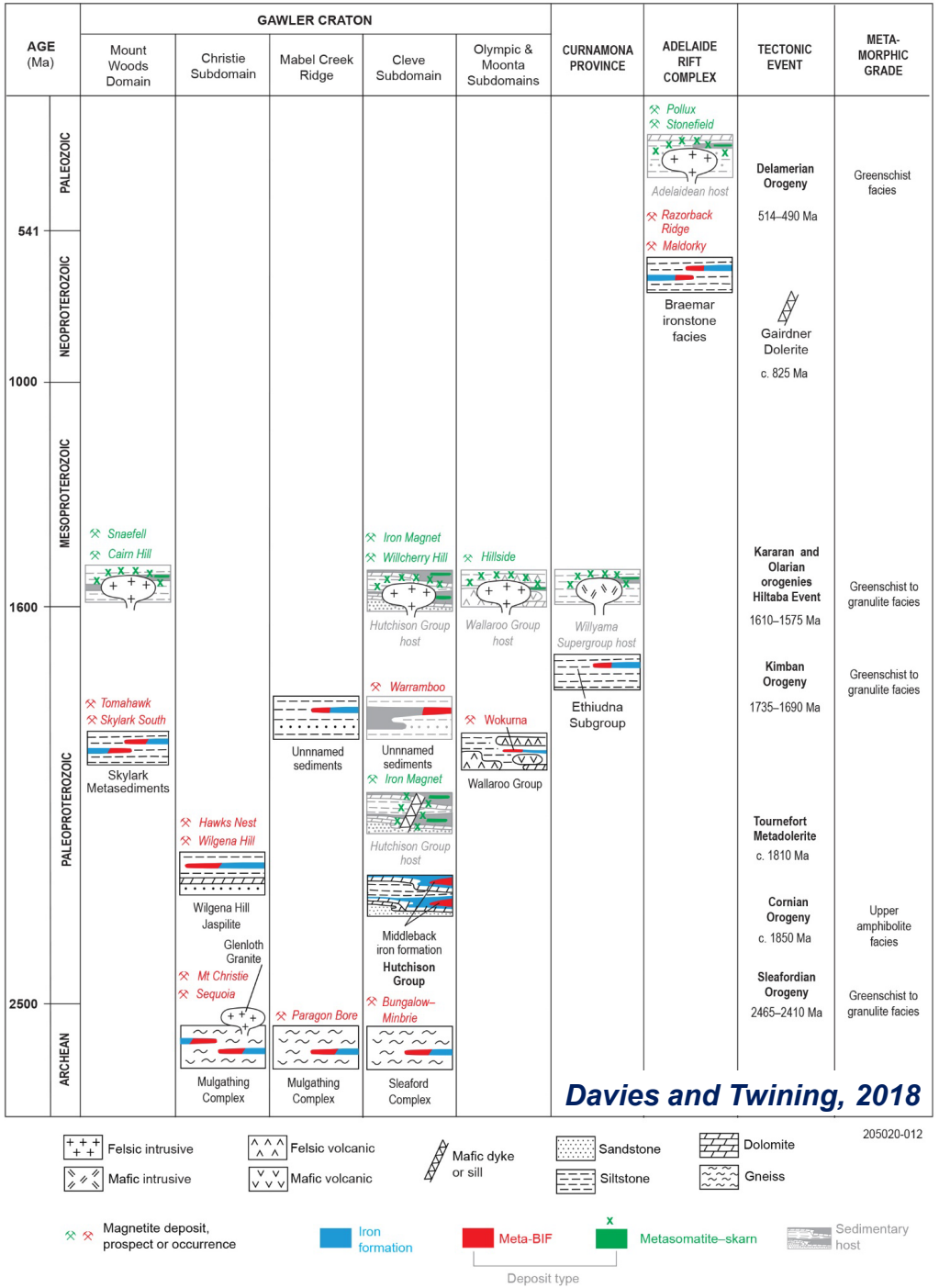
Identify gaps in knowledge on our magnetite deposits and investigate the geological controls on magnetite characteristics

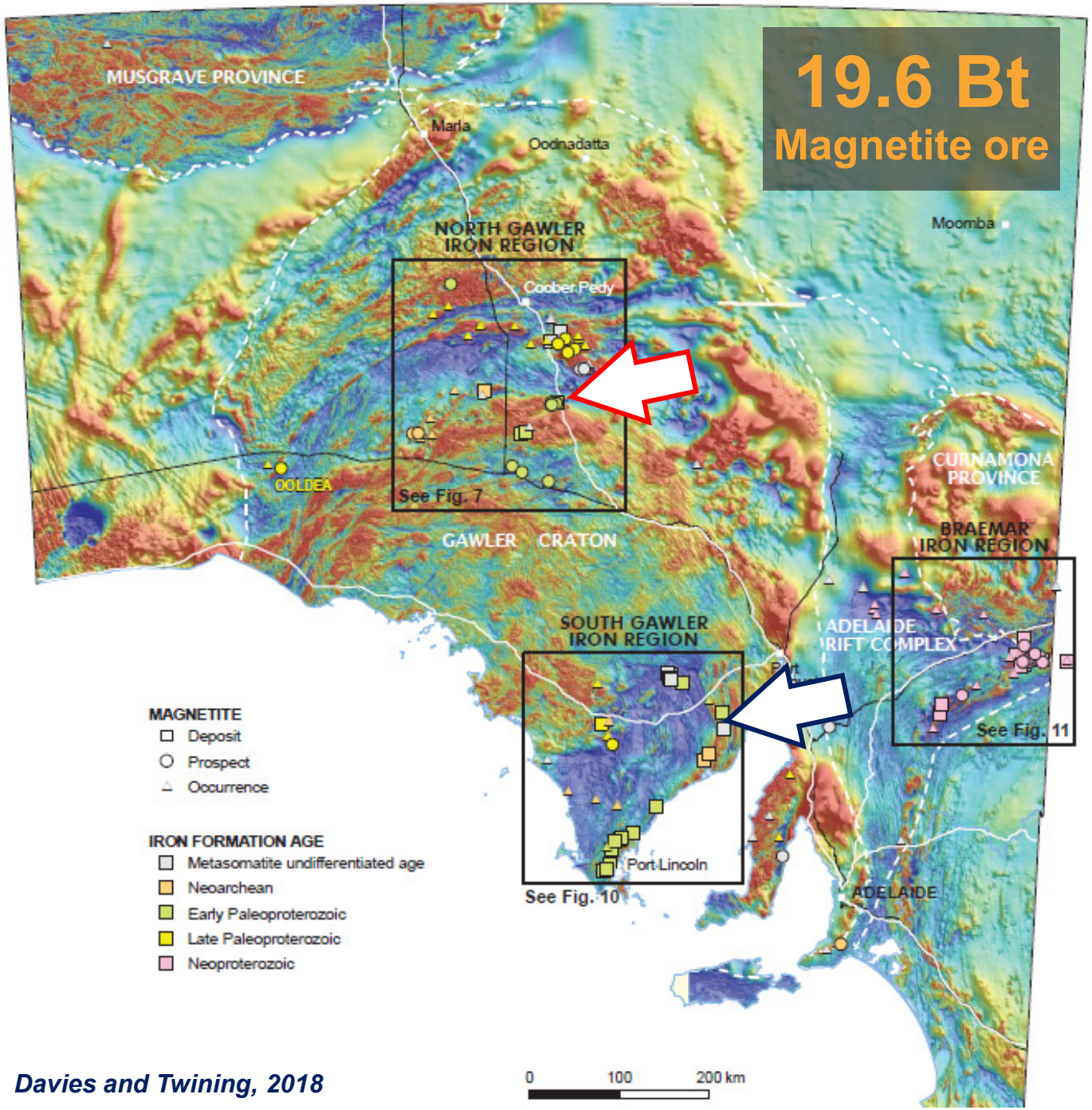


Wilgena Hill Jaspilite, Hawks Nest project



Davies and Twining, 2018





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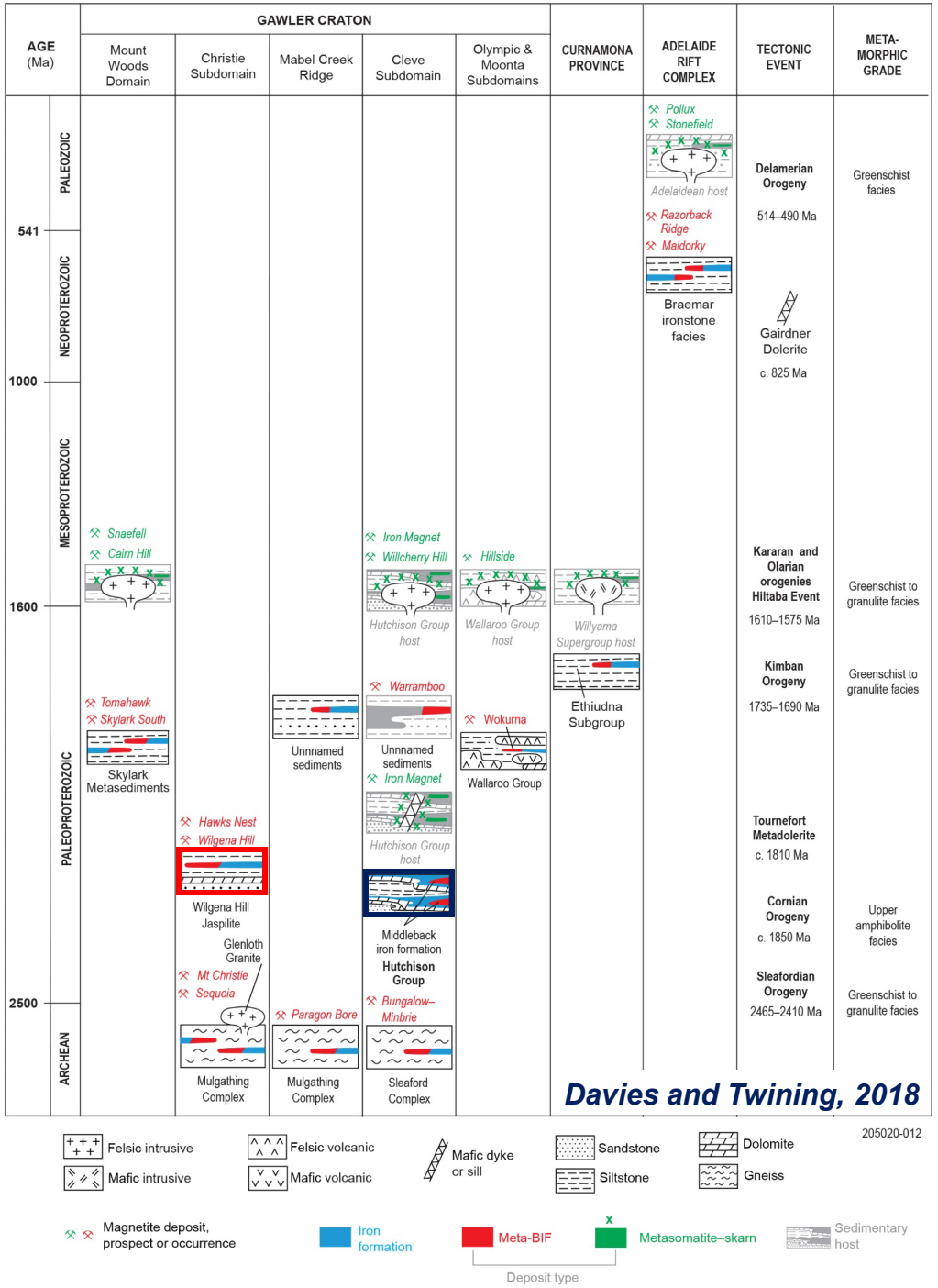

Eyre Peninsula

Array of magnetite deposit styles:

- **Iron formation(s)** (Archaean)
- **Iron formations** (Early Palaeoproterozoic)
- **Magnetite gneiss** (Late Palaeoproterozoic)
- **Metasomatites** (Early Mesoproterozoic)

Each deposit style associated with different characteristics

Unresolved debate around the age of the iron formation(s) in the Middleback Range.

