What the Yukon's "Second Gold Rush" has revealed about metallogeny of the northern Yukon-Tanana terrane

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GSA Denver 2013

Yukon Gold Project MDRU Mineral Deposit Research Unit

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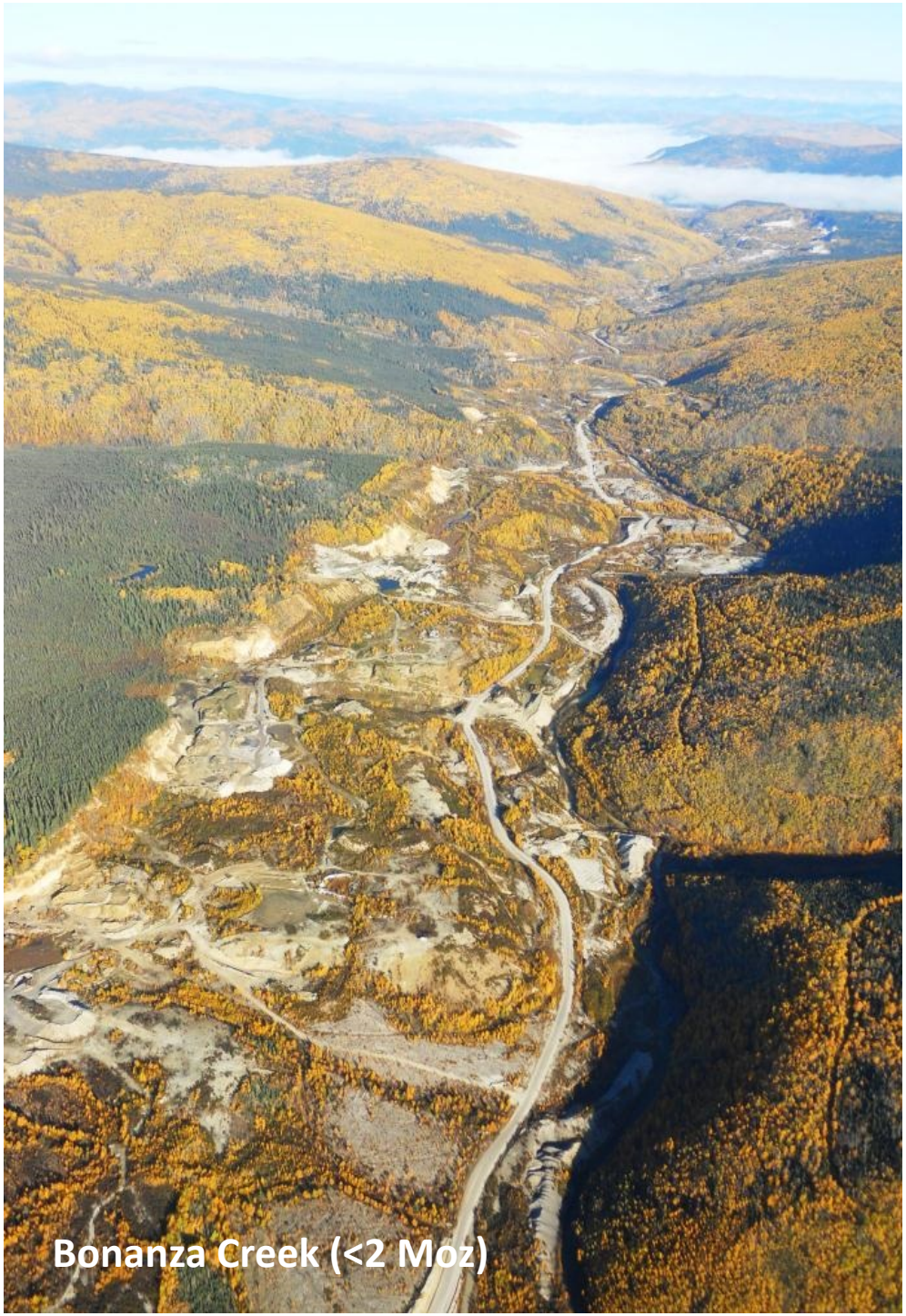
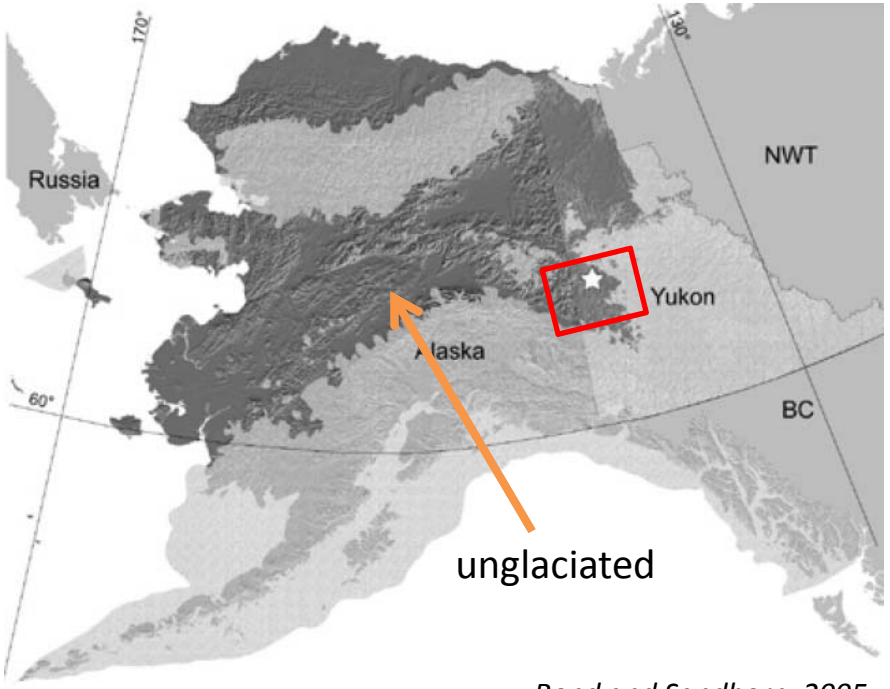
Presentation Outline

