Rhenium-Osmium Geochronology of Sulfide Minerals: An Industry Perspective

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Proposal:

Re-Os sulfide geochronology can be a valuable tool for mineral exploration programs in Saskatchewan.

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Benefits to the Mineral Industry?

- direct, unambiguous age determination on ore/ ore-related sulfide minerals (Re = 'chalcophile')
- delineation of ore-associated geologic events (e.g. host rock, felsic/mafic magmatism, metamorphism, intra-basinal fluid flow, etc.)
- promotes understanding of ore genesis; positions ore event within tectonic framework

= more efficient exploration targeting

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Rationale

- Re (and Os) preferentially partition into sulfides from precipitating fluid/melt
- ^{187}Re decays to ^{187}Os ($T_{\frac{1}{2}}$ = 41.6 b.y.) from time of crystallization to present
- if Re/Os composition remains undisturbed(*), yields time of mineralization

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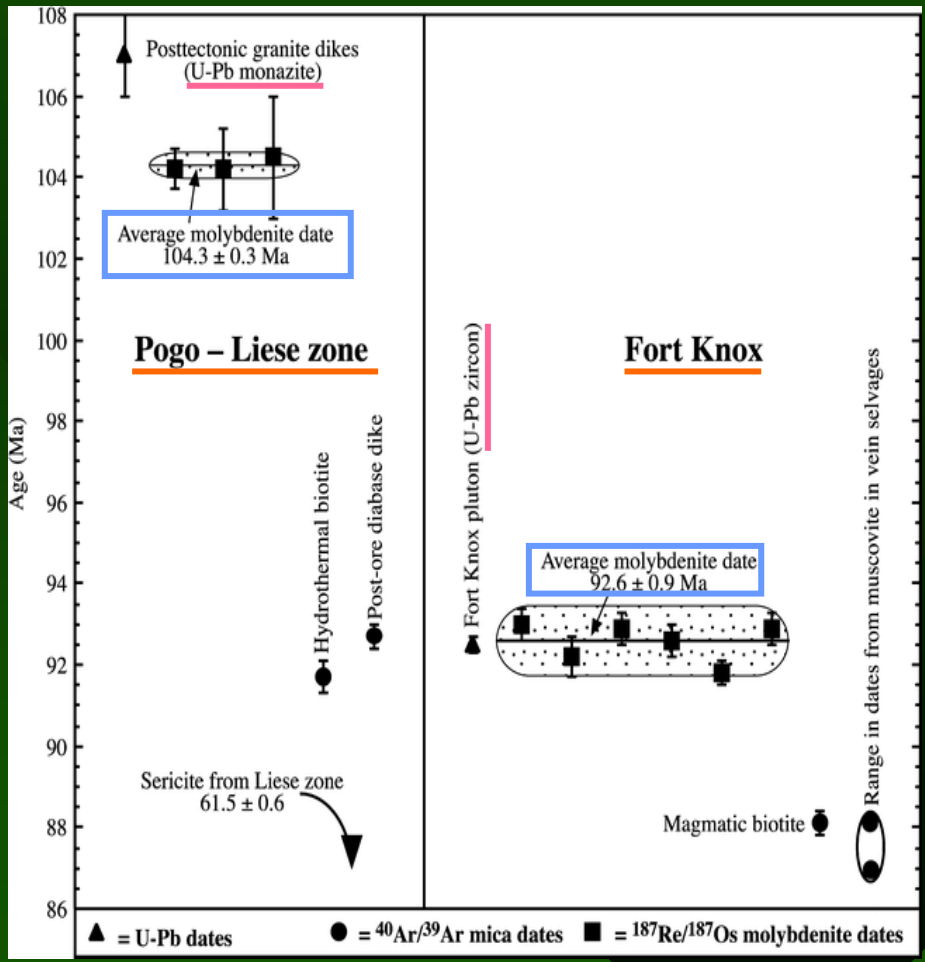
Re-Os Molybdenite Geochronology



Selby et al., 2002, *Geology*: v.30, p.791-794.

Re-Os 'low-level' sulfide geochronology

- fulfills a need to obtain absolute ages for common minerals with a cogenetic association with ore.
- theoretically sound, extremely difficult in practice (analytical considerations, extremely low Re, Os concentrations).
- 'isochron' construction usually required
- testing for accuracy and precision required using natural examples with reasonable age constraints and well defined thermal histories