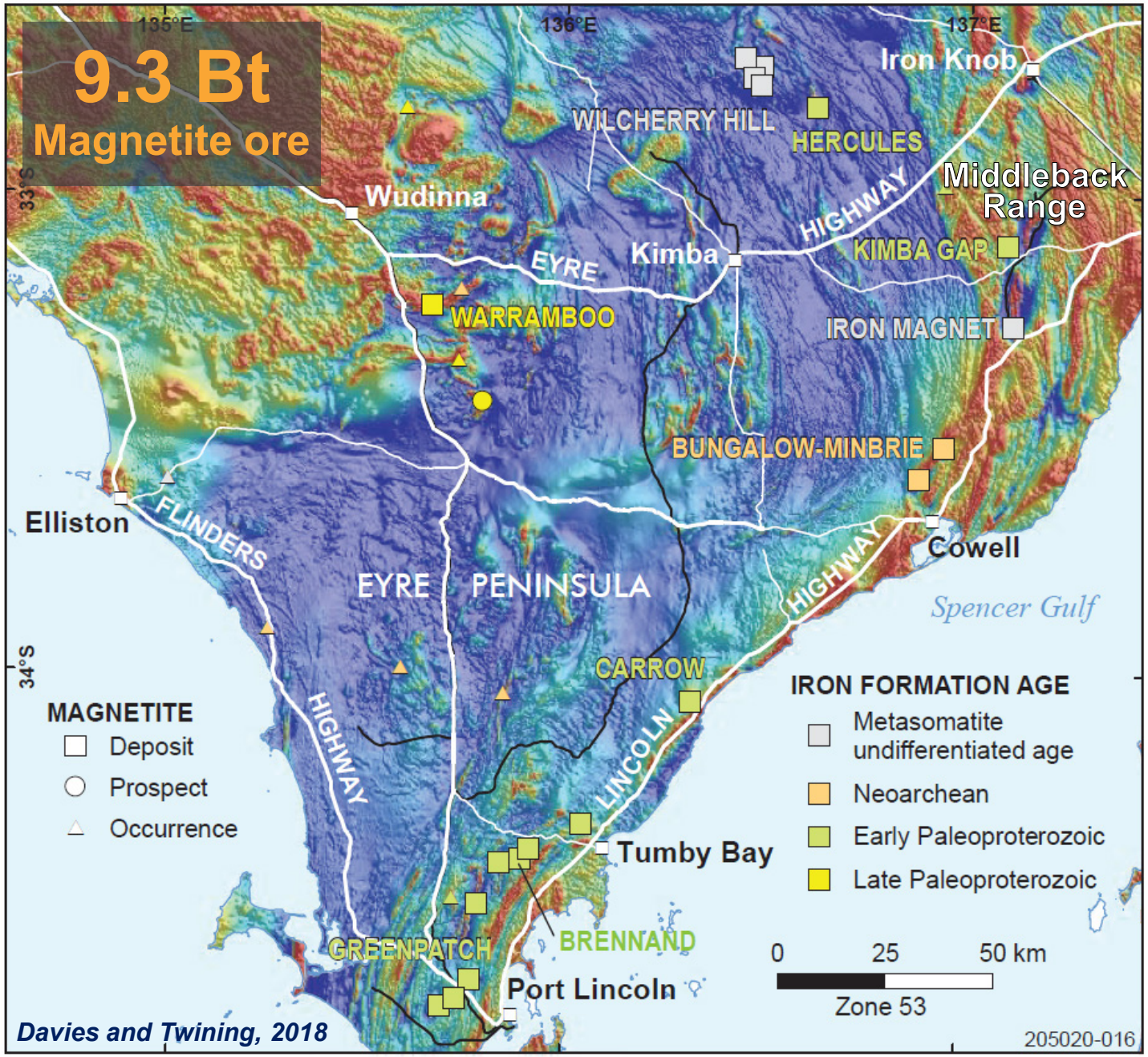

**Figure made prior to Duchess South and Chieftain West resources in Middleback Range*

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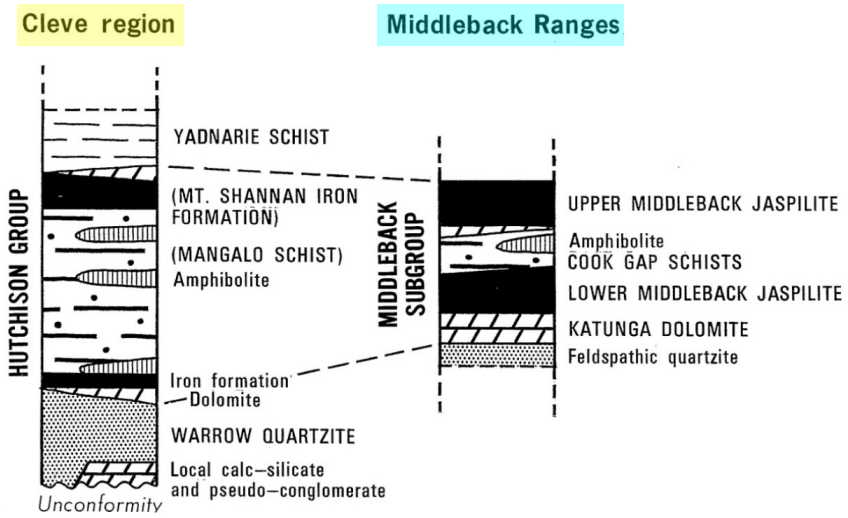
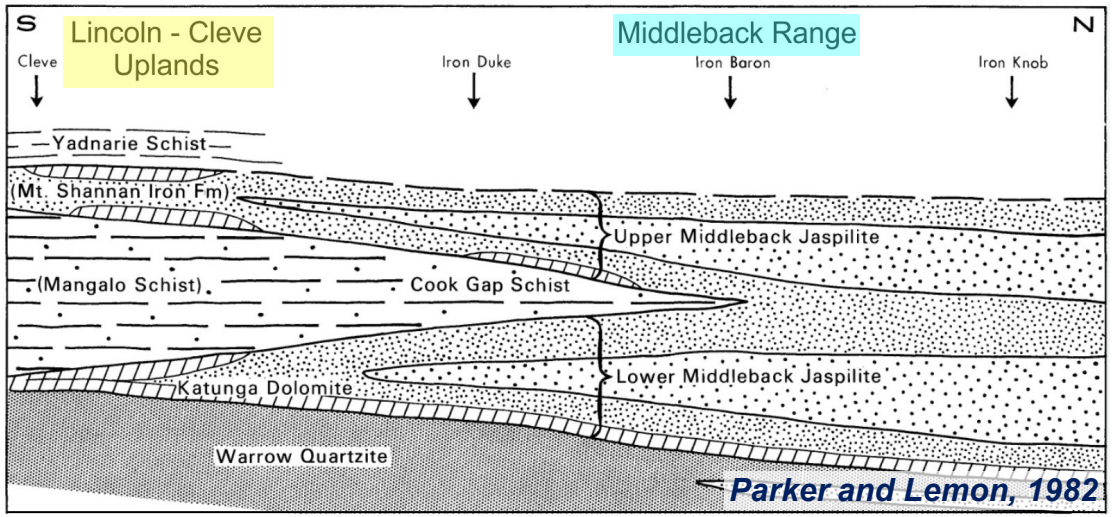
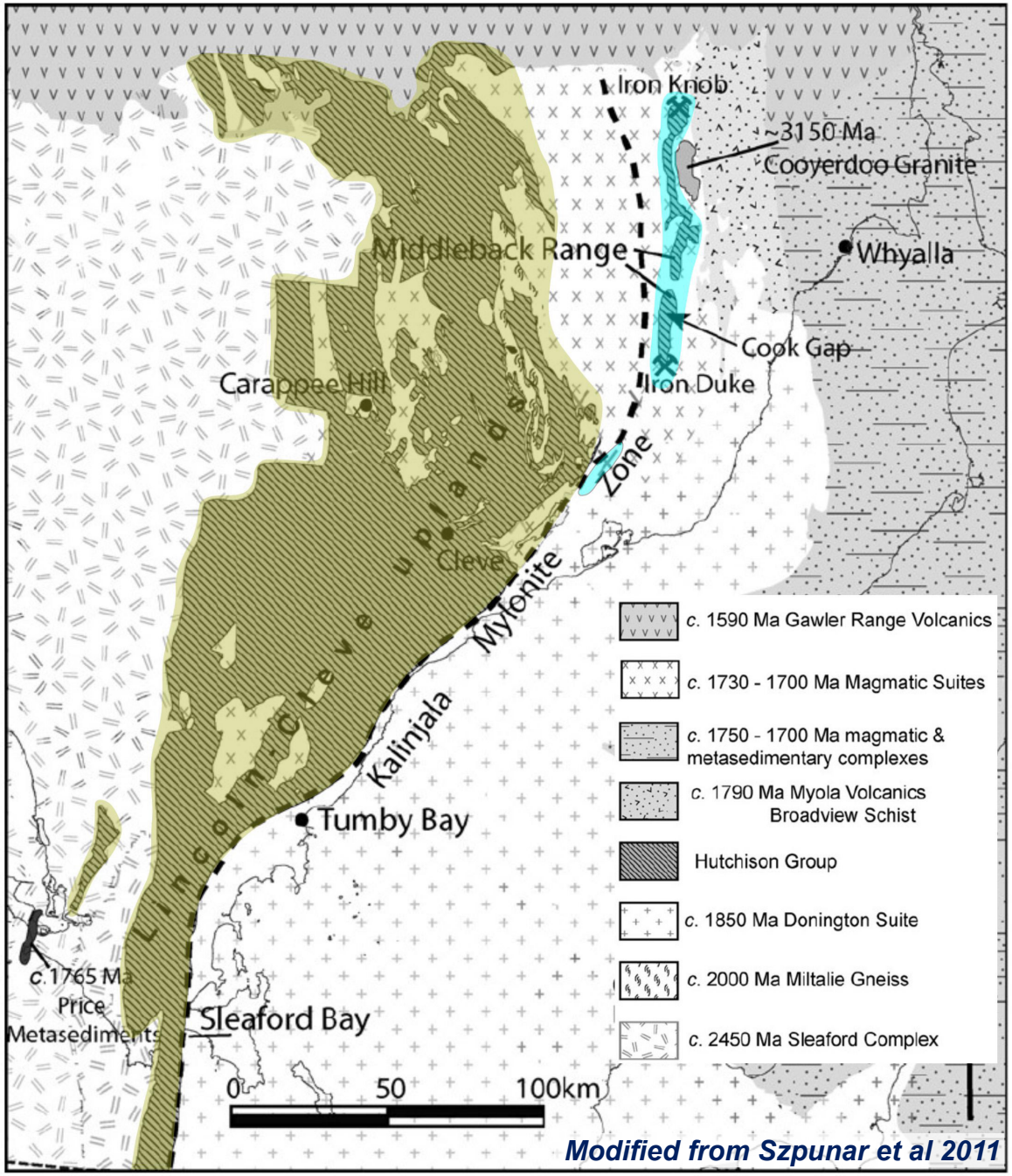
Parker and Lemon, 1982

- Correlated metasediments in the Middleback Range and Lincoln-Cleve Uplands and interpreted as a single ocean basin formed in the mid-Palaeoprot. (Hutchison Group)

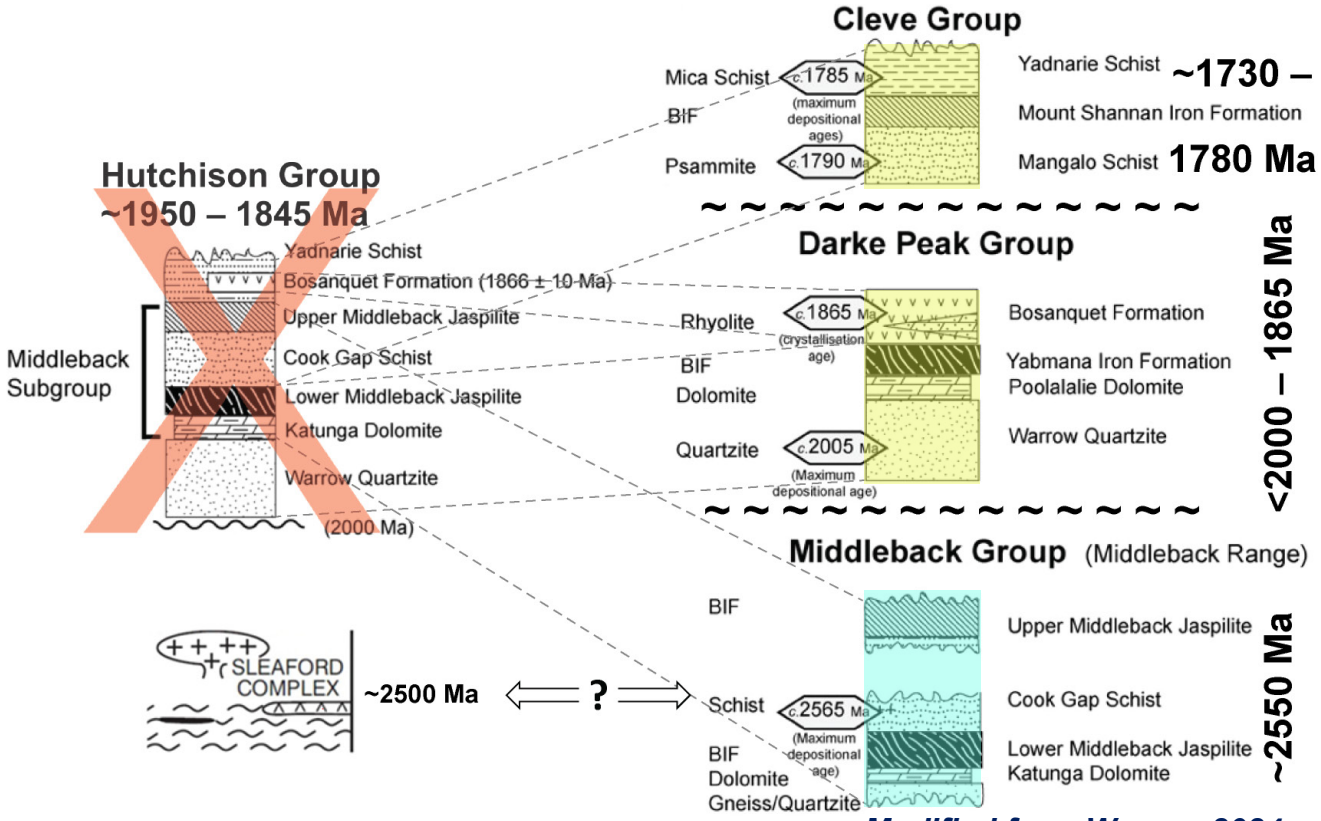




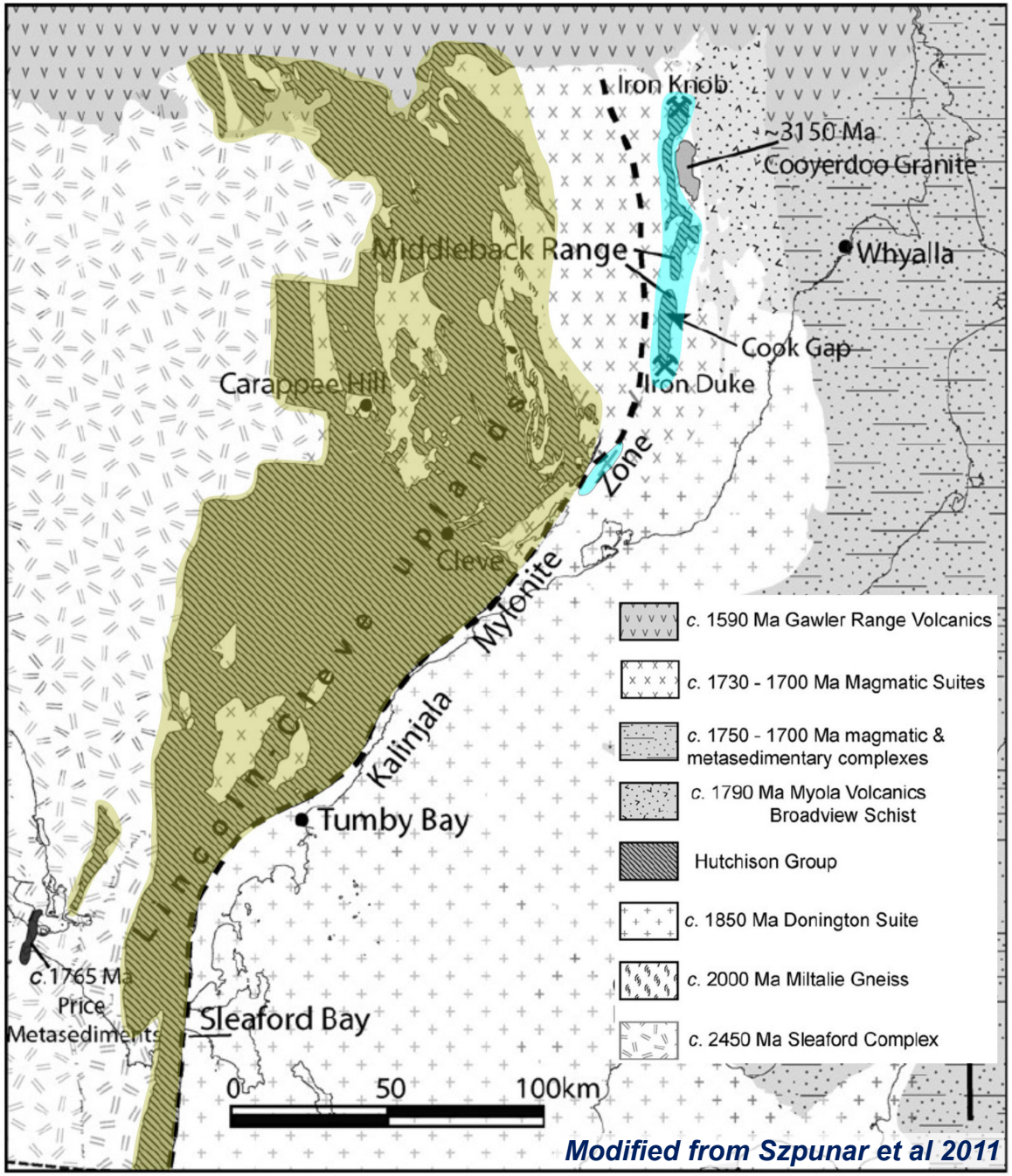


Szpunar et al. 2011

- Proposed three distinct sedimentary packages based on detrital zircon geochronology
- Cleve Group and Darke Peak Group deposited during mid – late Palaeoproterozoic (now Hutchison Supergroup)
- Middleback Group deposited during the Archaean



Modified from Werner, 2024



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Szpunar et al. 2011

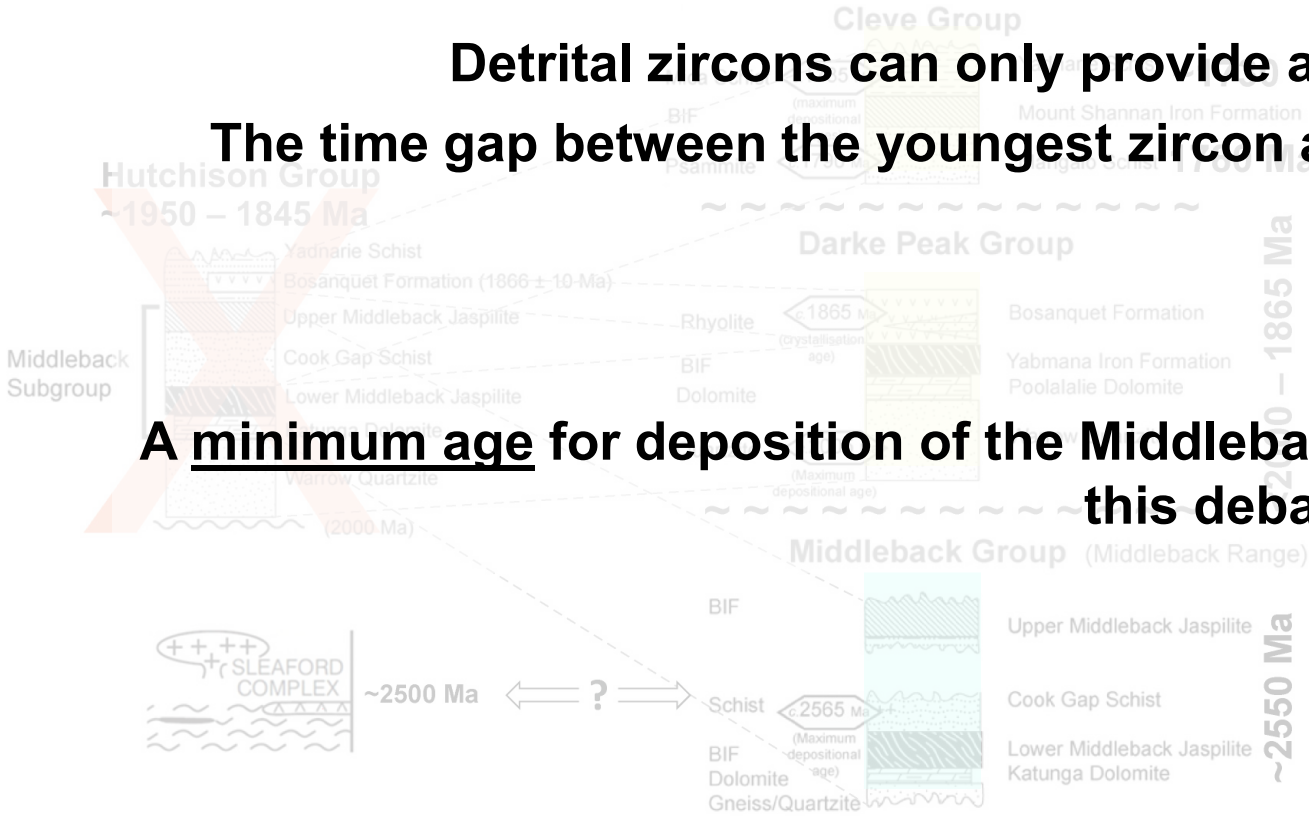
- Proposed three distinct sedimentary packages based on detrital zircon geochronology
- Cleve Group and Darke Peak Group deposited during the mid – late Palaeoproterozoic
- Middleback Group deposited during the Archaean

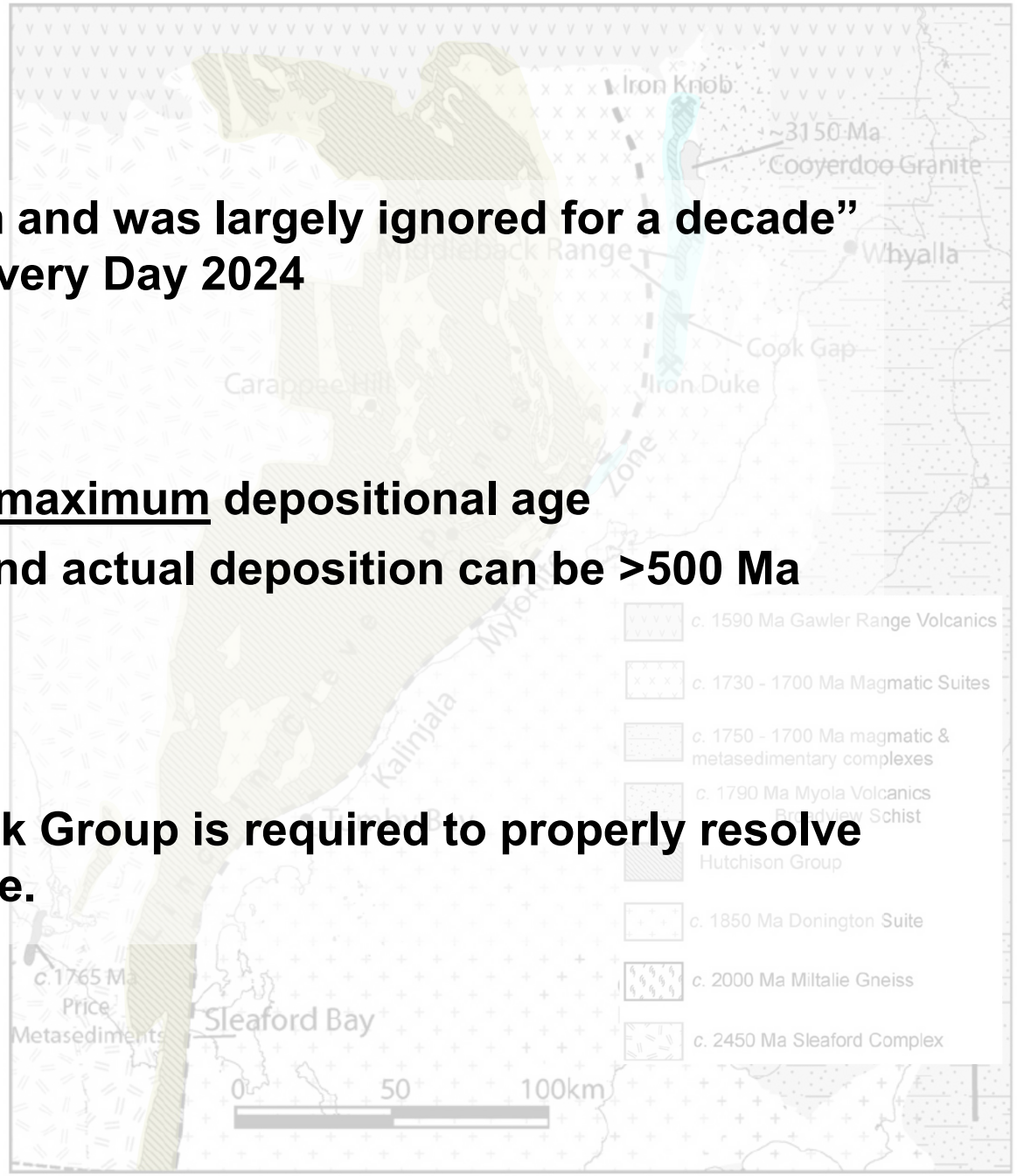
“This proposal was met with a lot of scepticism and was largely ignored for a decade”
– Mario Werner, Discovery Day 2024