1. "Second Gold Rush" of 2008-2012 & the discovery of the White Gold and Coffee deposits
2. Tectonic & metallogenic setting of the Yukon-Tanana terrane
3. New framework for gold metallogeny in emerging exploration areas

FULL DETAILS:
Magmatic and Metallogenic Framework for west-central Yukon and eastern Alaska
Allan et al., 2013, SEG Special Publication 17



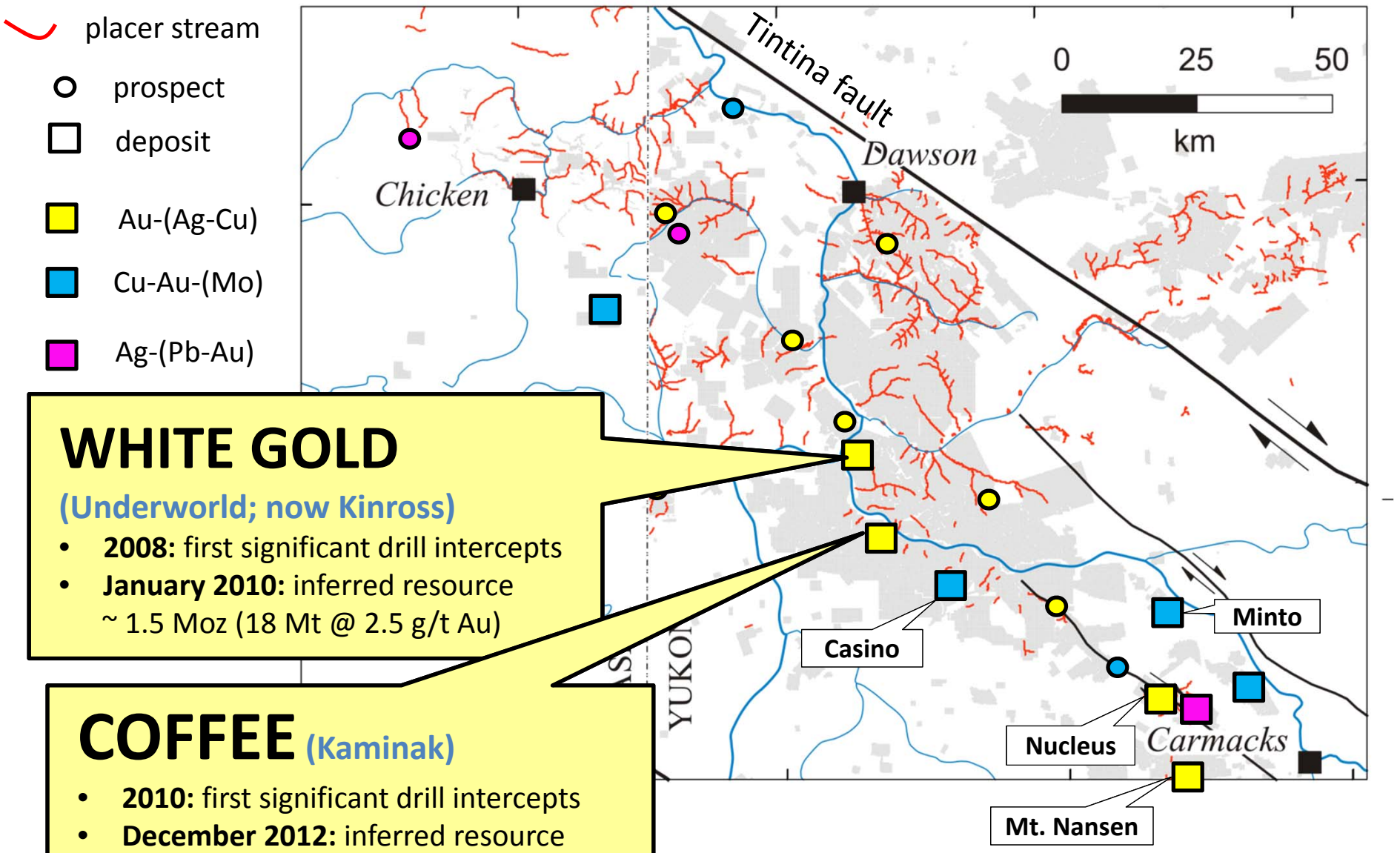


Bond and Sandborn, 2005

- **Region unaffected by Quaternary glaciation**
- **Deep regolith, poor outcrop**
- **Extensive development of placer gold deposits = obvious lode gold potential**
- **Soil geochemistry highly effective exploration method**