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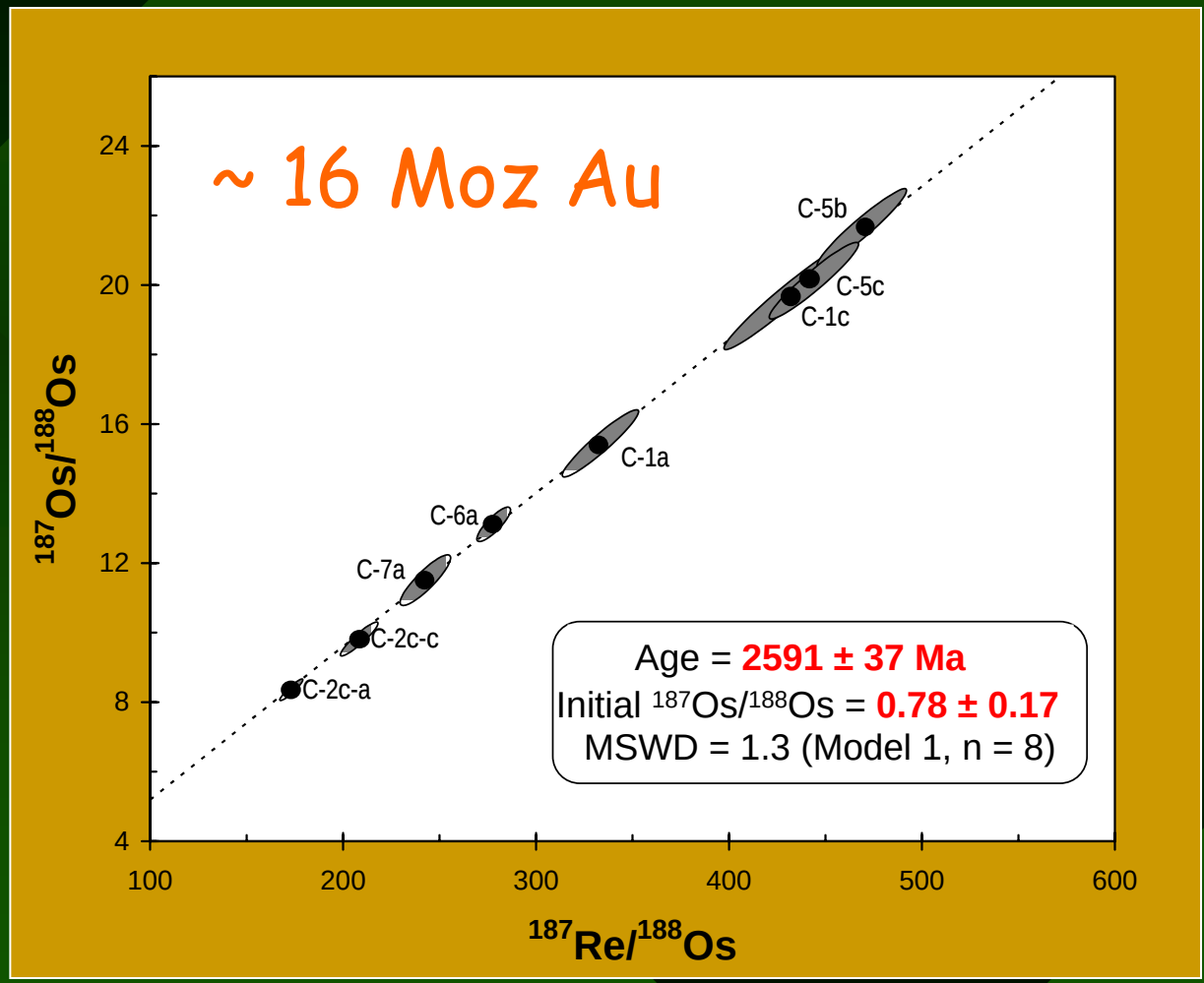
i. Archean gold: Con Deposit, NWT