Detrital zircons can only provide a <u>maximum</u> depositional age

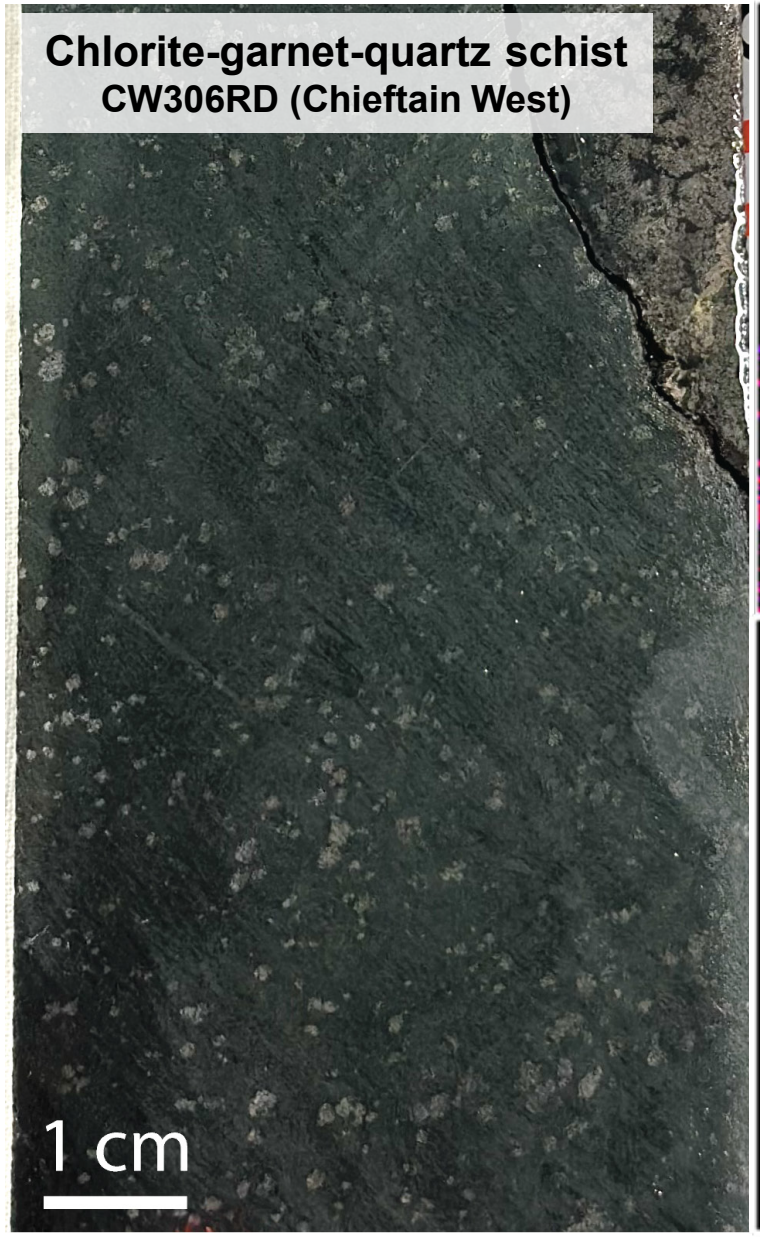
The time gap between the youngest zircon and actual deposition can be >500 Ma

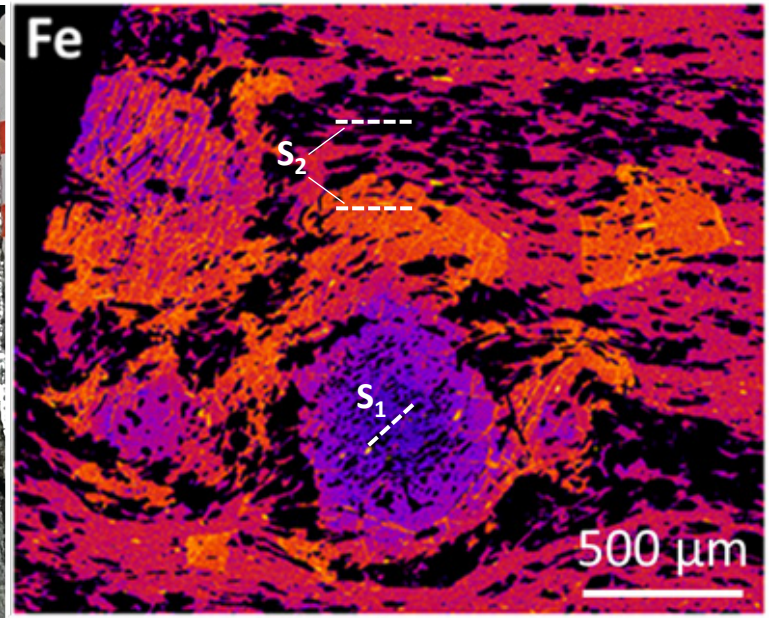
A <u>minimum age</u> for deposition of the Middleback Group is required to properly resolve this debate.