Recent Exploration Activity

Claims as of August 2013



WHITE GOLD

(Underworld; now Kinross)

- **2008:** first significant drill intercepts
- **January 2010:** inferred resource
  ~ 1.5 Moz (18 Mt @ 2.5 g/t Au)

COFFEE (Kaminak)

- **2010:** first significant drill intercepts
- **December 2012:** inferred resource
  3.24 Moz (64 Mt @ 1.56 g/t Au)

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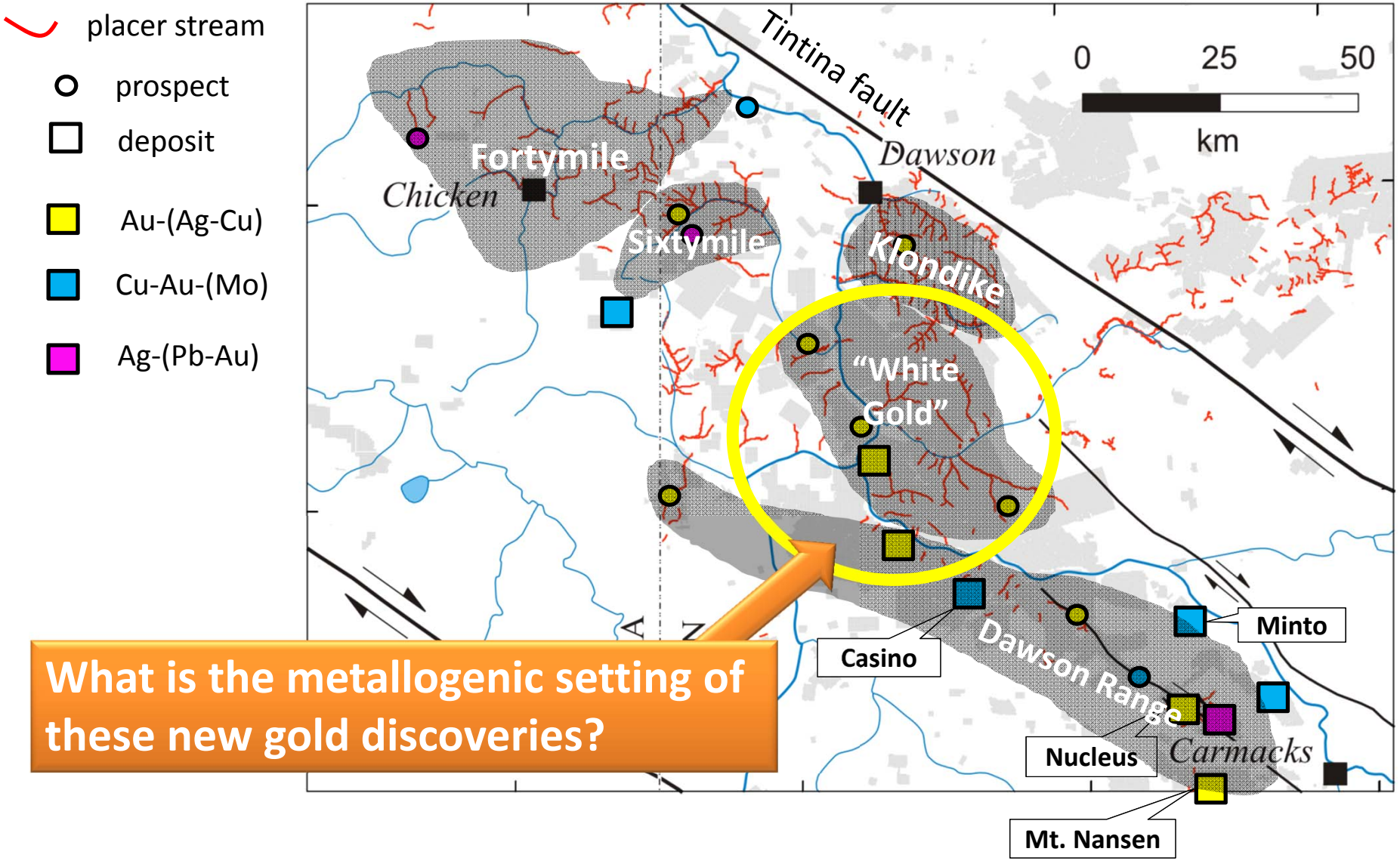
Recent Exploration Activity

Claims as of August 2013



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Tectonic & Metallogenic Setting