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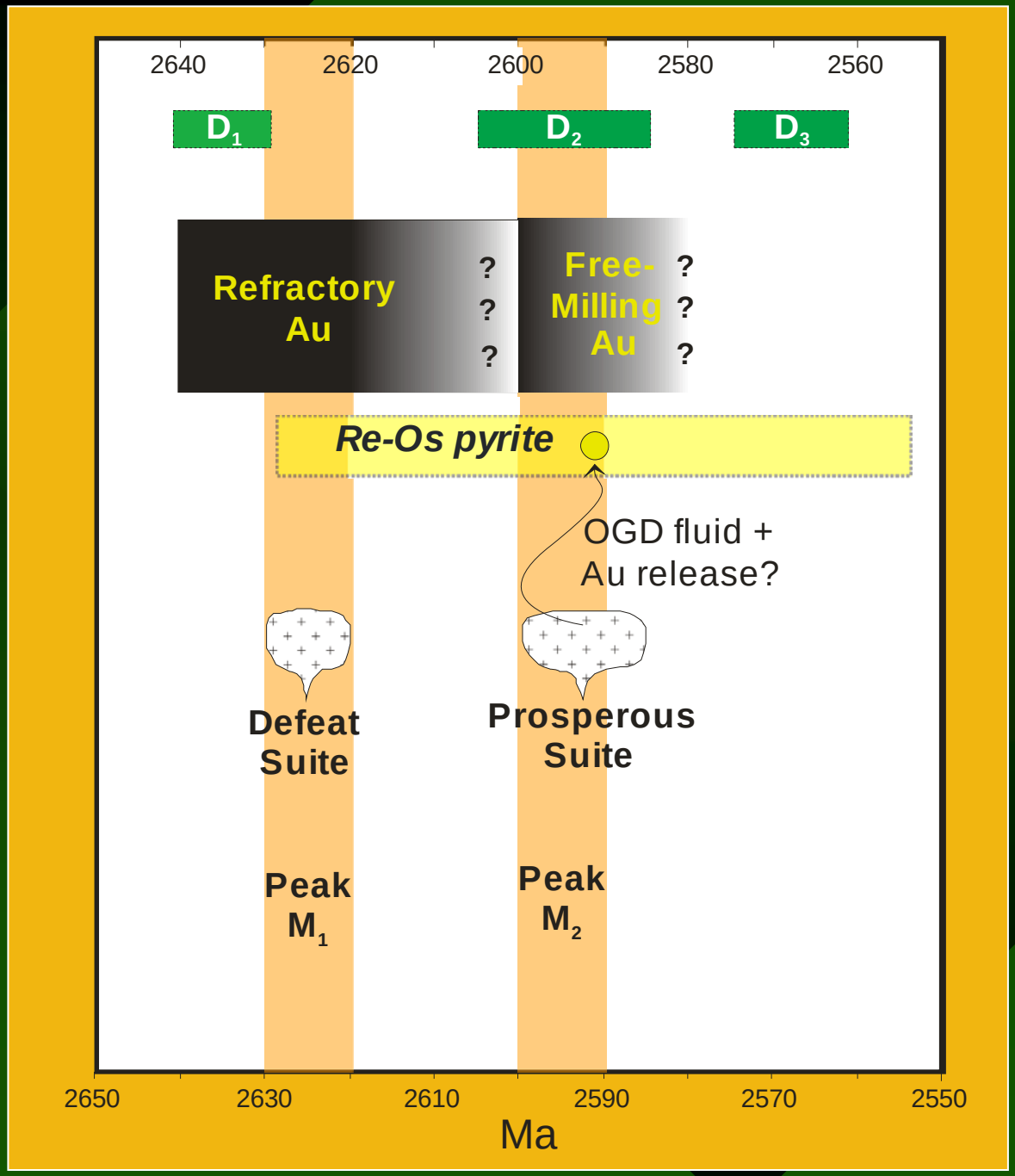

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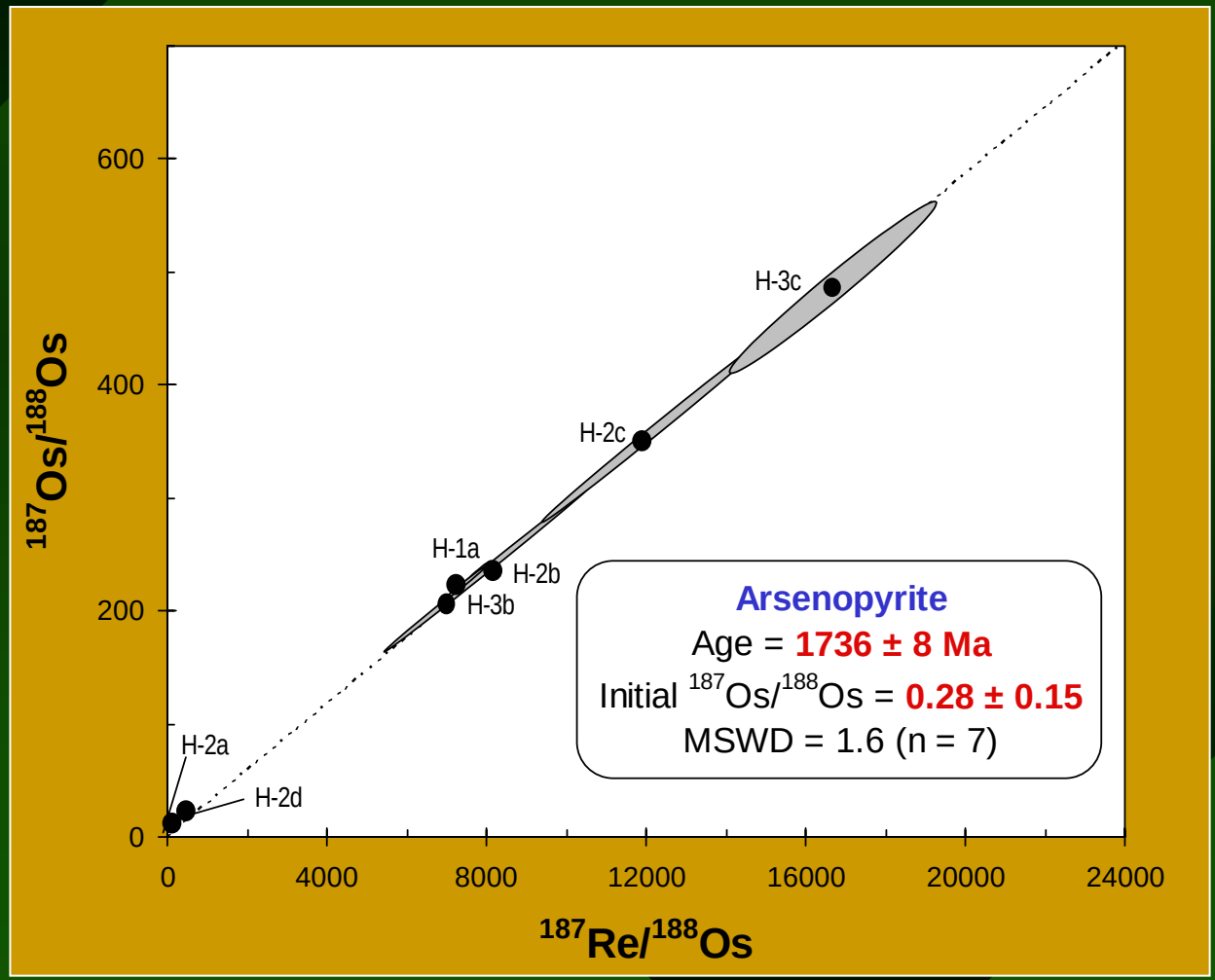
ii. Homestake, South Dakota