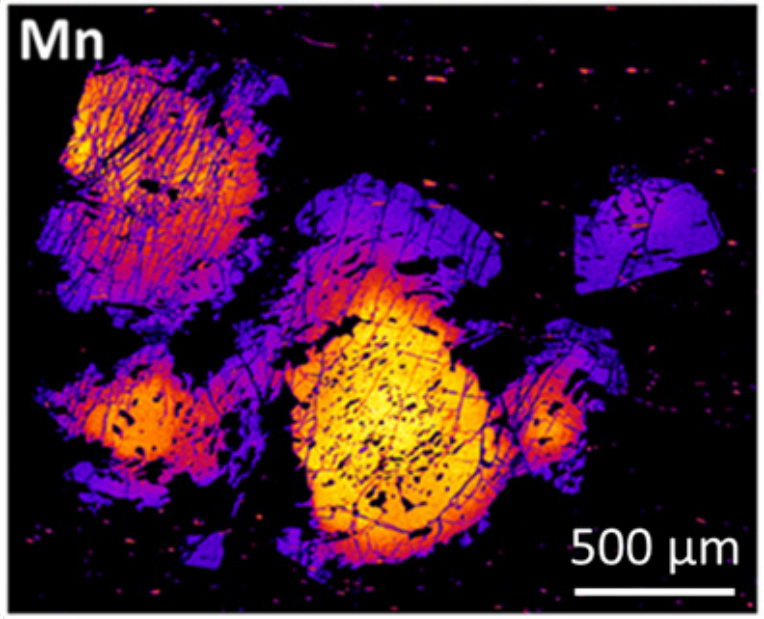


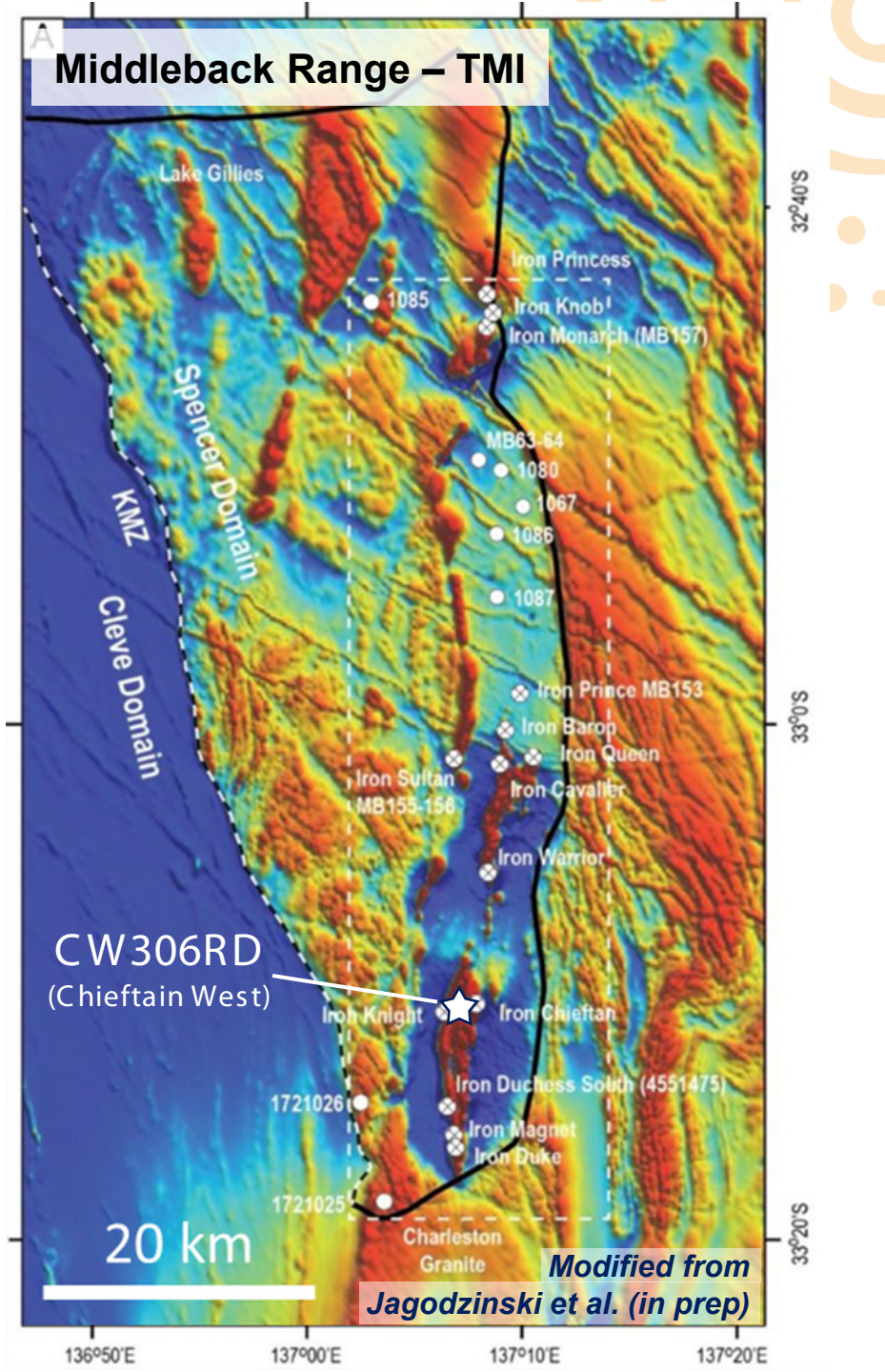


Cook Gap Schist



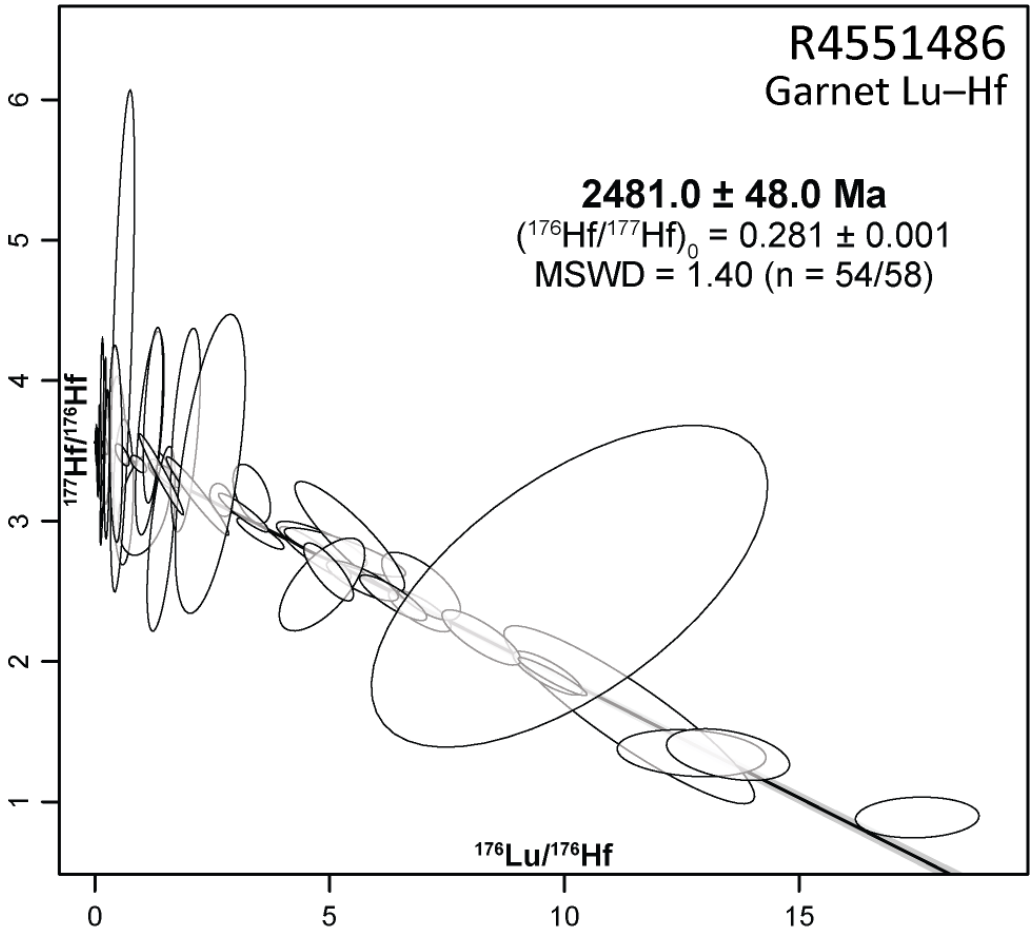


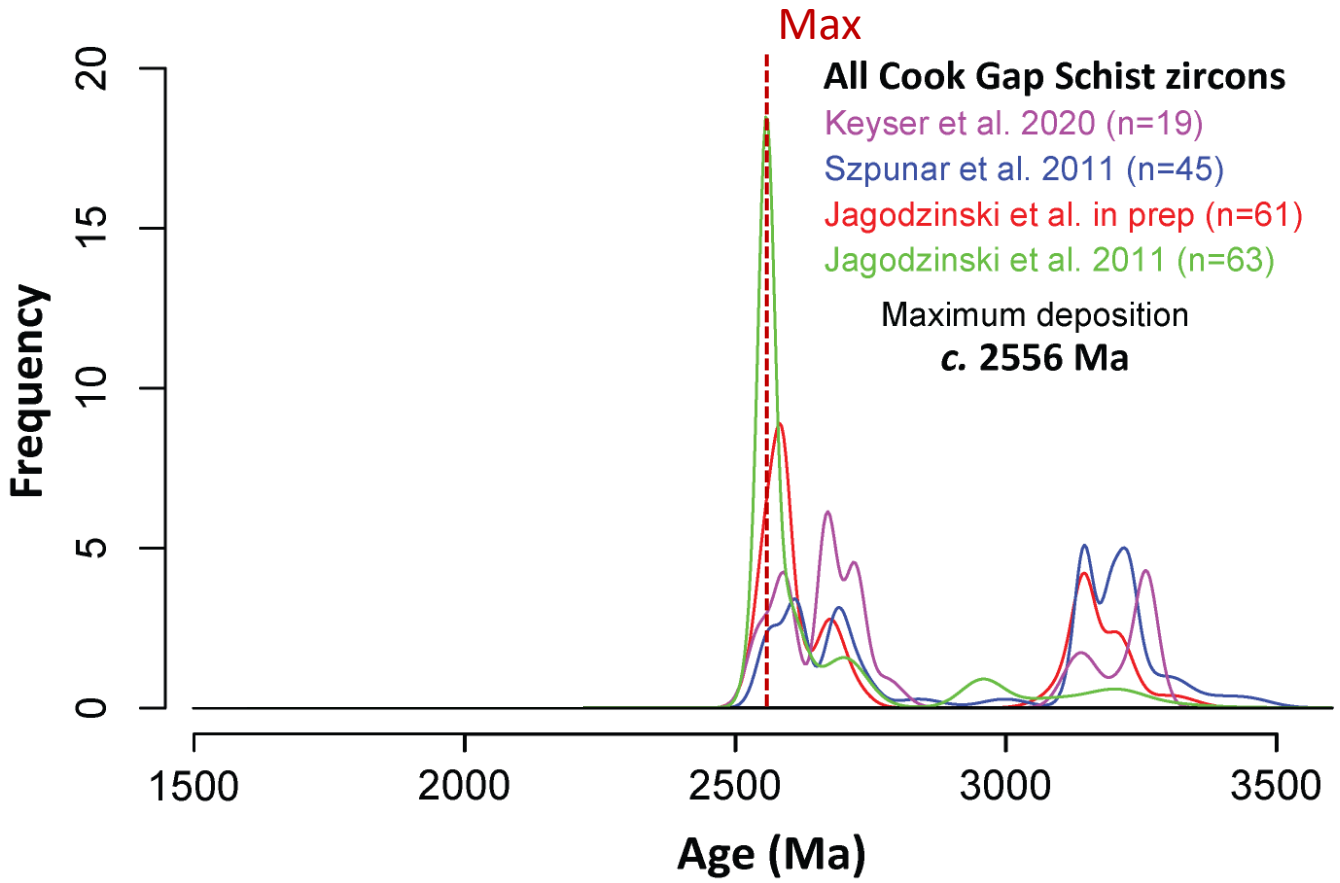




Cook Gap Schist

- Metamorphosed during the Sleafordian Orogeny at *c.* 2480 Ma





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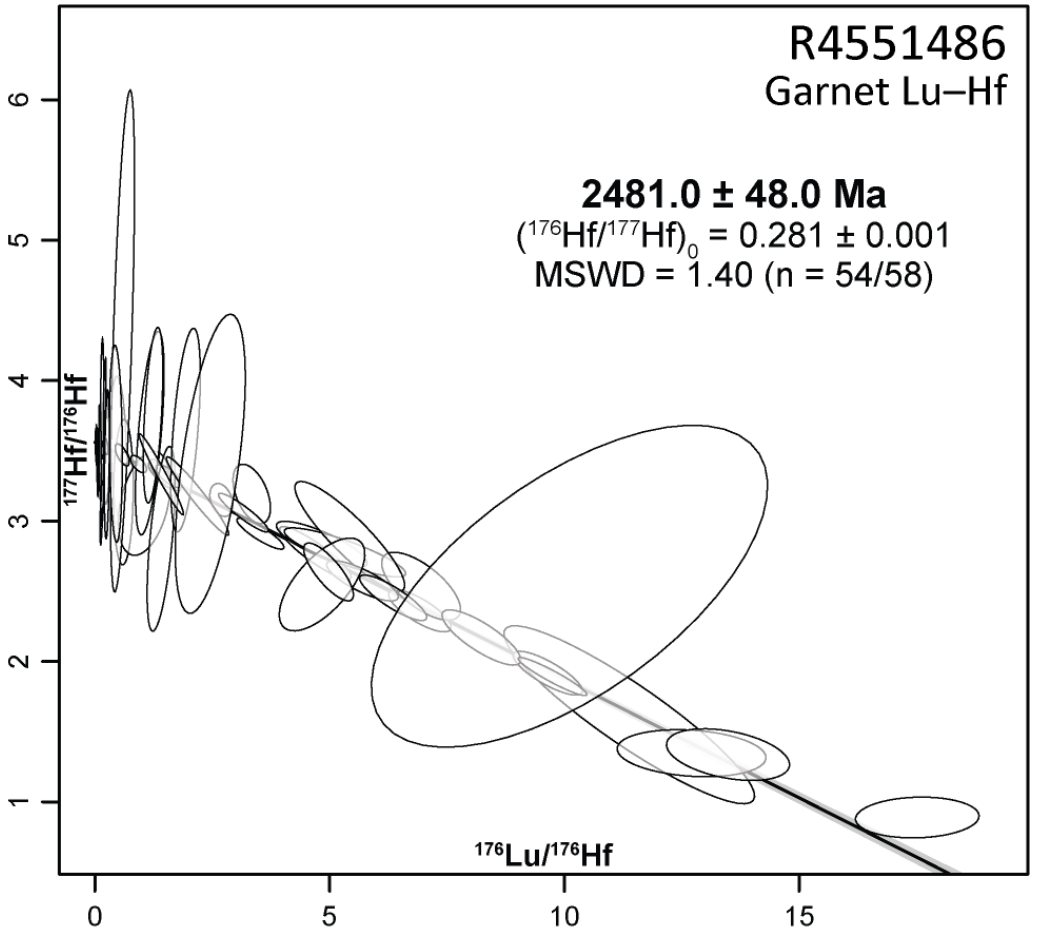
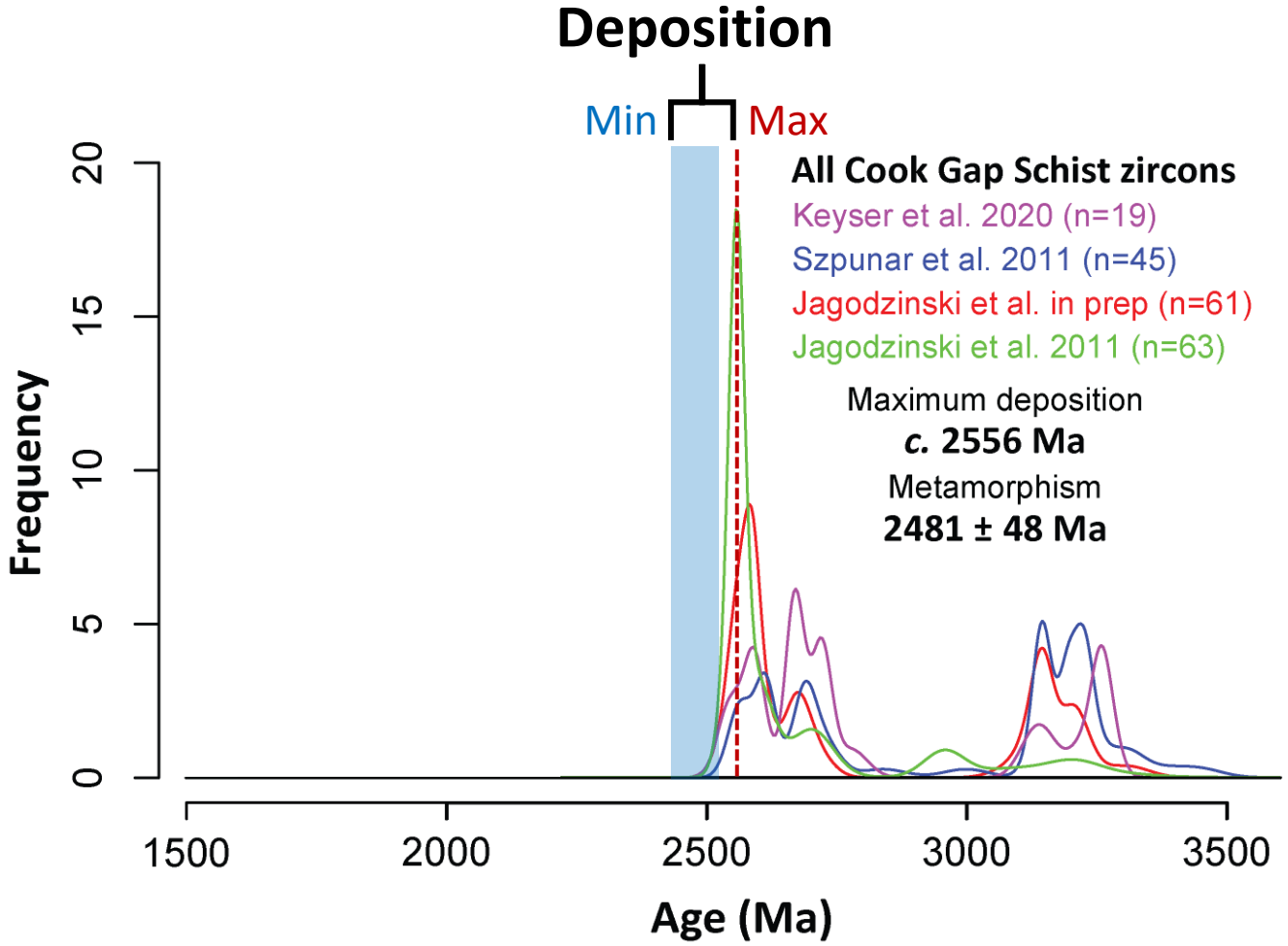
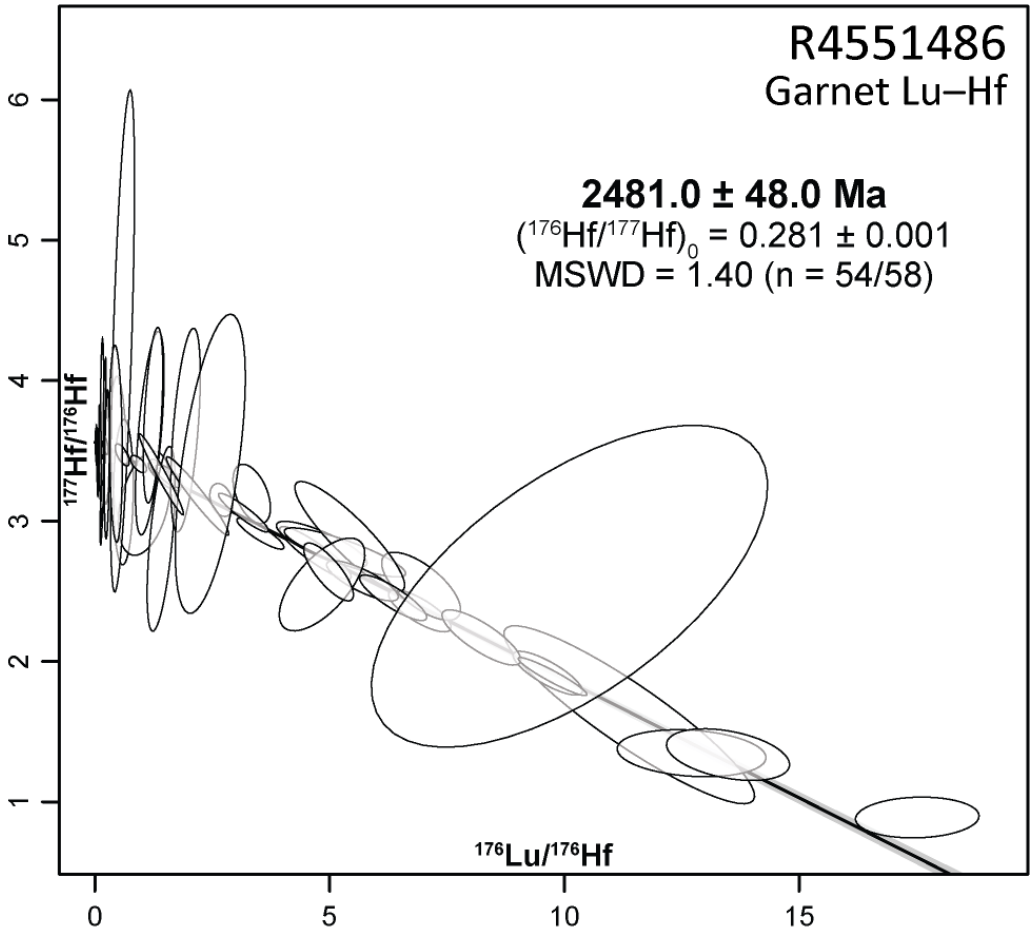
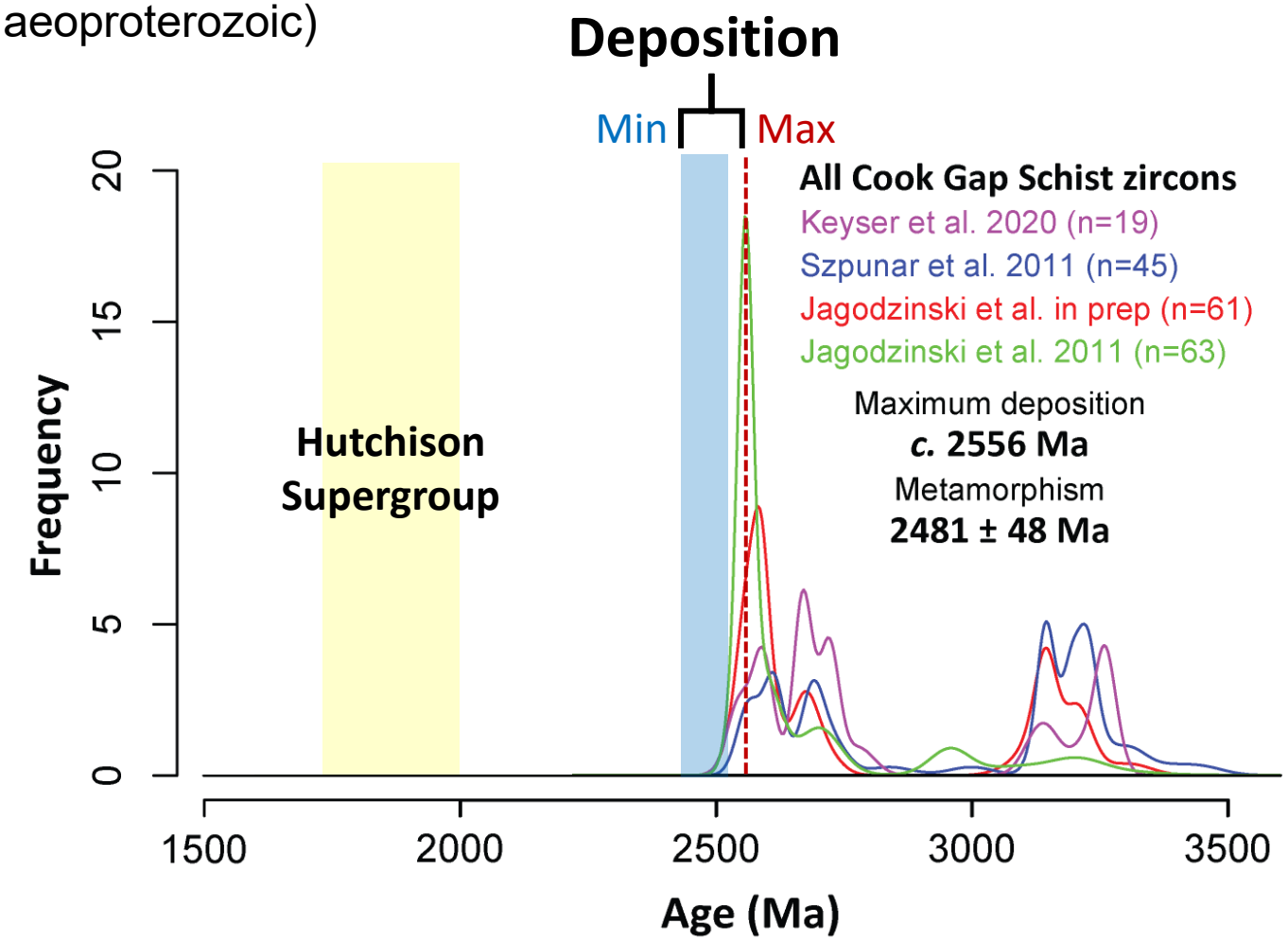




Cook Gap Schist

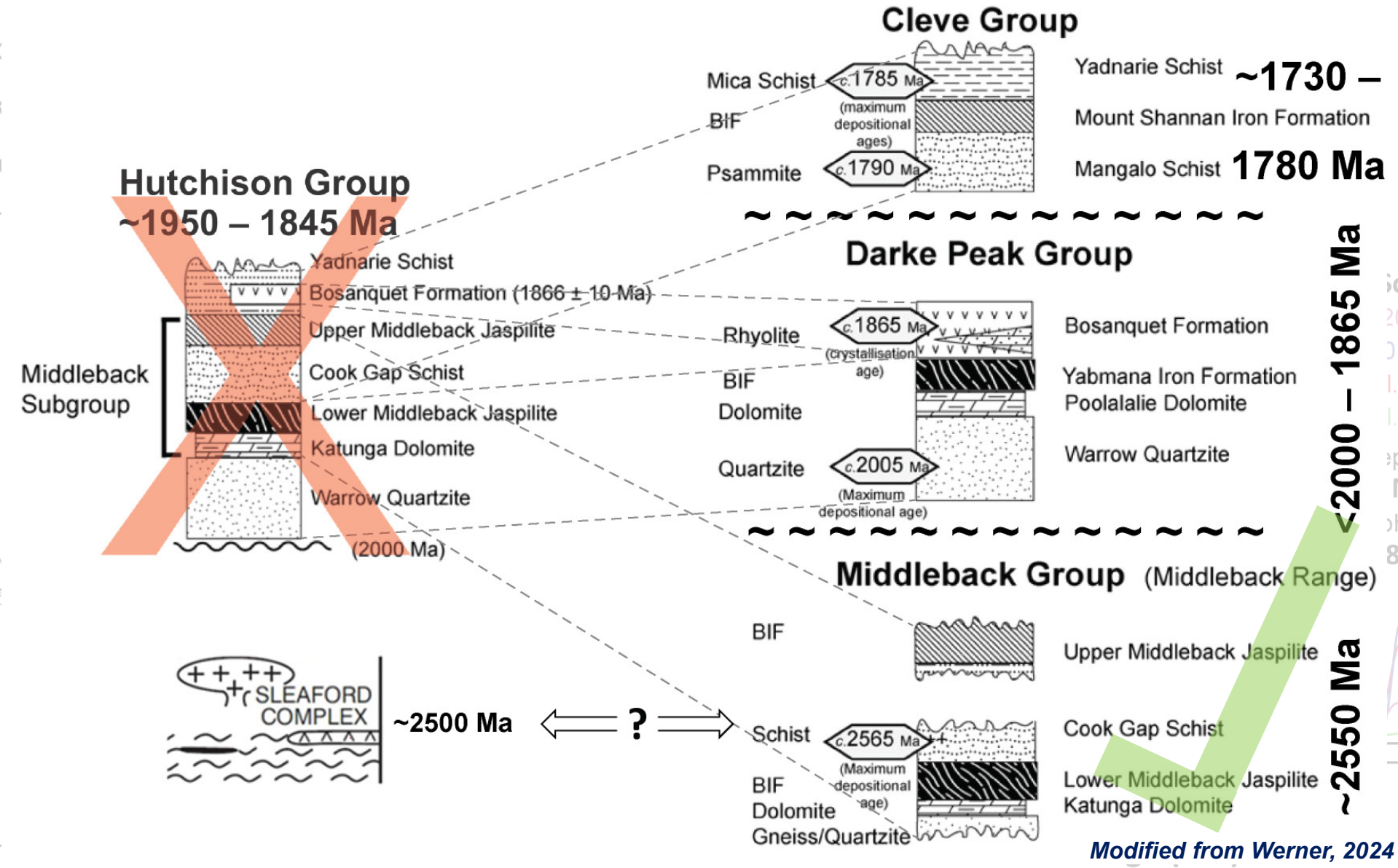
- Metamorphosed during the Sleafordian Orogeny at *c.* 2480 Ma
- The Cook Gap Schist was deposited prior to the Hutchison Supergroup
- Middleback Jaspilite is Archaean (or earliest Palaeoproterozoic)





Cook Gap Schist

- Metamorp
- The Cook
- Middleba



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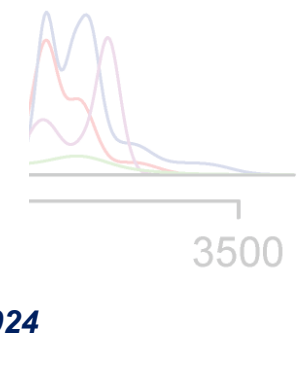