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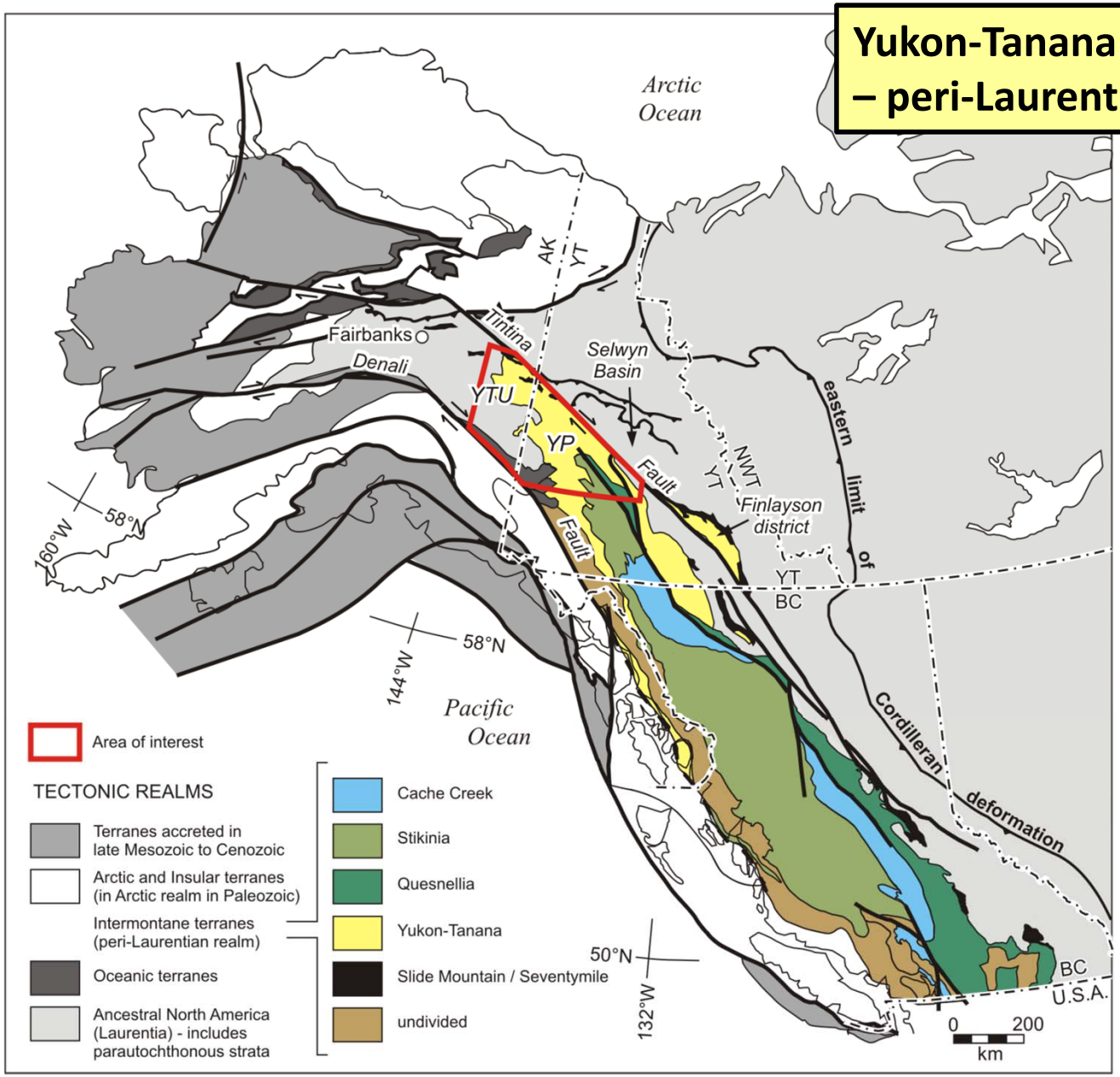
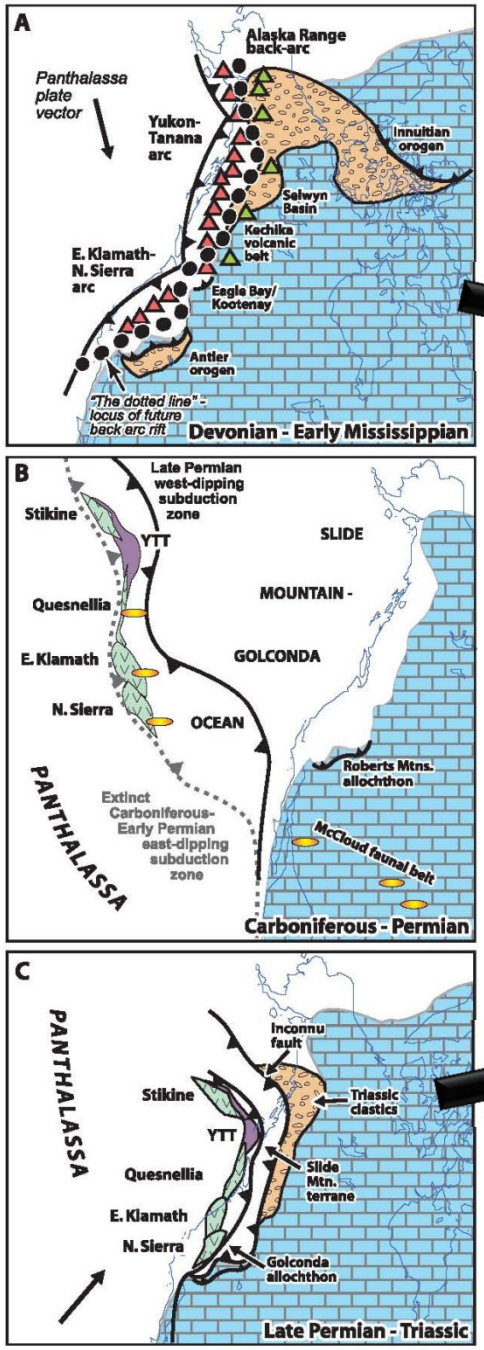
Yukon-Tanana terrane (YTT) – peri-Laurentian realm