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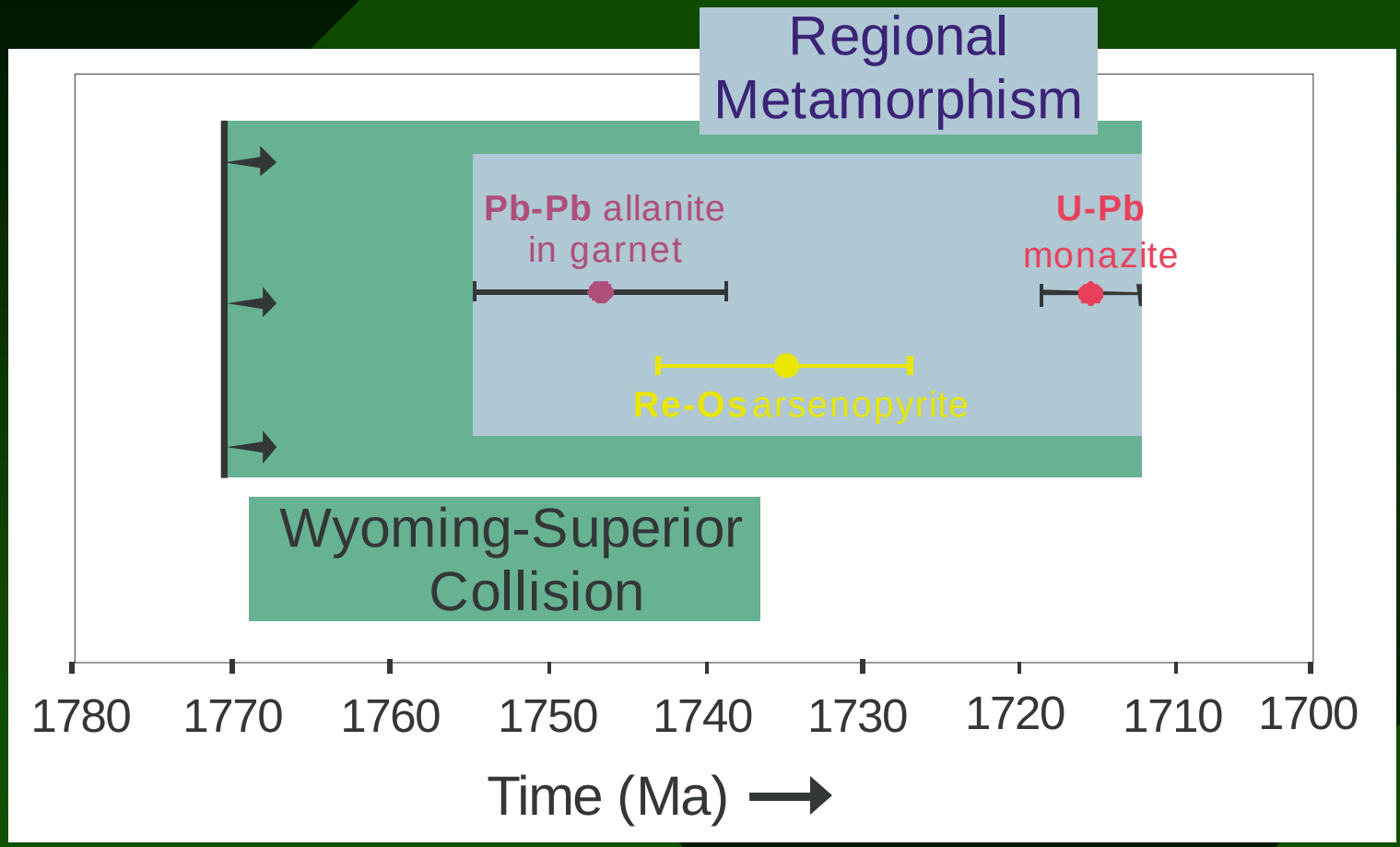