Iron Mount

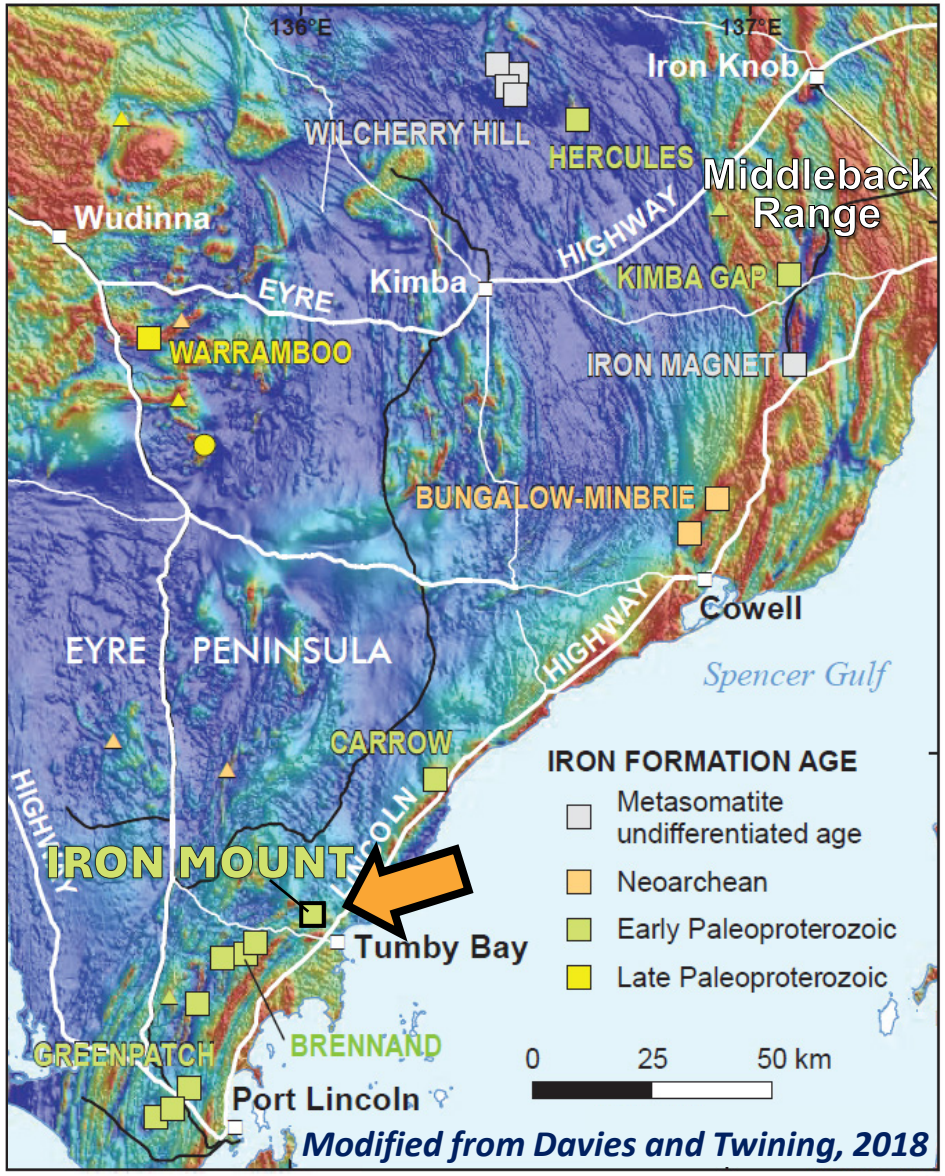
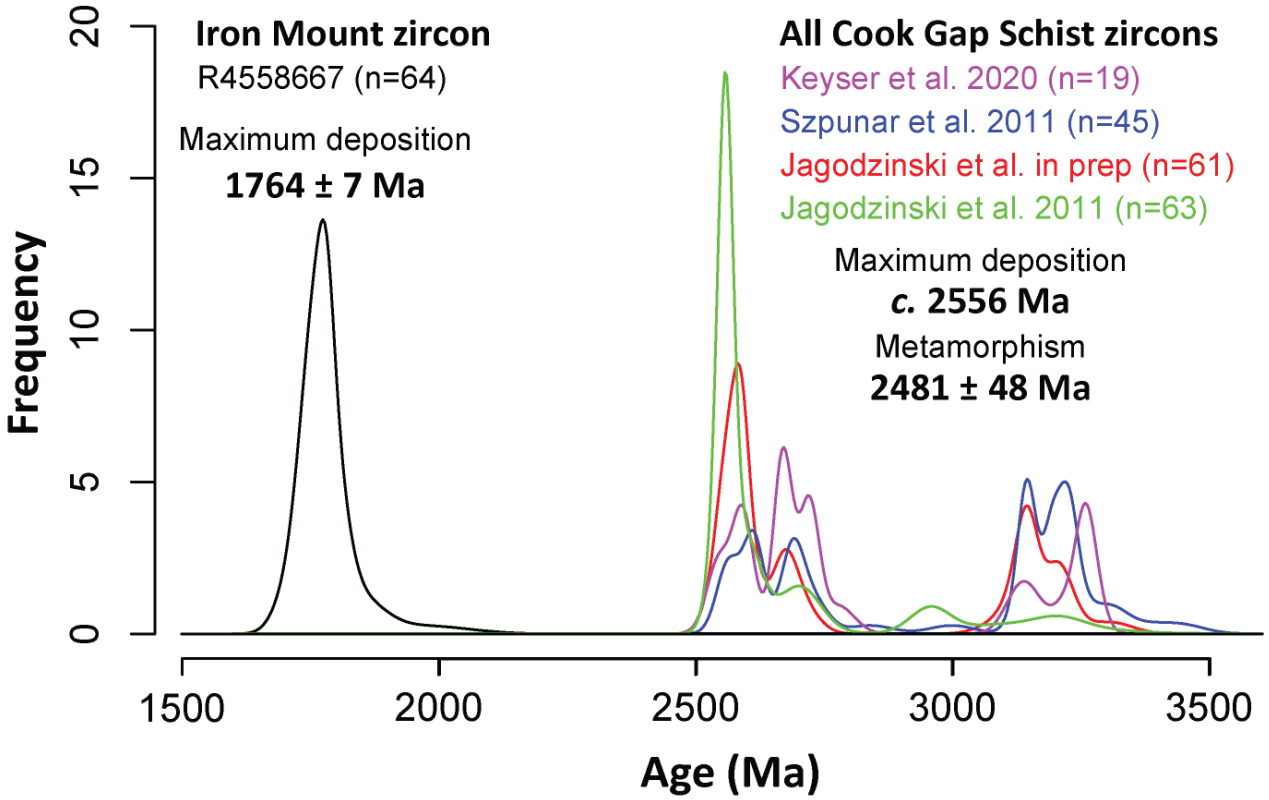
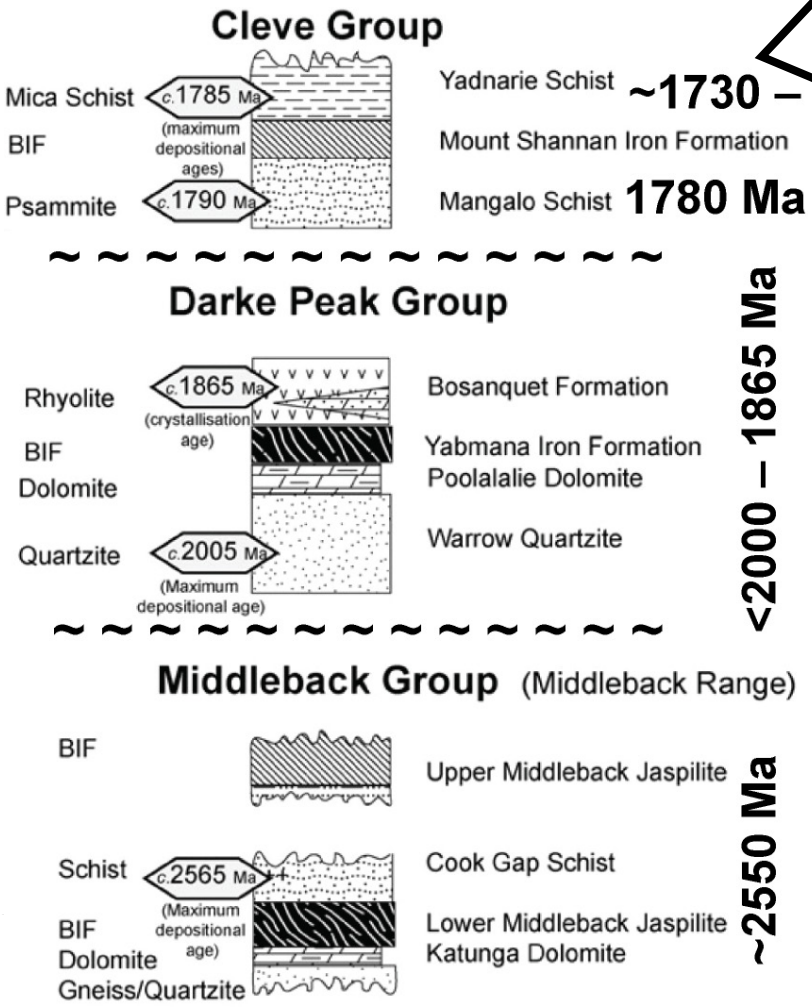


**Figure made prior to Duchess South and Chieftain West resources*

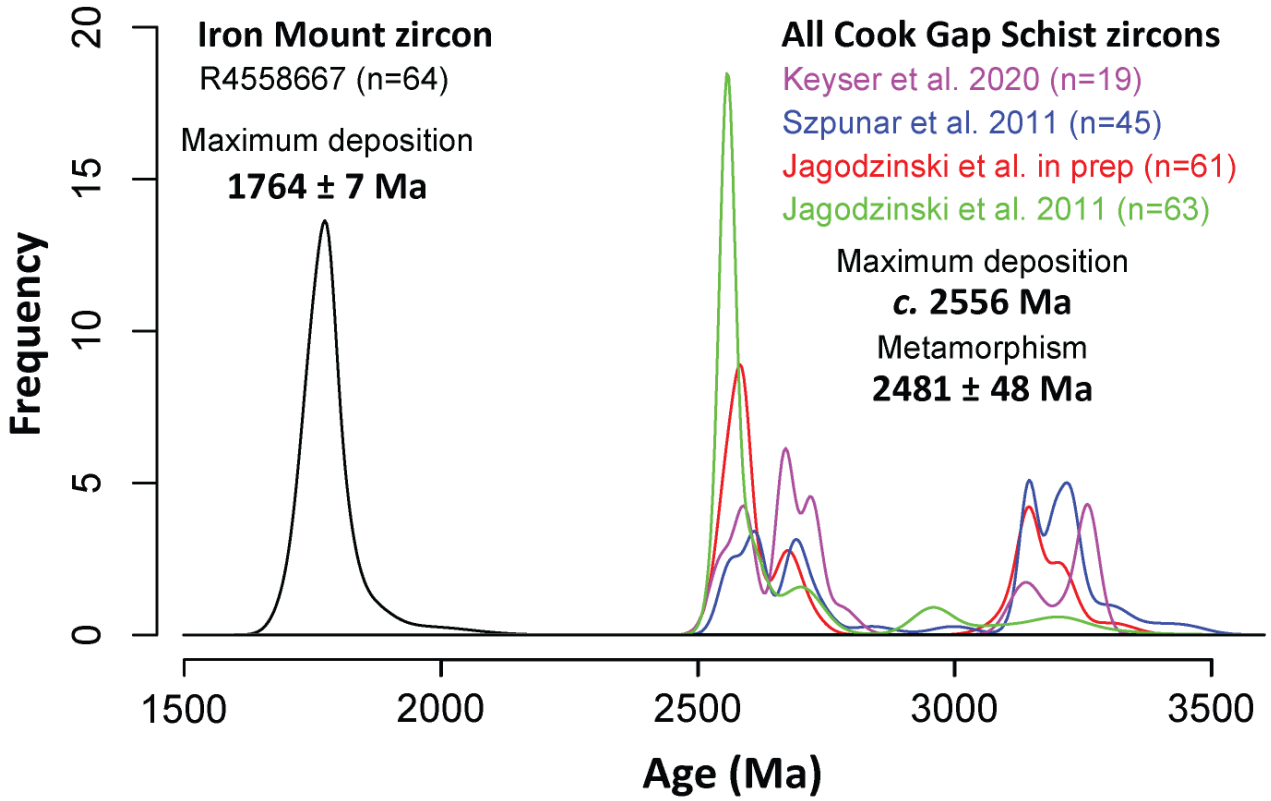


Iron Mount

Mount Shannan Iron Formation



Modified from Szpunar et al 2011



Iron Mount

Garnet-biotite-sillimanite gneiss

Cleve Group

Mica Schist — c.1785 Ma (maximum depositional ages)
BIF
Psammite — c.1790 Ma

Yadnarie Schist
Mount Shannan Iron Formation
Mangalo Schist

~1730 – 1780 Ma

Darke Peak Group

Rhyolite — c.1865 Ma (crystallisation age)
BIF
Dolomite
Quartzite — c.2005 Ma (Maximum depositional age)

Bosanquet Formation
Yabmana Iron Formation
Poolalalie Dolomite
Warrow Quartzite

<2000 – 1865 Ma

Hutchison Group
~1950 – 1845 Ma

Middleback Subgroup

Yadnarie Schist
Bosanquet Formation (1866 ± 10 Ma)
Upper Middleback Jaspilite
Cook Gap Schist
Lower Middleback Jaspilite
Katunga Dolomite
Warrow Quartzite
(2000 Ma)

Middleback Group (Middleback Range)

BIF
Upper Middleback Jaspilite

Schist — c.2565 Ma (Maximum depositional age)
BIF
Dolomite
Gneiss/Quartzite

Cook Gap Schist
Lower Middleback Jaspilite
Katunga Dolomite

~2550 Ma

SLEAFORD COMPLEX ~2500 Ma ⟺ ? ⟹

Modified from Werner, 2024

Age (Ma)

Magnetite characteristics on Eyre Peninsula

Metasomatites
- High grade, low tonnage

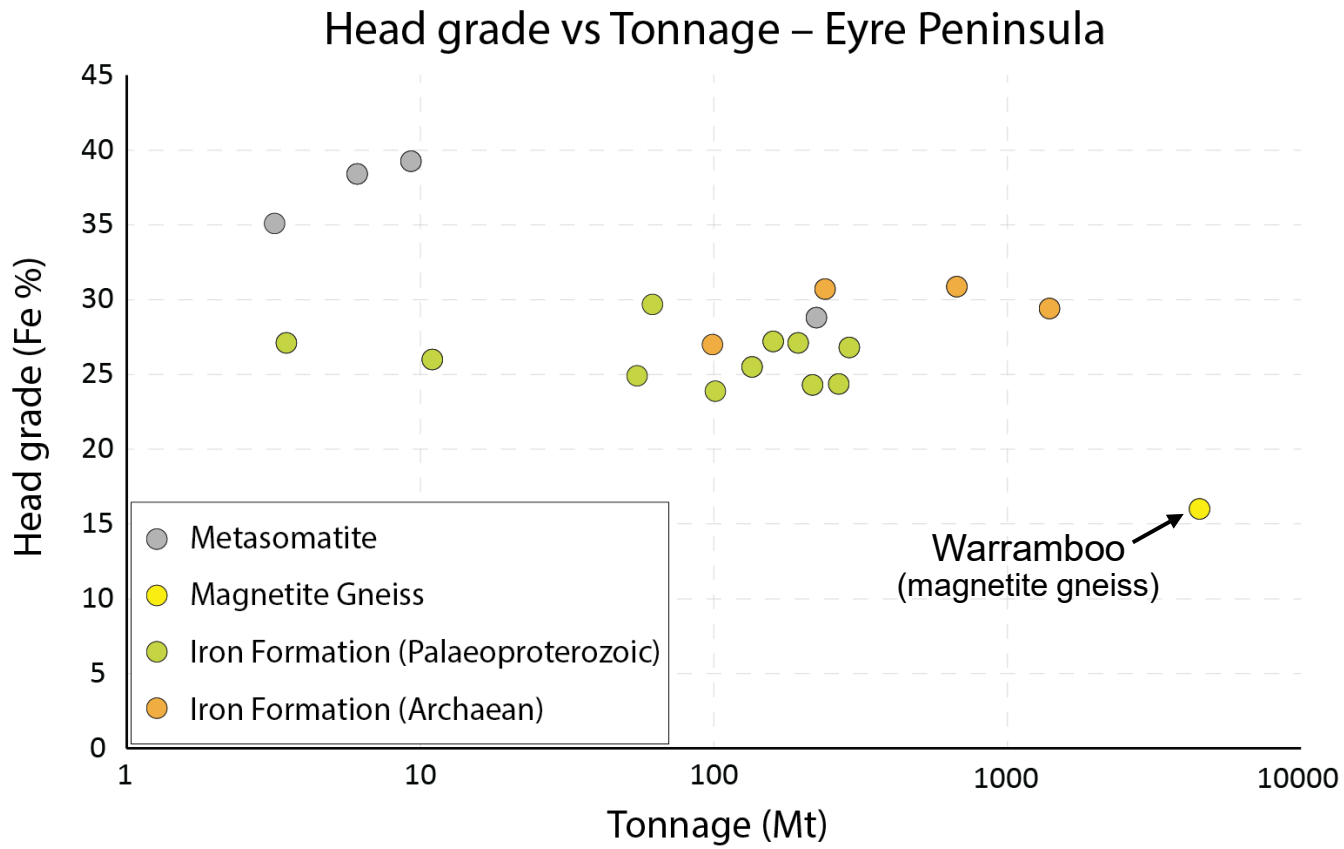
Magnetite gneiss
- Low grade, high tonnage