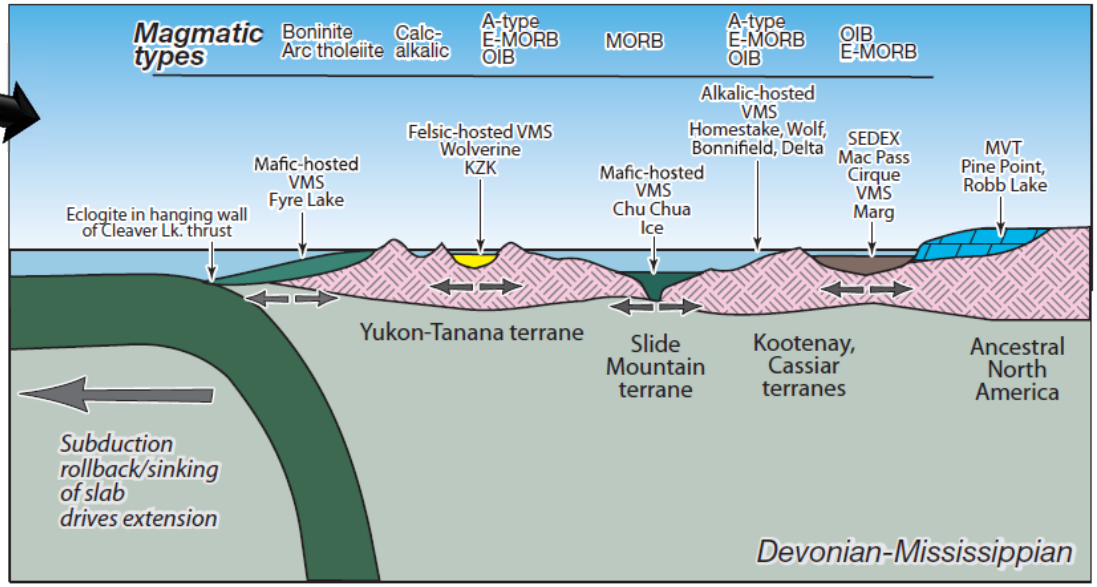
Allan et al., SEG SP17, 2013



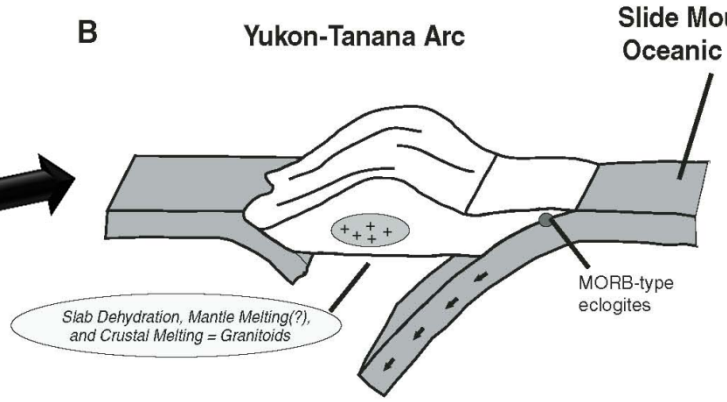
Colpron et al. (2007)