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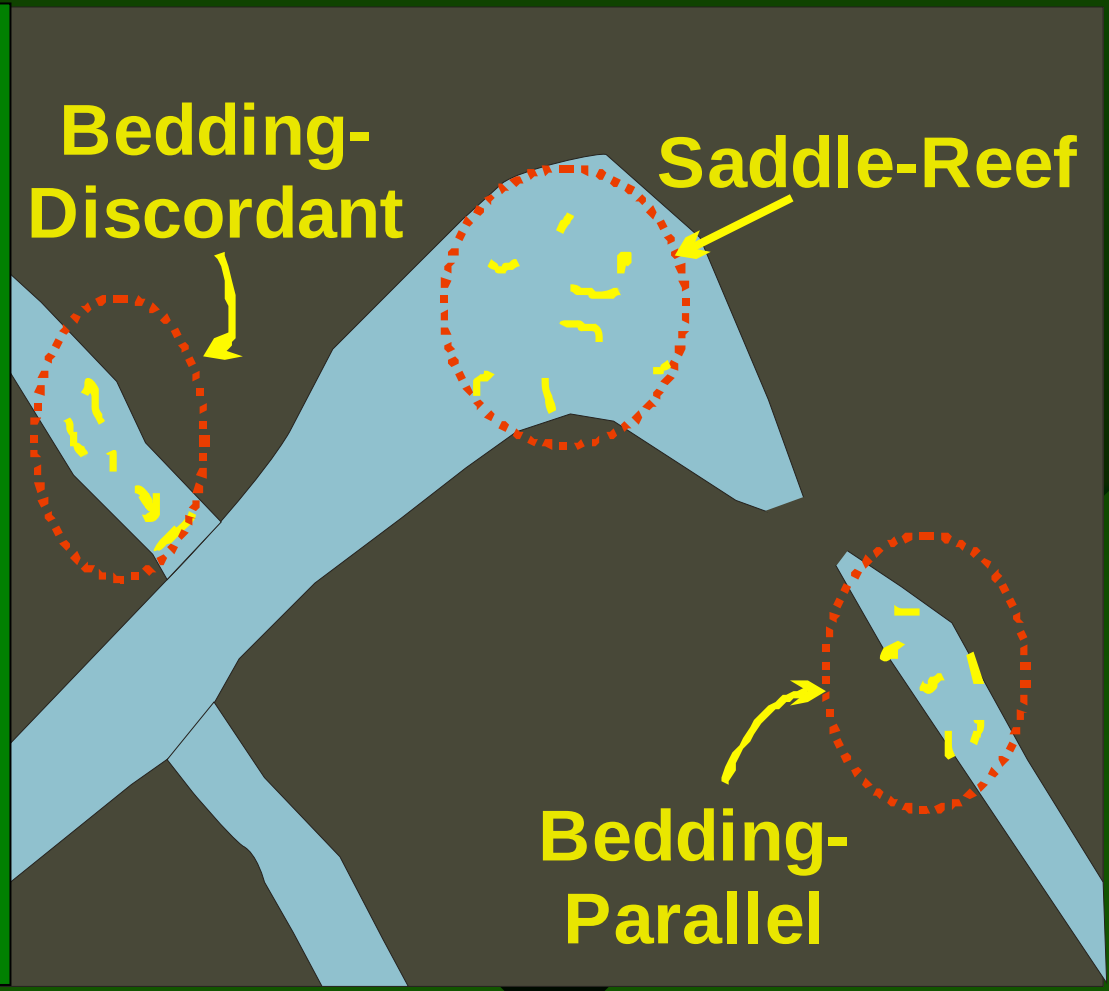
iii. Meguma Deposits, Nova Scotia

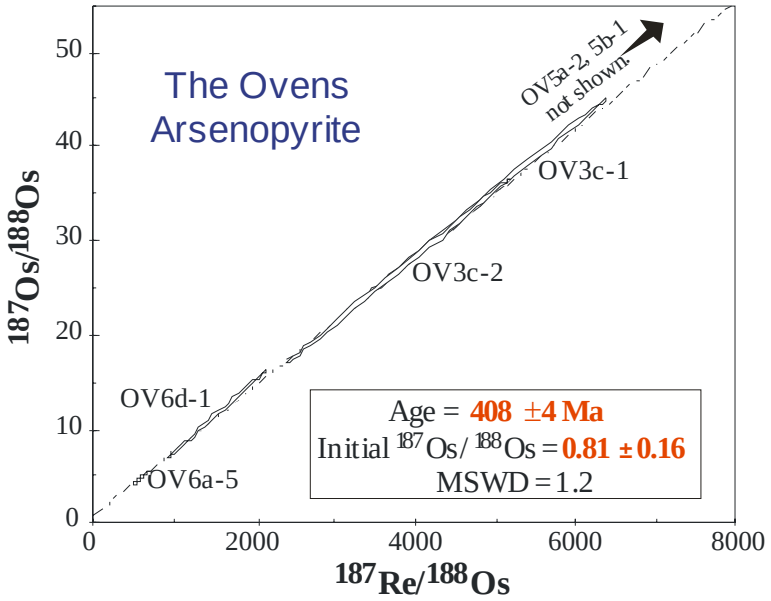
-all vein types present at Dufferin, Ovens, other deposits