Iron Formations

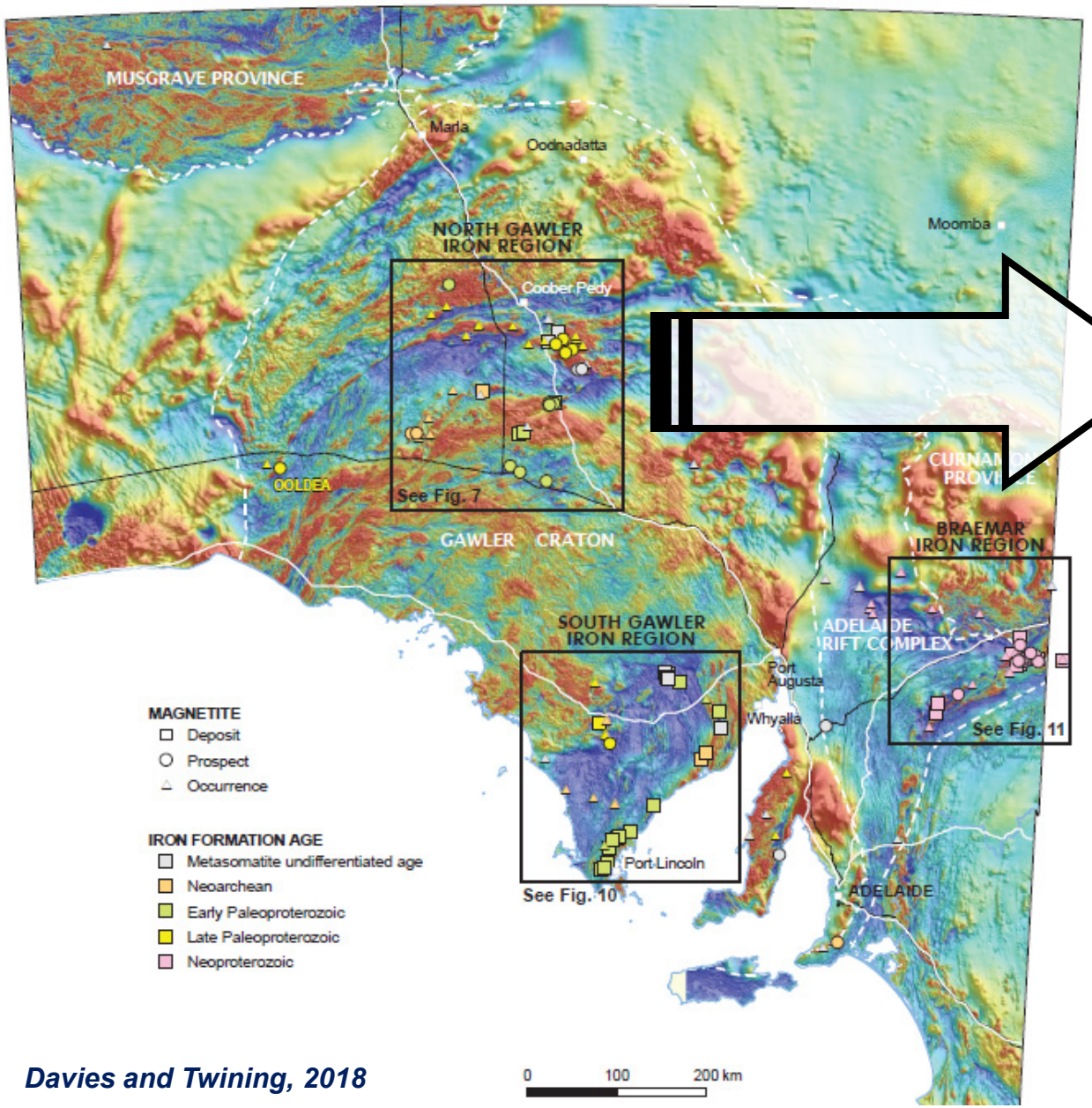
Archaean
- Higher grade and tonnage

Palaeoproterozoic
- Lower grade and tonnage

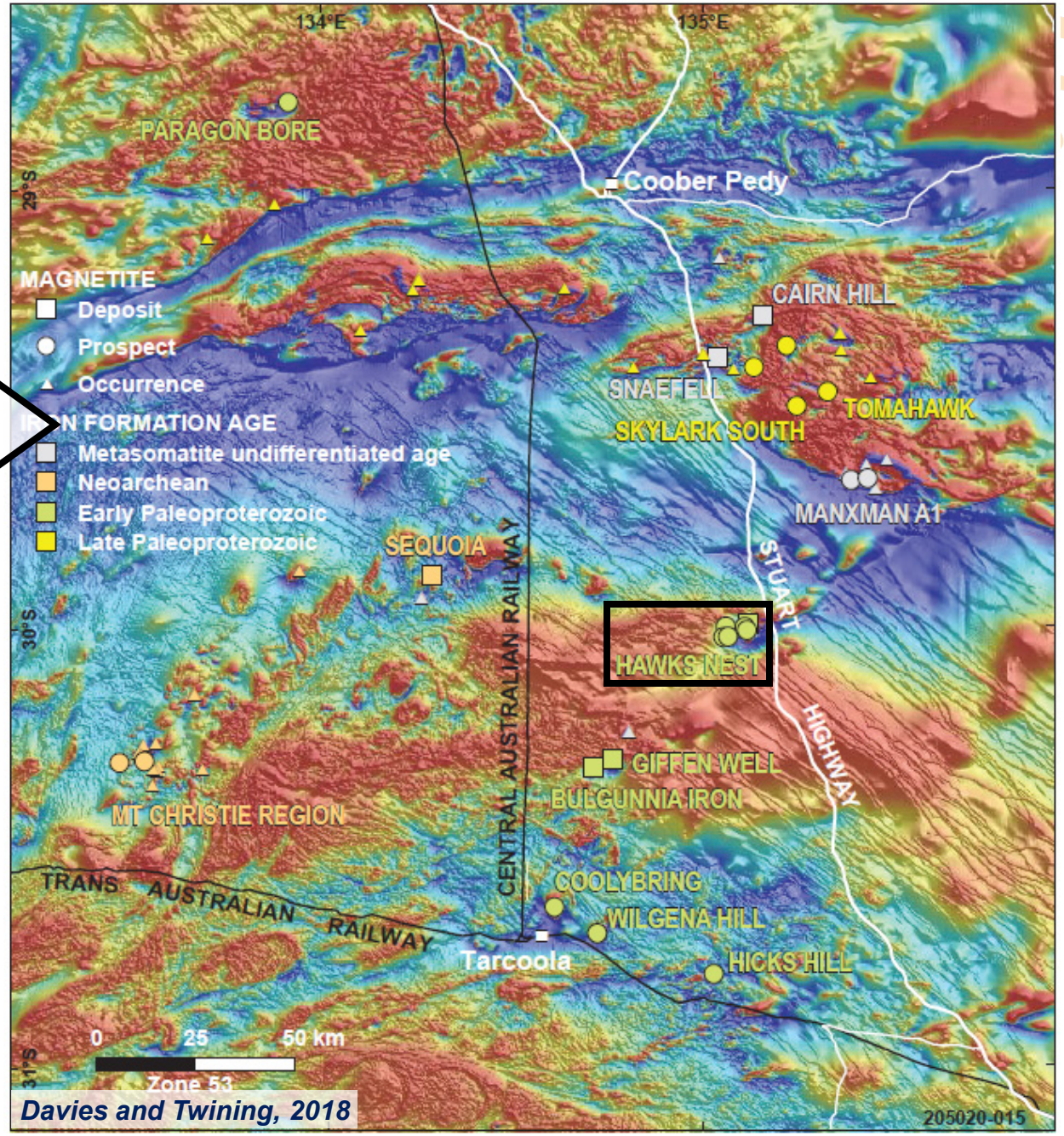
Depositional environment (age) is a primary control on the size and grade of magnetite deposits in iron formations on the Eyre Peninsula



North Gawler Iron Region



Davies and Twining, 2018



Davies and Twining, 2018

Hawks Nest

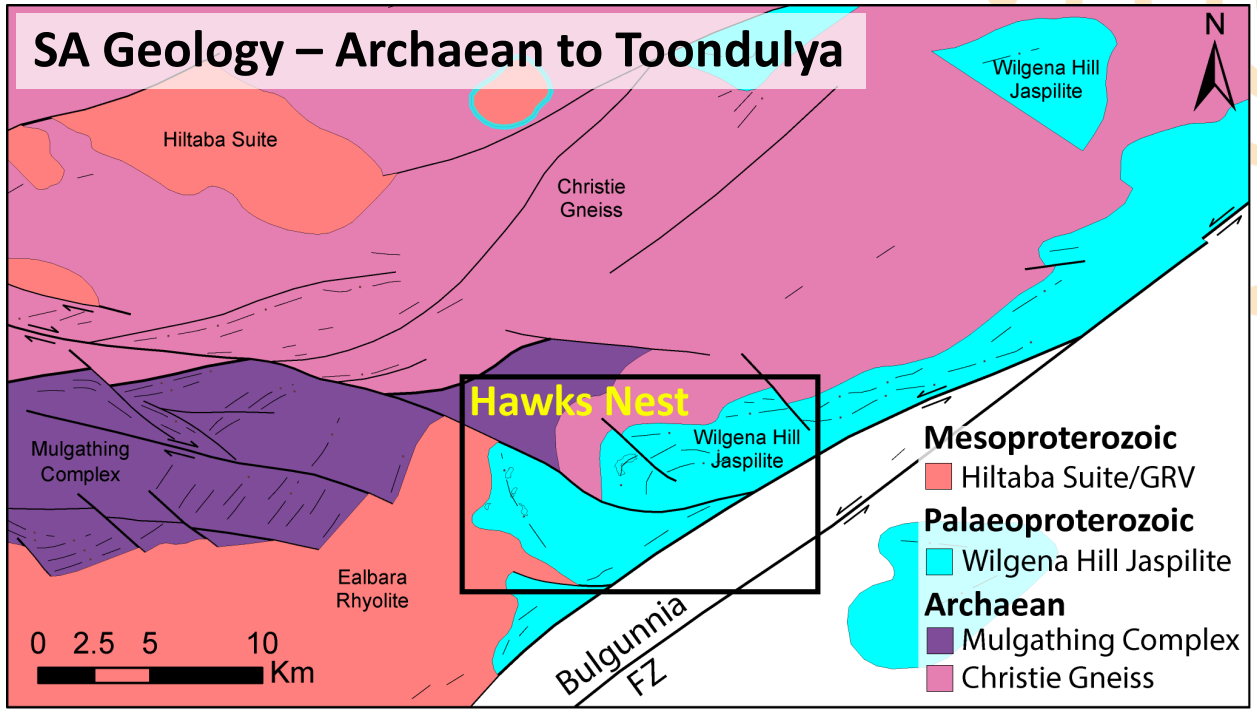
Hawks Nest is a group of hematite and magnetite deposits with magnetite BIF head grades around **35% Fe** and zones of **~60% Fe** (Kite deposit)

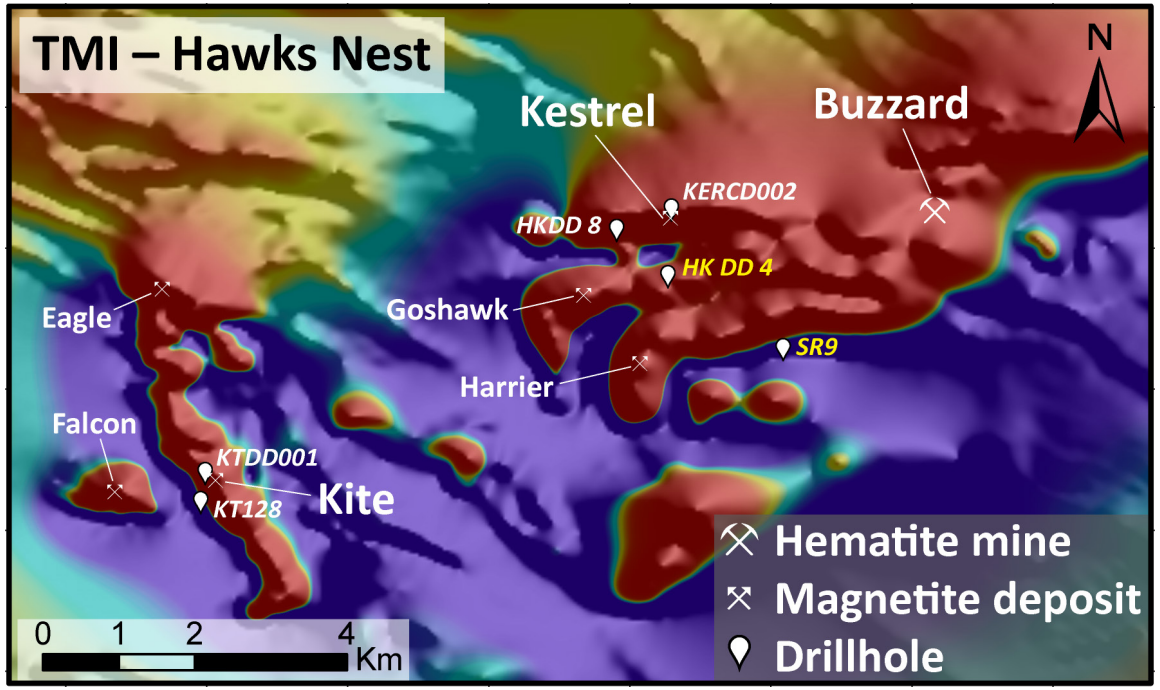
Previously interpreted as Skylark Metasediments (*c.* 1750 Ma) and Wilgena Hill Jaspilite (Palaeoprot.)

Previous geochronology

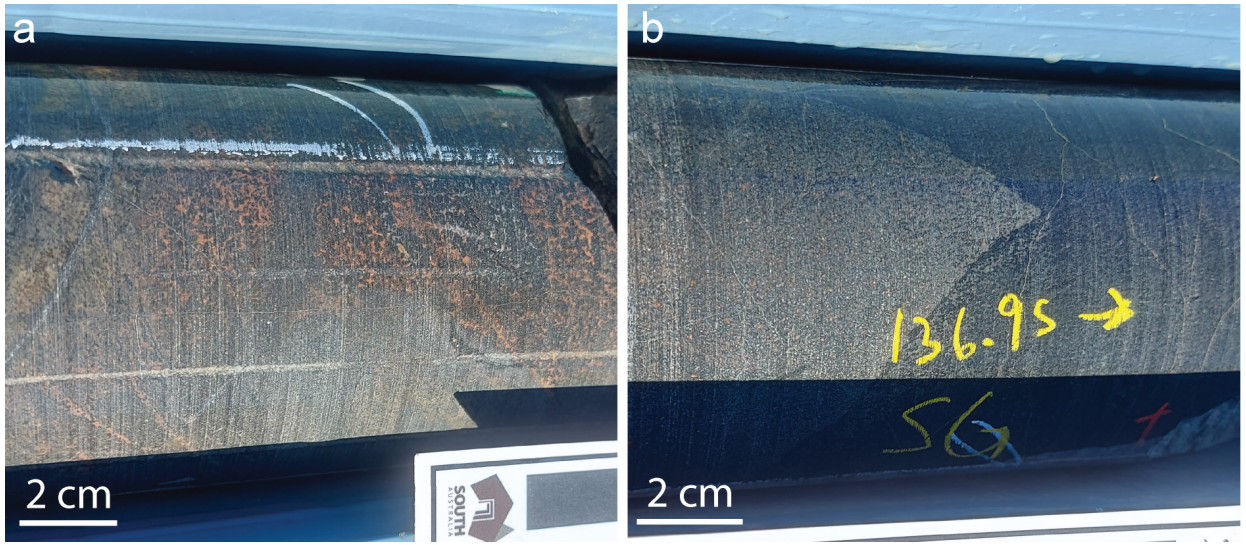
- **SR9**: Max depositional age of *c.* 2543 Ma but relationship to iron formation unknown (Jagodzinski, 2005)
- **HK DD 4**: Max depositional age of *c.* 1706 Ma from unconformable conglomerate (Reid, 2013)

The age of the iron formation at Hawks Nest is very poorly constrained.



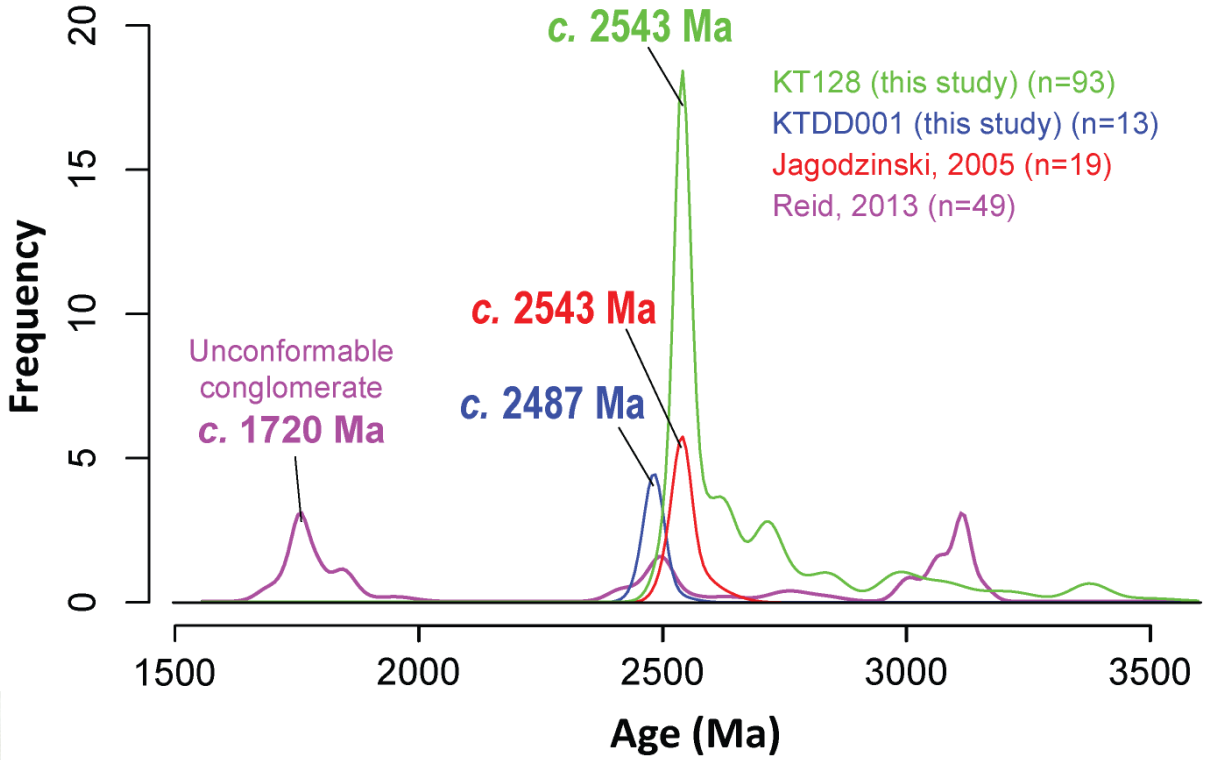


Quartzofeldspathic metasediment KT128 (Kite)



?Migmatitic metasediment KTDD001 (Kite)