LATE DEVONIAN-EARLY MISSISSIPPIAN

- arc magmatism (Finlayson/Fortymile River assemblages)
- **VMS productivity**



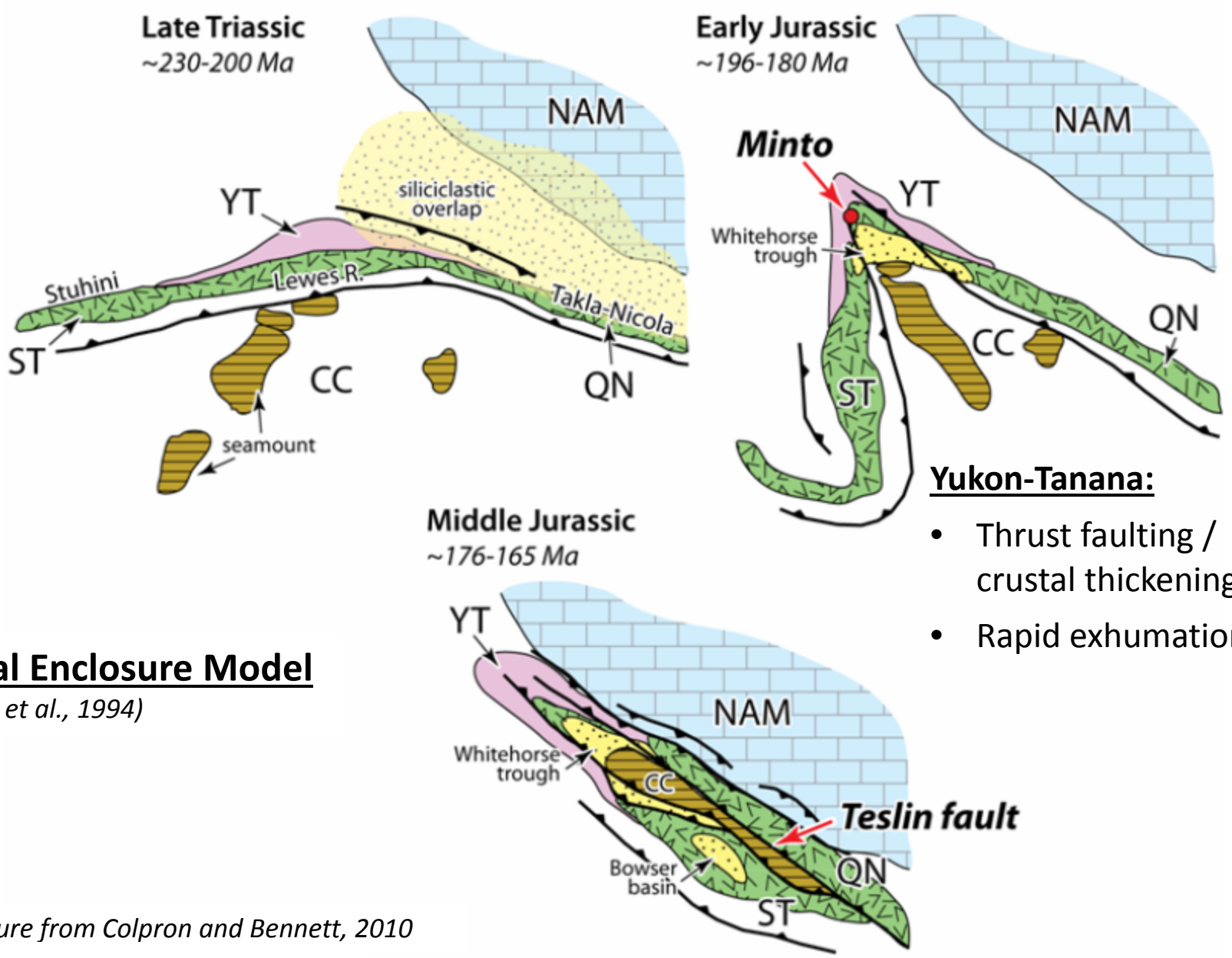
Nelson et al. (2013)



Ruks et al. (2006)

LATE PERMIAN

- subduction reversal & arc formation (Klondike assemblage)
- **VMS productivity**



Oroclinal Enclosure Model

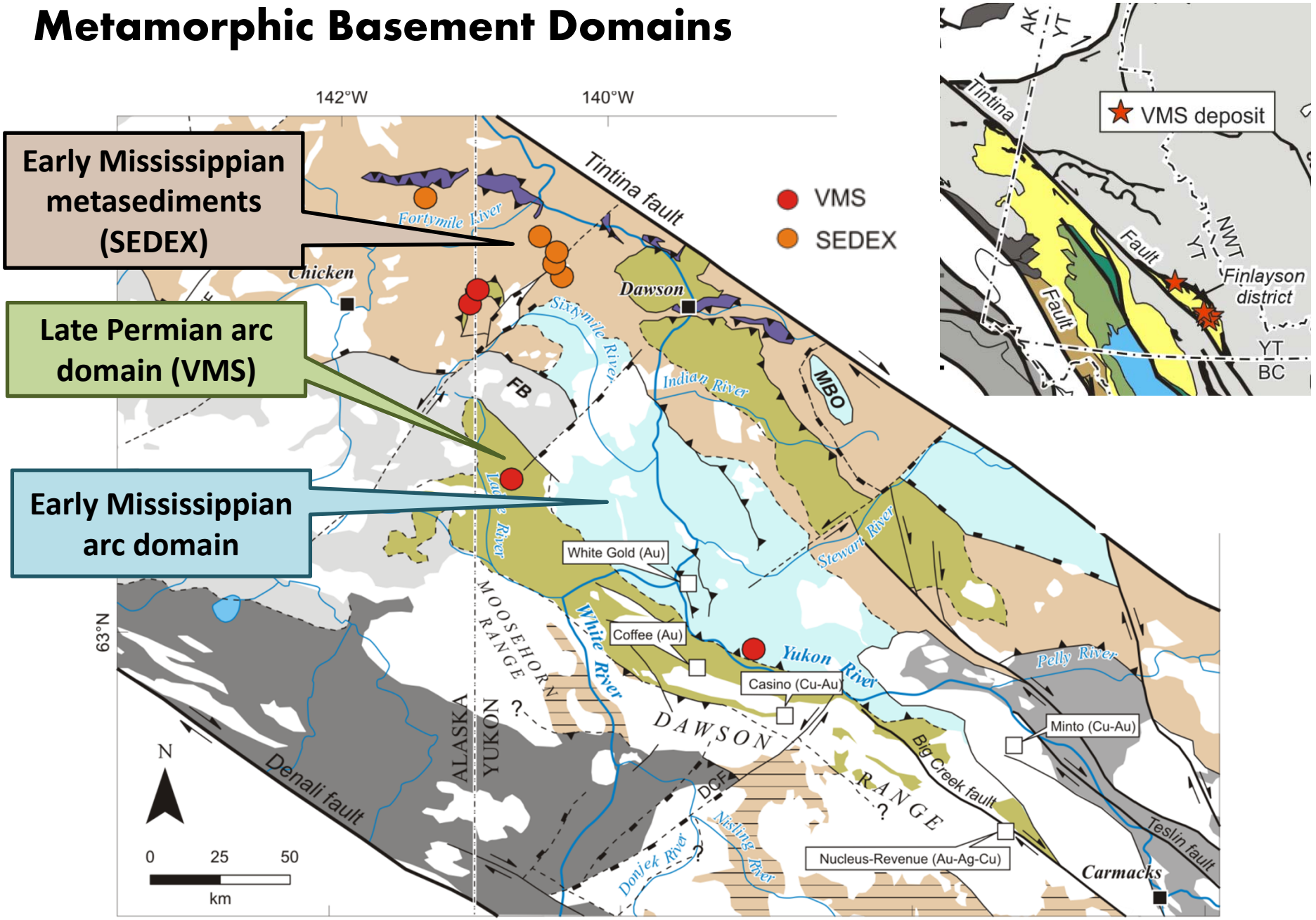
(Mihalynuk et al., 1994)