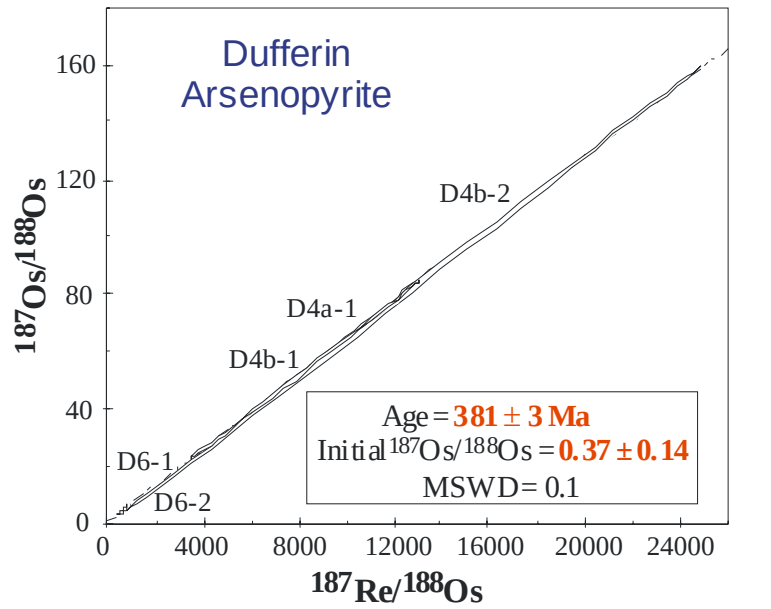
- <u>all</u> gold ca. 375 Ma (Ar-Ar mica)