All zircons from metasediments at Hawks Nest



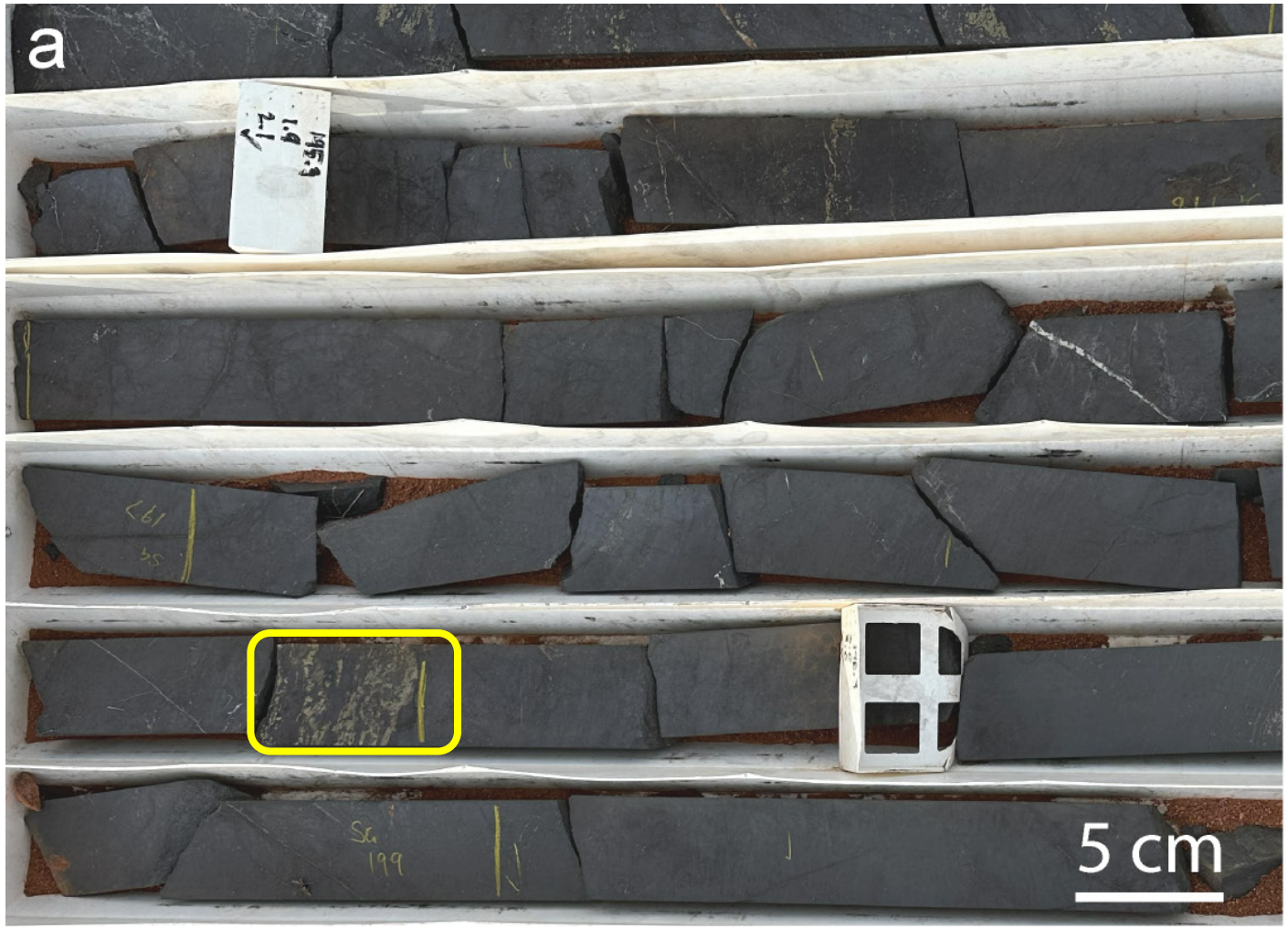
New zircon data reveals nothing younger than *c.* 2490 Ma (no evidence for Skylark Metasediments)

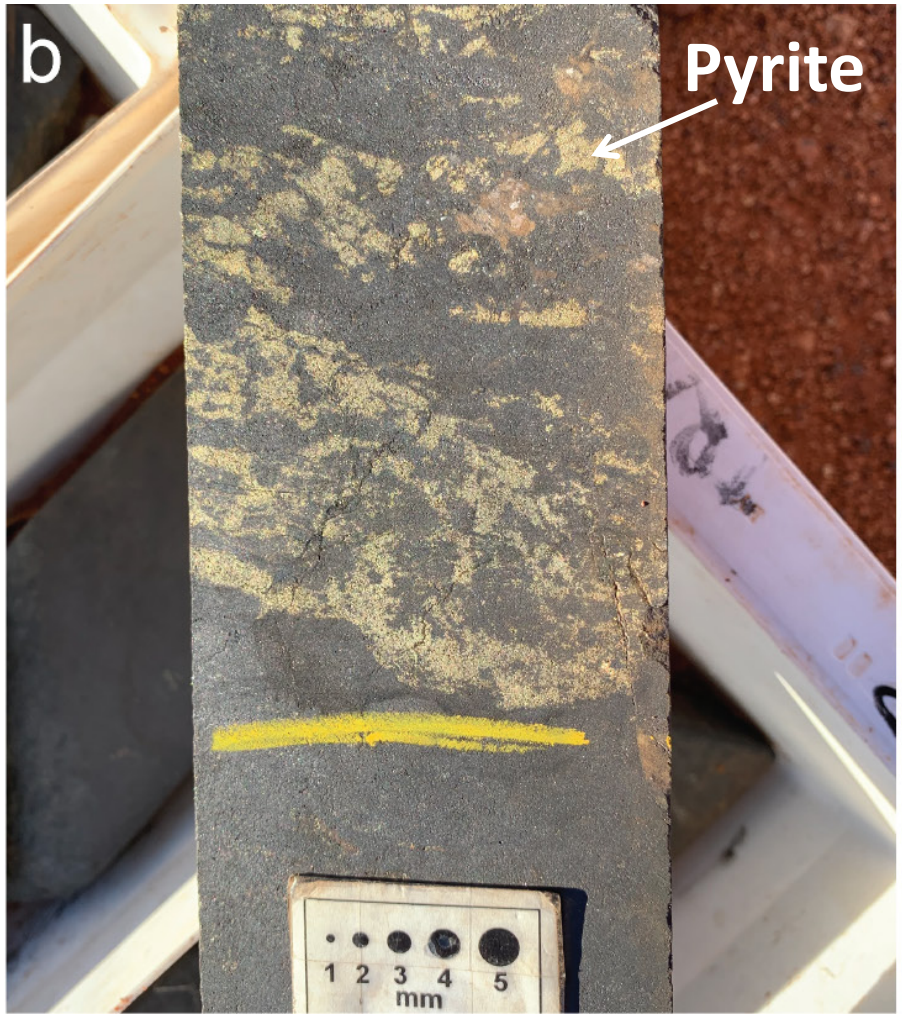
Relationship between these sediments and the iron formation still unclear

An Archaean iron formation at Hawks Nest possible

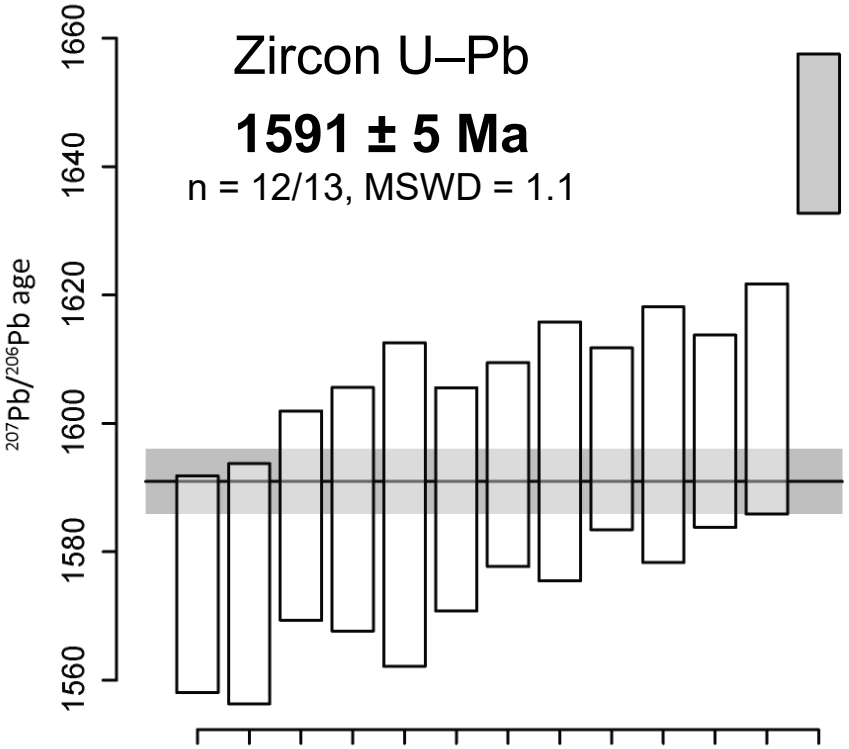
Direct Shipping Magnetite (DSM)

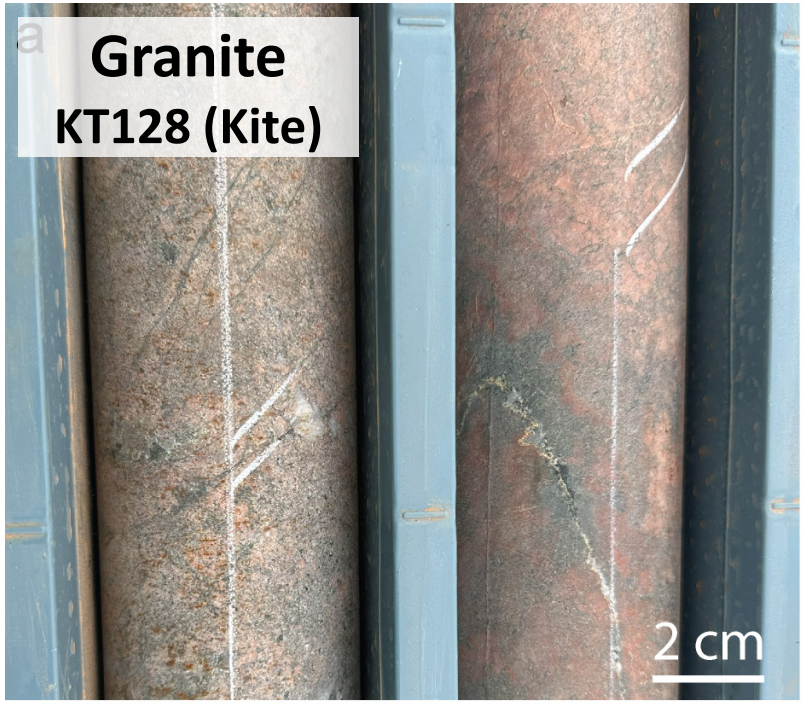
Significant magnetite resource with **~60% Fe head grade** within the Kite deposit

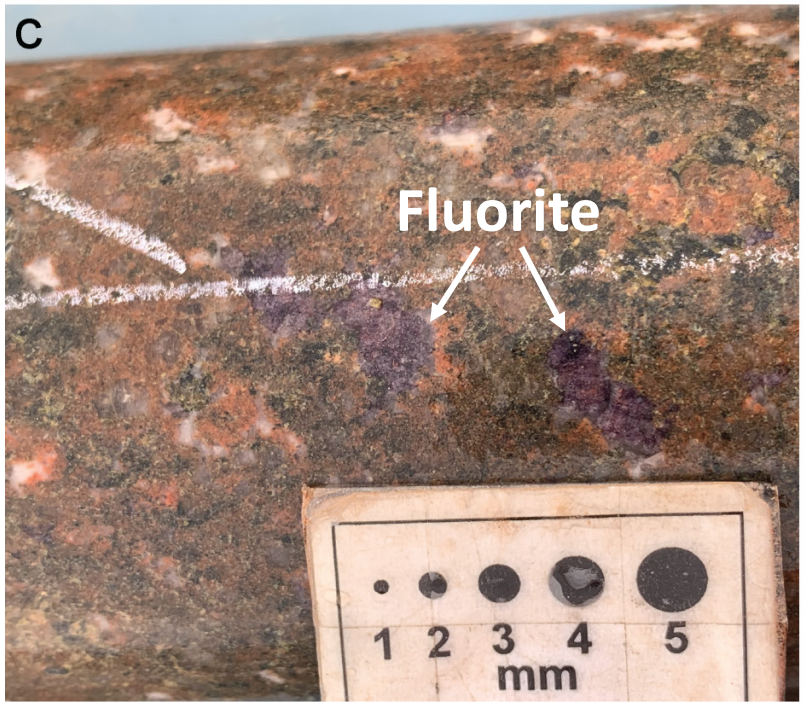




Hiltaba Suite







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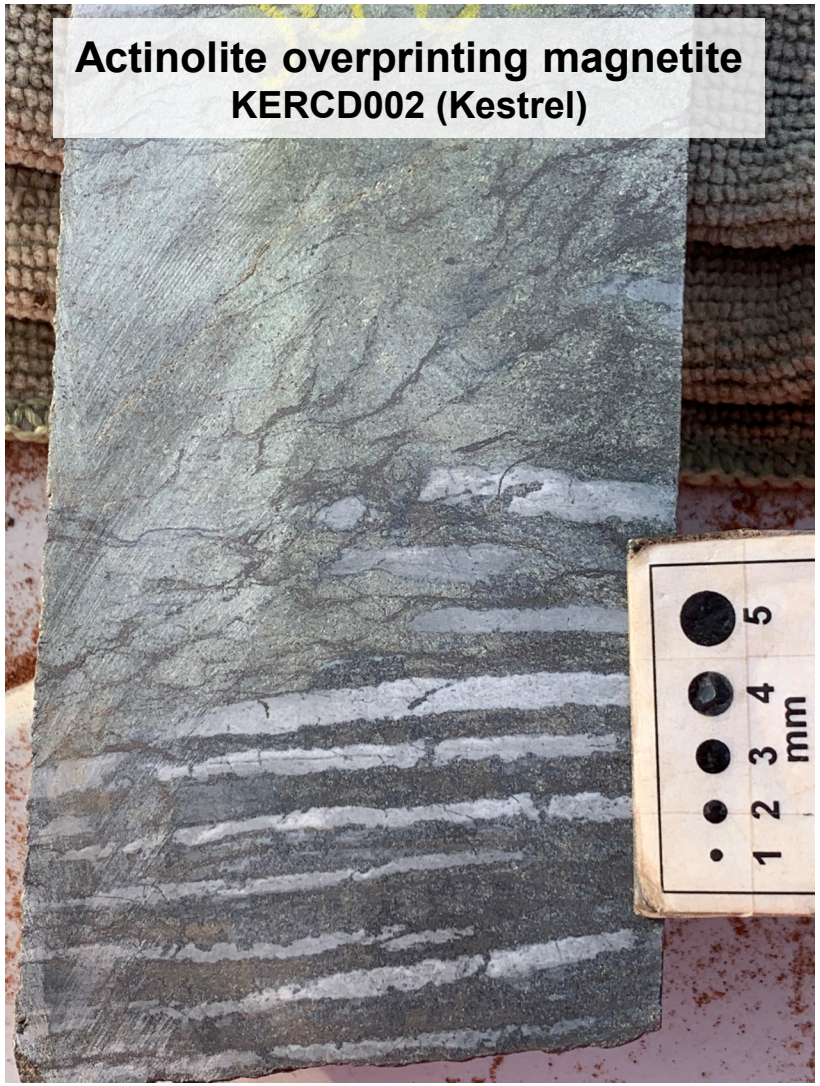
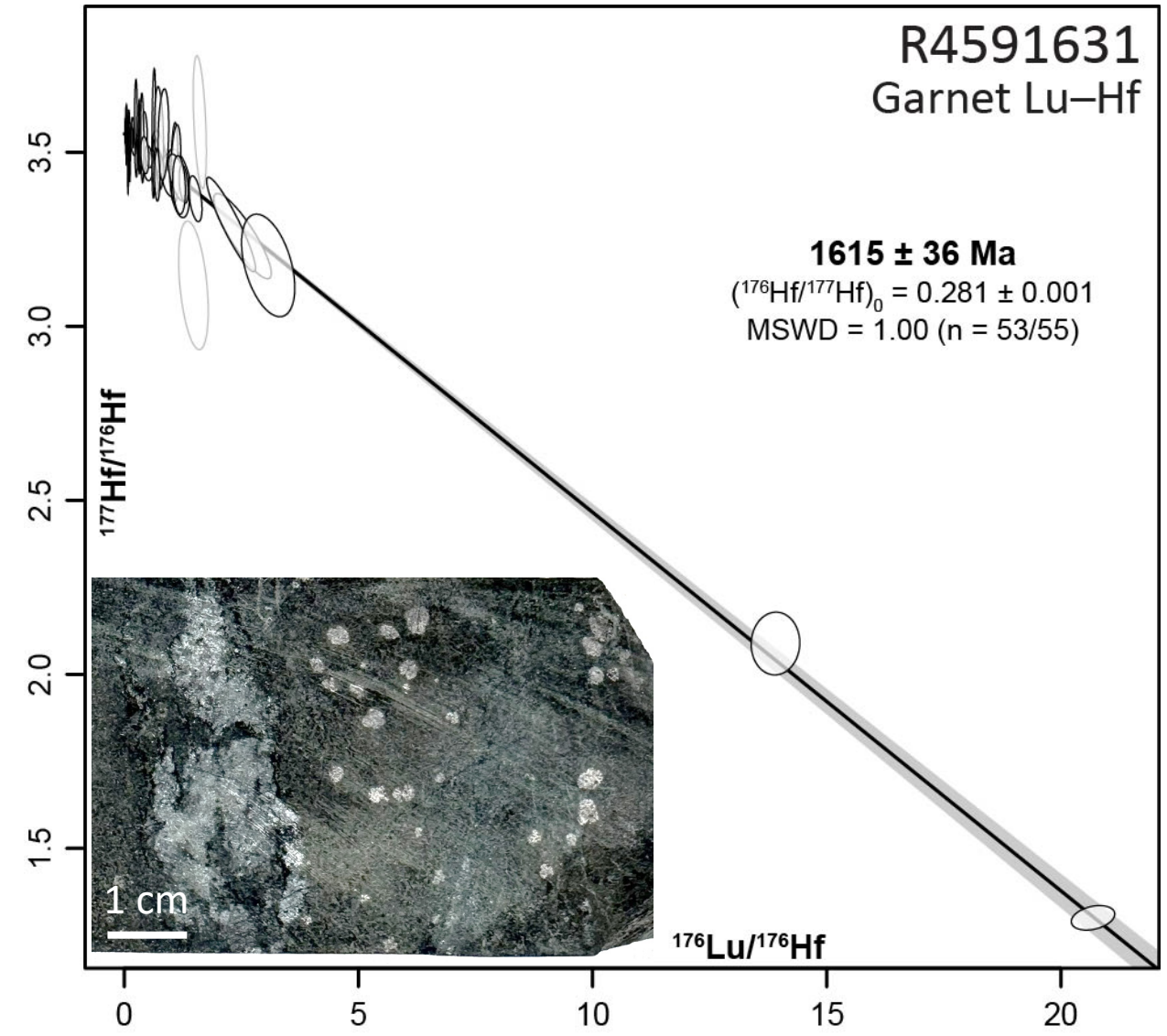
Actinolite alteration & Fe mobilisation

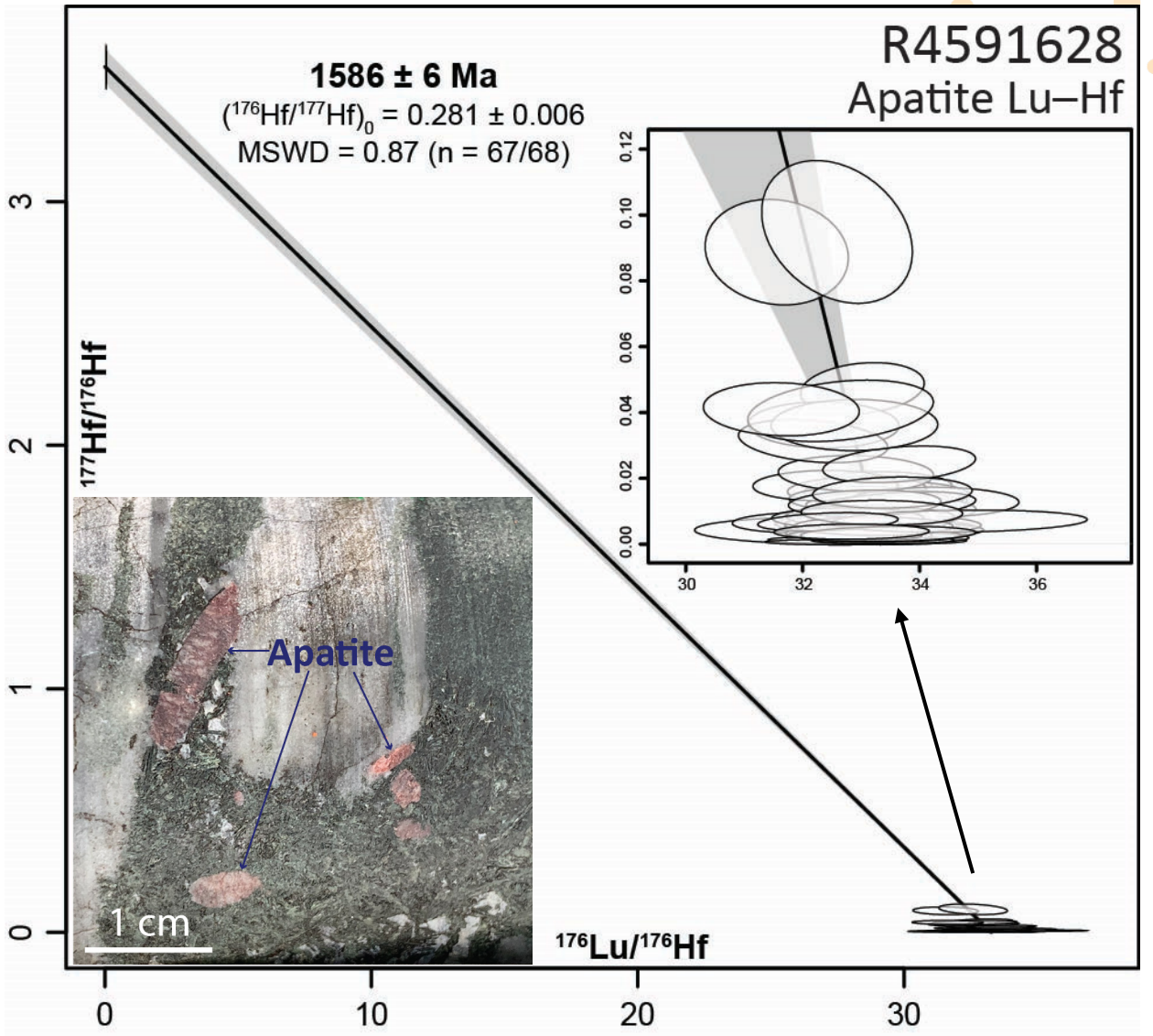


Replacement

Kite Deposit
KT128 241.9 – 242 m

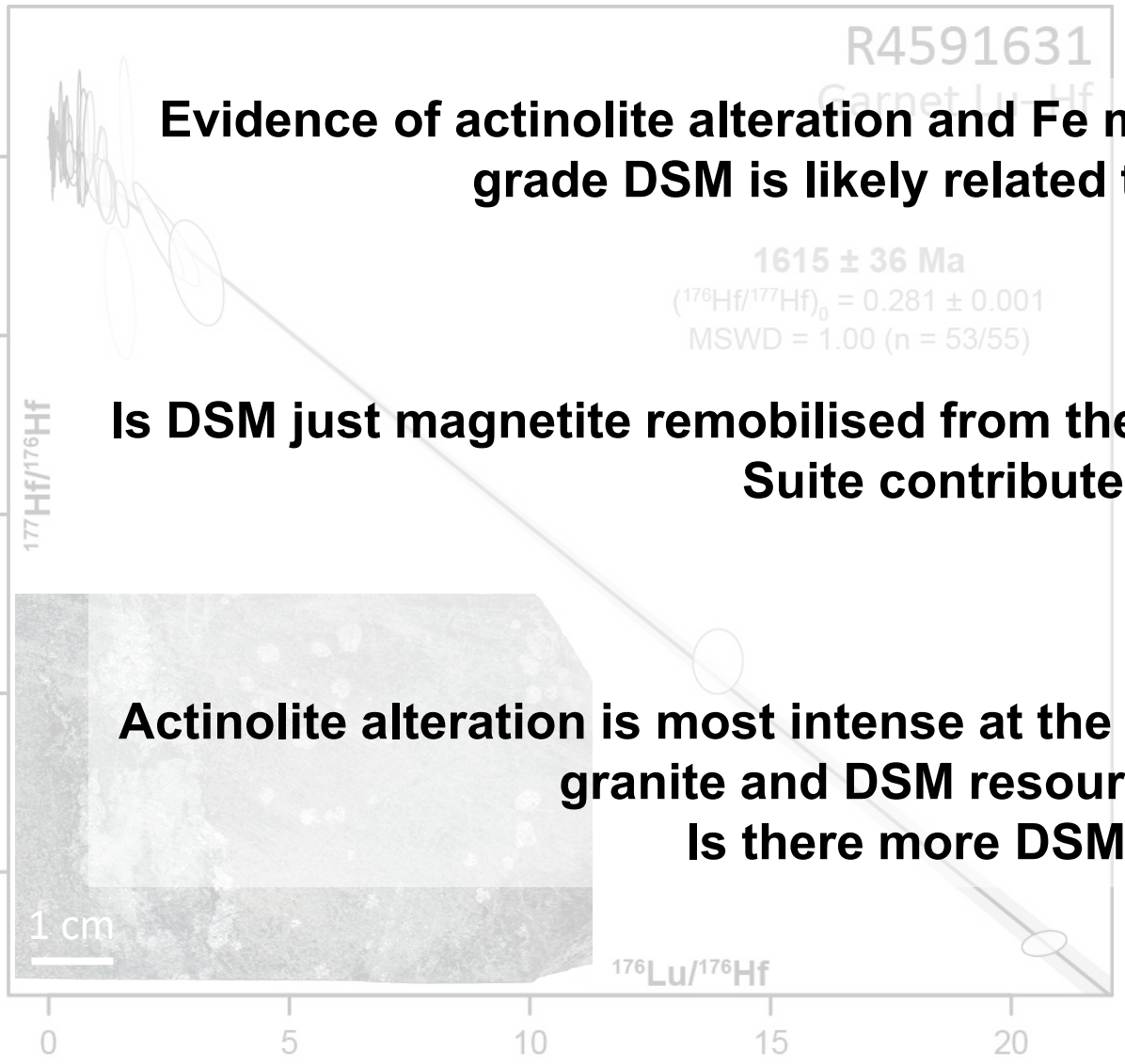


Kestrel Deposit
KERCD002 275 – 275.15 m



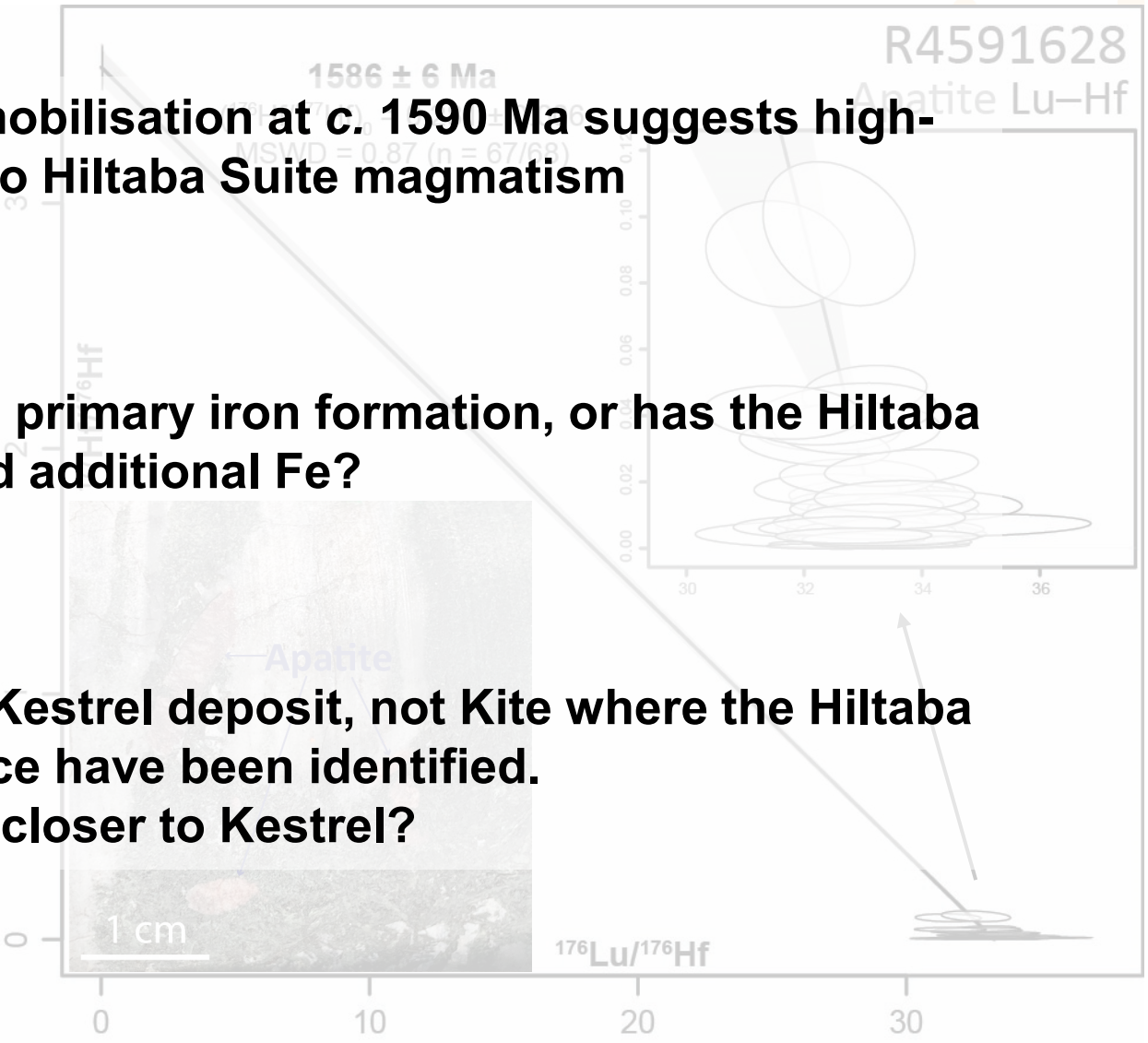
Kite Deposit

KT128 241.9 – 242 m



Kestrel Deposit

KERCD002 275 – 275.15 m



Evidence of actinolite alteration and Fe mobilisation at *c.* 1590 Ma suggests high-grade DSM is likely related to Hiltaba Suite magmatism

Is DSM just magnetite remobilised from the primary iron formation, or has the Hiltaba Suite contributed additional Fe?

Actinolite alteration is most intense at the Kestrel deposit, not Kite where the Hiltaba granite and DSM resource have been identified.
Is there more DSM closer to Kestrel?

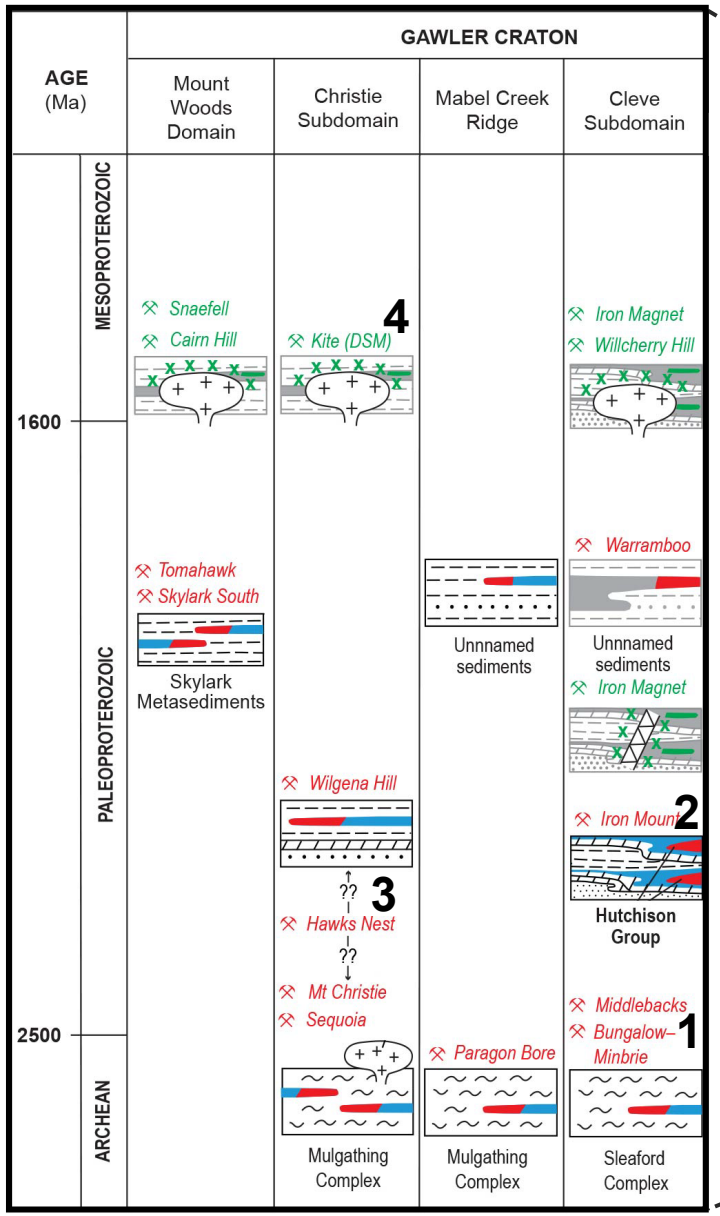
Updates to magnetite stratigraphy

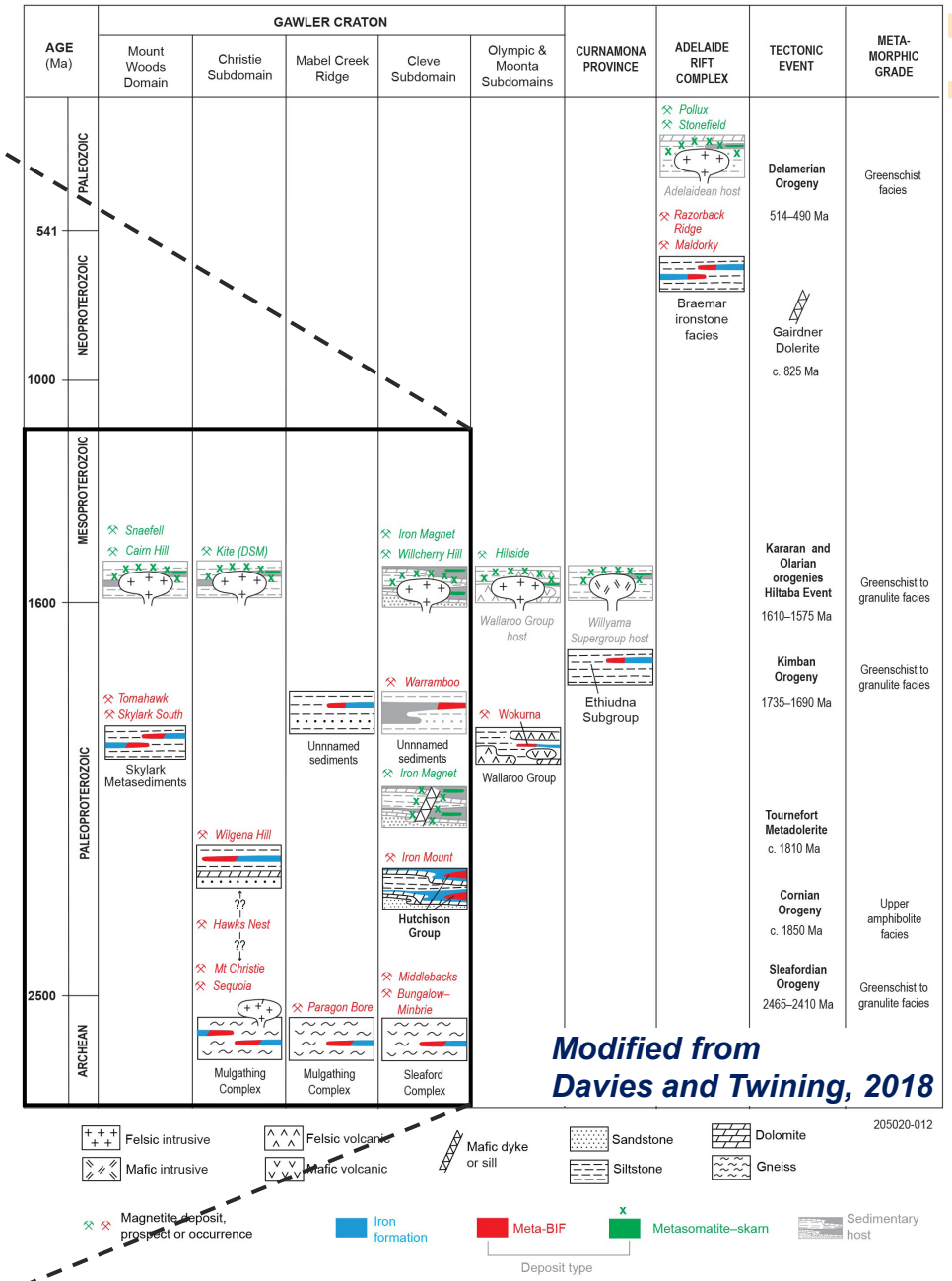
1. Middleback Jaspilite moved from Hutchison Group (Palaeoprot.) to Sleaford Complex equiv. (Archaean)

2. Iron Mount in Mount Shannan Iron Formation, Hutchison Supergroup (Palaeoproterozoic)

3. Hawks Nest unconstrained between Mulgathing Complex and Wilgena Hill Jaspilite – possibly Archaean

4. Kite DSM (Hawks Nest) formed during Hiltaba Event (*c.* 1590 Ma)





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