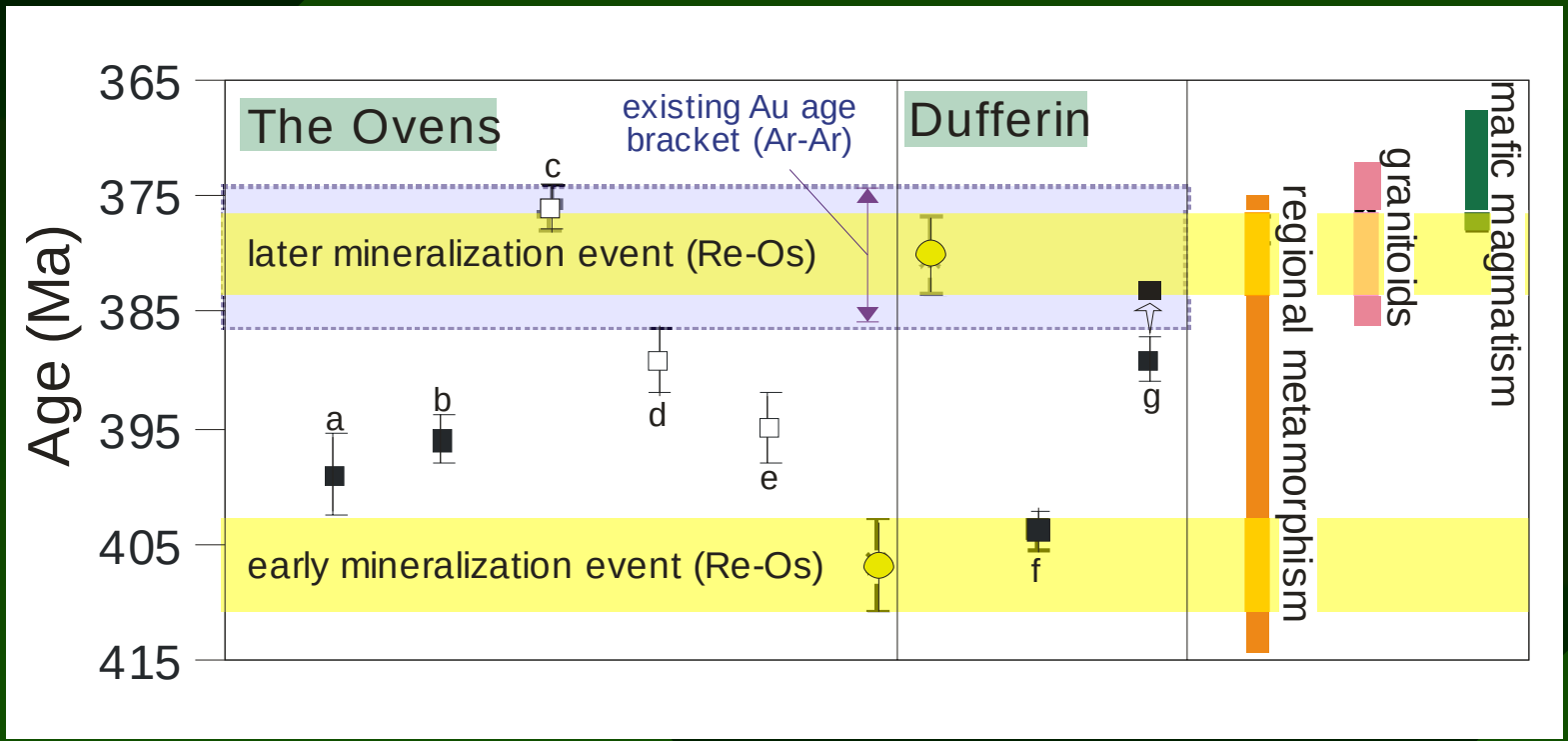


The Ovens:
< 50,000 oz Au

Dufferin:
~ 97,000 oz Au







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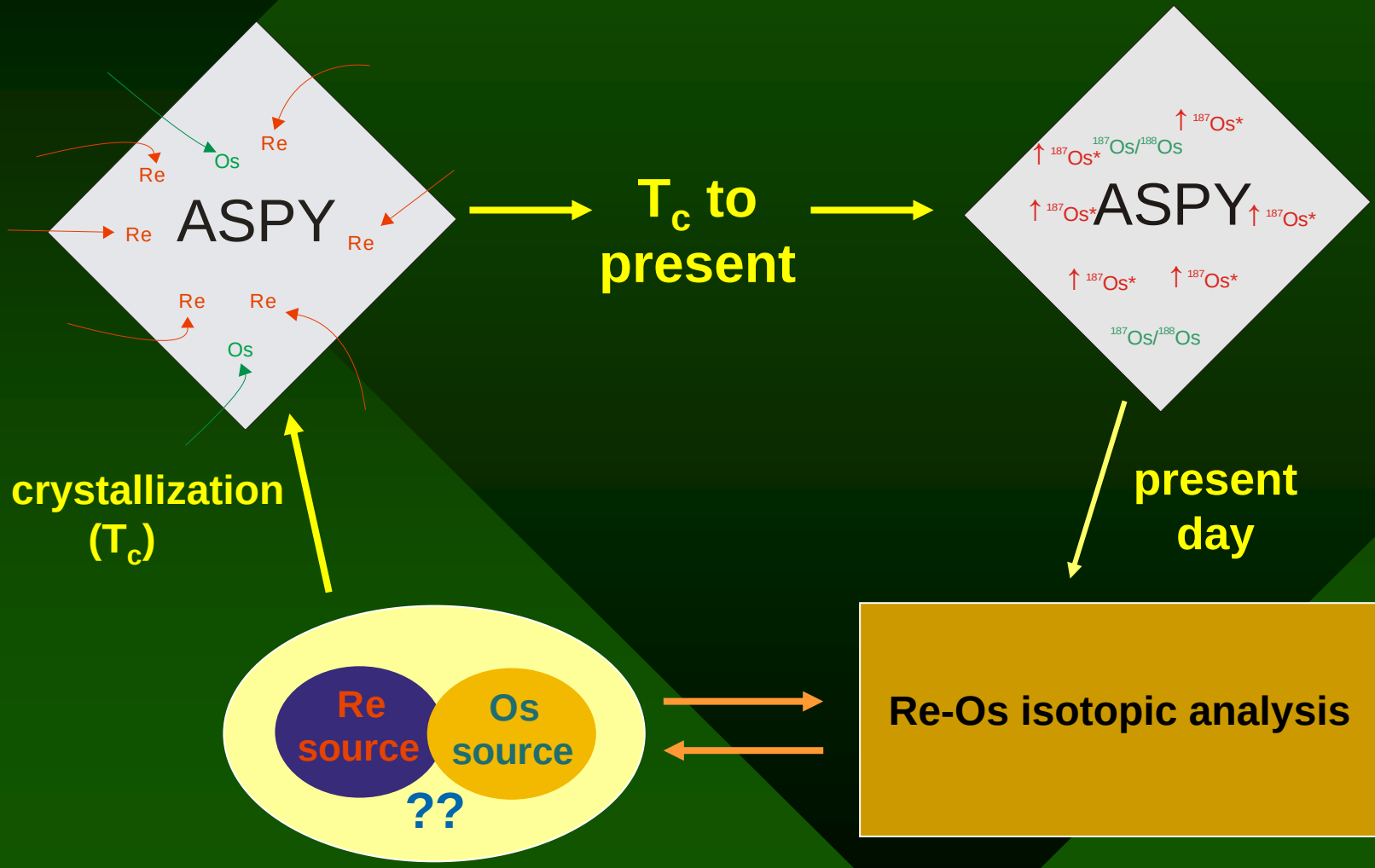
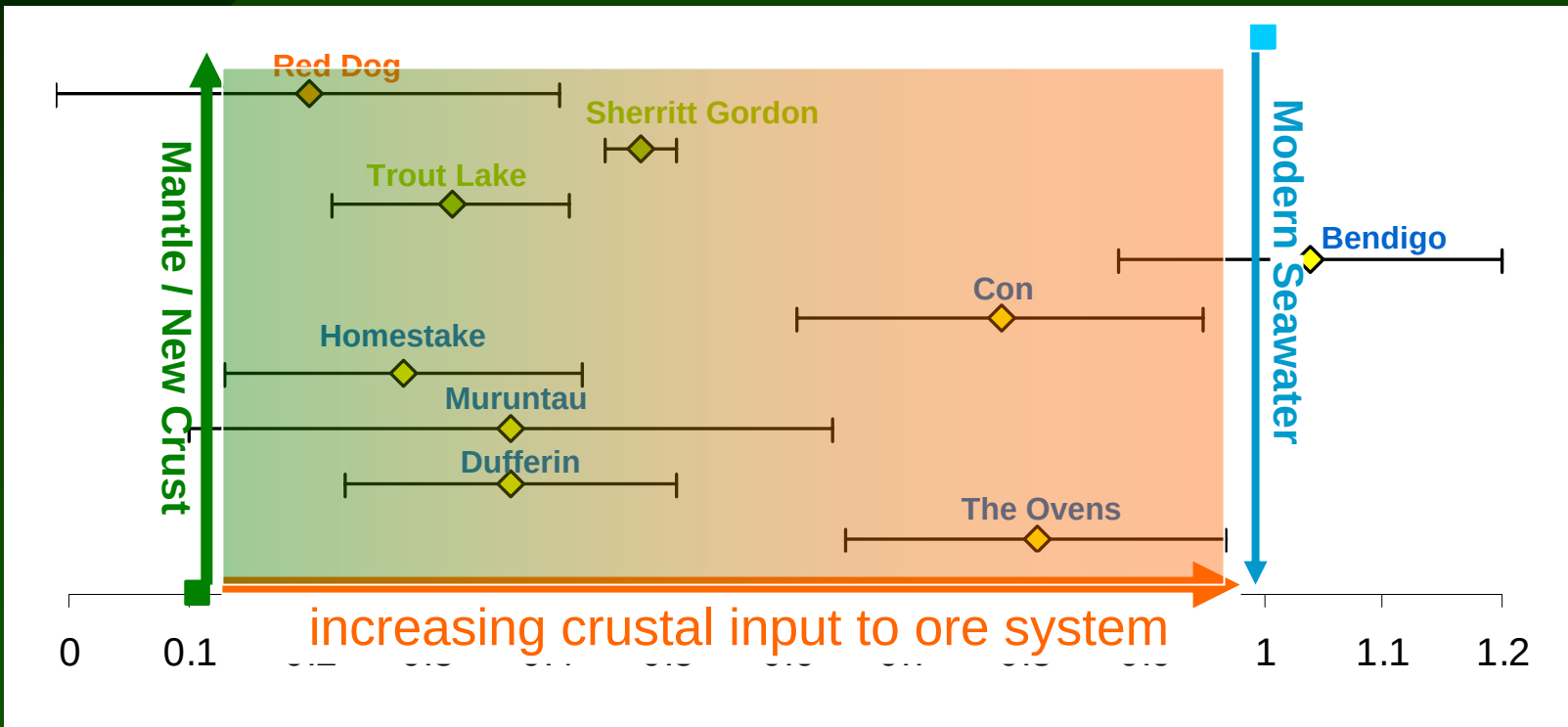
'Initial' $^{187}Os/^{188}Os$ ratios:



'Initial' Os cont'd:



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Other Studies:

X

Red Lake Au, Ontario

Kalgoorlie Au, W. Australia

Touquoy Au, Nova Scotia

✓

Con Au, NWT

Homestake Au, USA

Meguma Au, Nova Scotia (The Ovens, Dufferin)

Muruntau, Uzbekistan

THO VMS (Trout Lk., Konuto Lk., Harmin, Sherritt Gordon)

Red Dog Zn-Pb Sedex

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Conclusions / Current Status

- Re-Os sulfide geochronology can be an extremely valuable exploration tool by revealing (i) **timing of ore deposition** and (ii) **metal sources to deposits**, through initial Os ratios
- molybdenite is superior for Re-Os geochronology (but, no initial Os ratios)
- pyrite and arsenopyrite are robust Re-Os chronometers (>500°C); chalcopyrite moderately robust (~400°C?)
- sphalerite and pyrrhotite are poor choices (< 350°C)
- also Re-Os dating of black shales, bitumen, hydrocarbons, diamond sulfide inclusions.....

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Thank you!!

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