Yukon-Tanana:

- Thrust faulting / crustal thickening
- Rapid exhumation

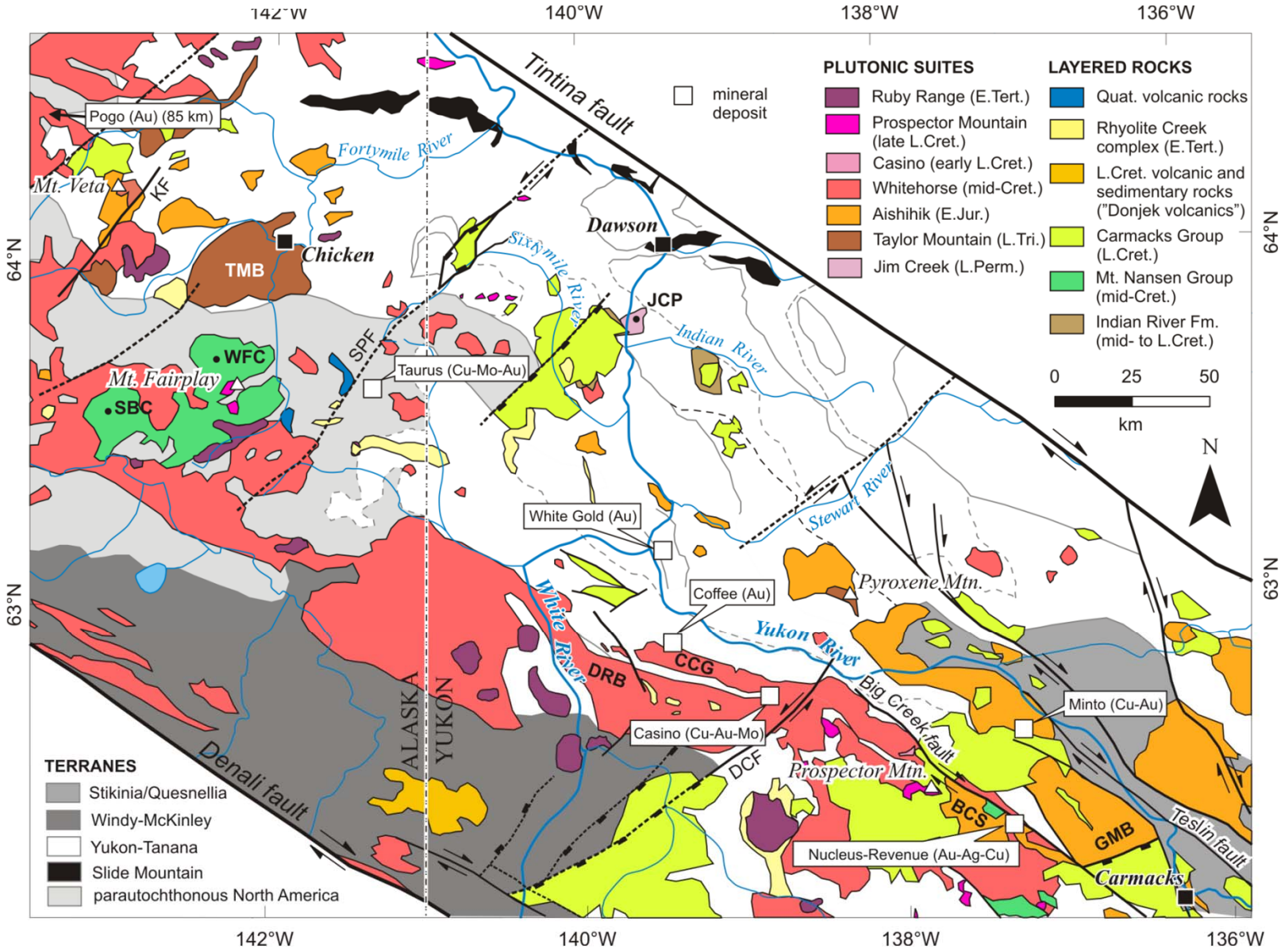
Figure from Colpron and Bennett, 2010

Metamorphic Basement Domains



modified from Allan et al., SEG SP17, 2013

Magmatic Framework

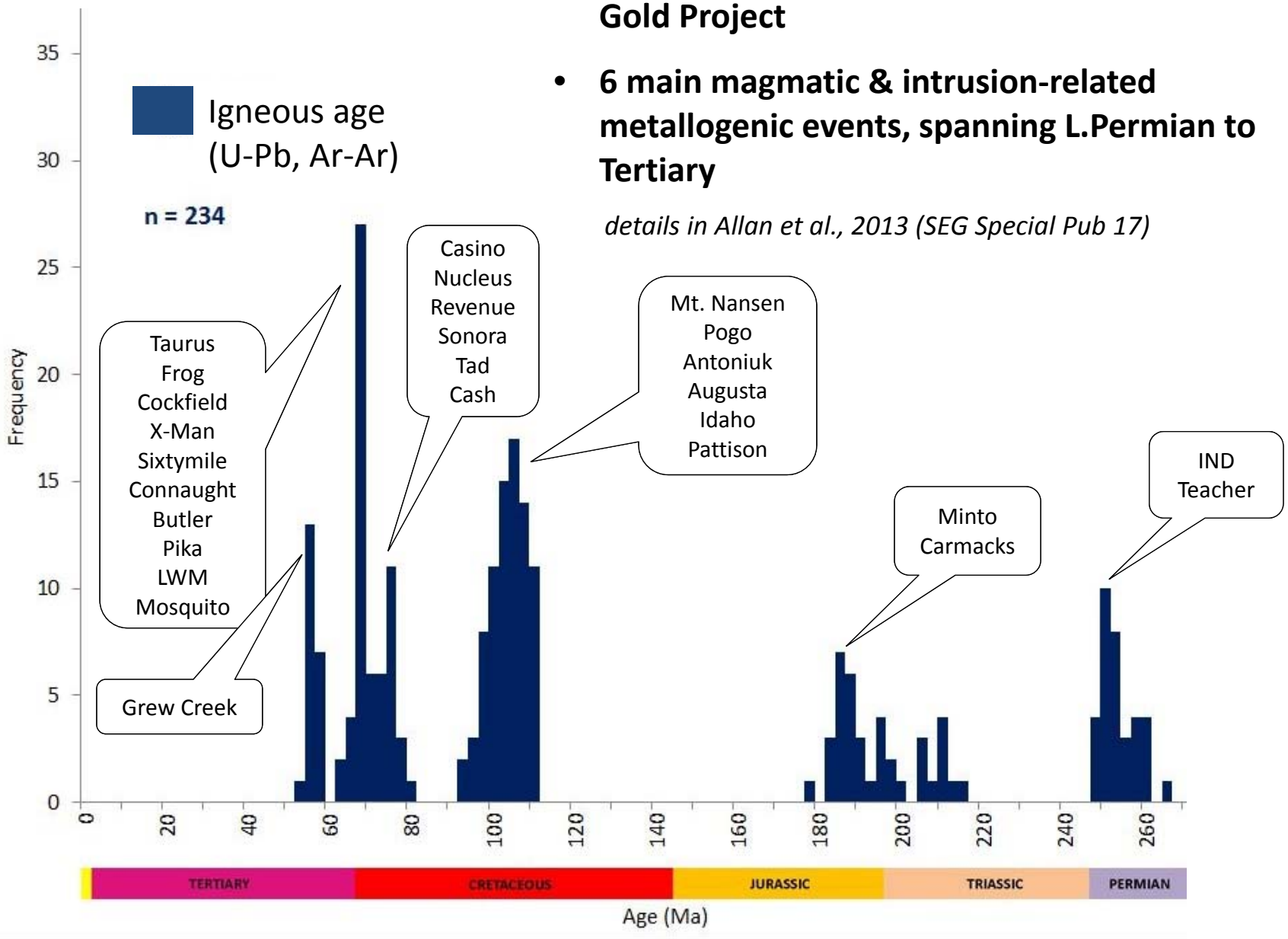


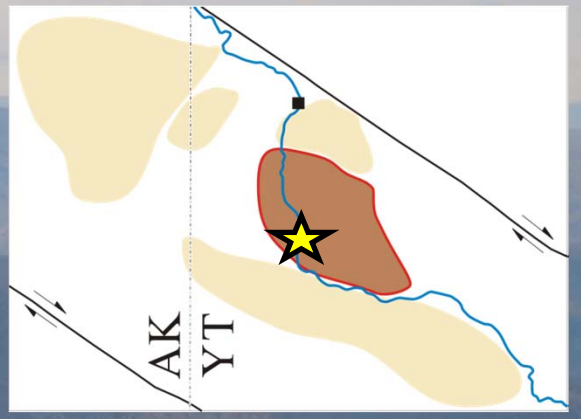
Allan et al., SEG SP17, 2013

Magmatic Framework

- **Extensive U-Pb and Ar-Ar dating during Yukon Gold Project**
- **6 main magmatic & intrusion-related metallogenic events, spanning L.Permian to Tertiary**

details in Allan et al., 2013 (SEG Special Pub 17)





Metallogenic Framework: White Gold District

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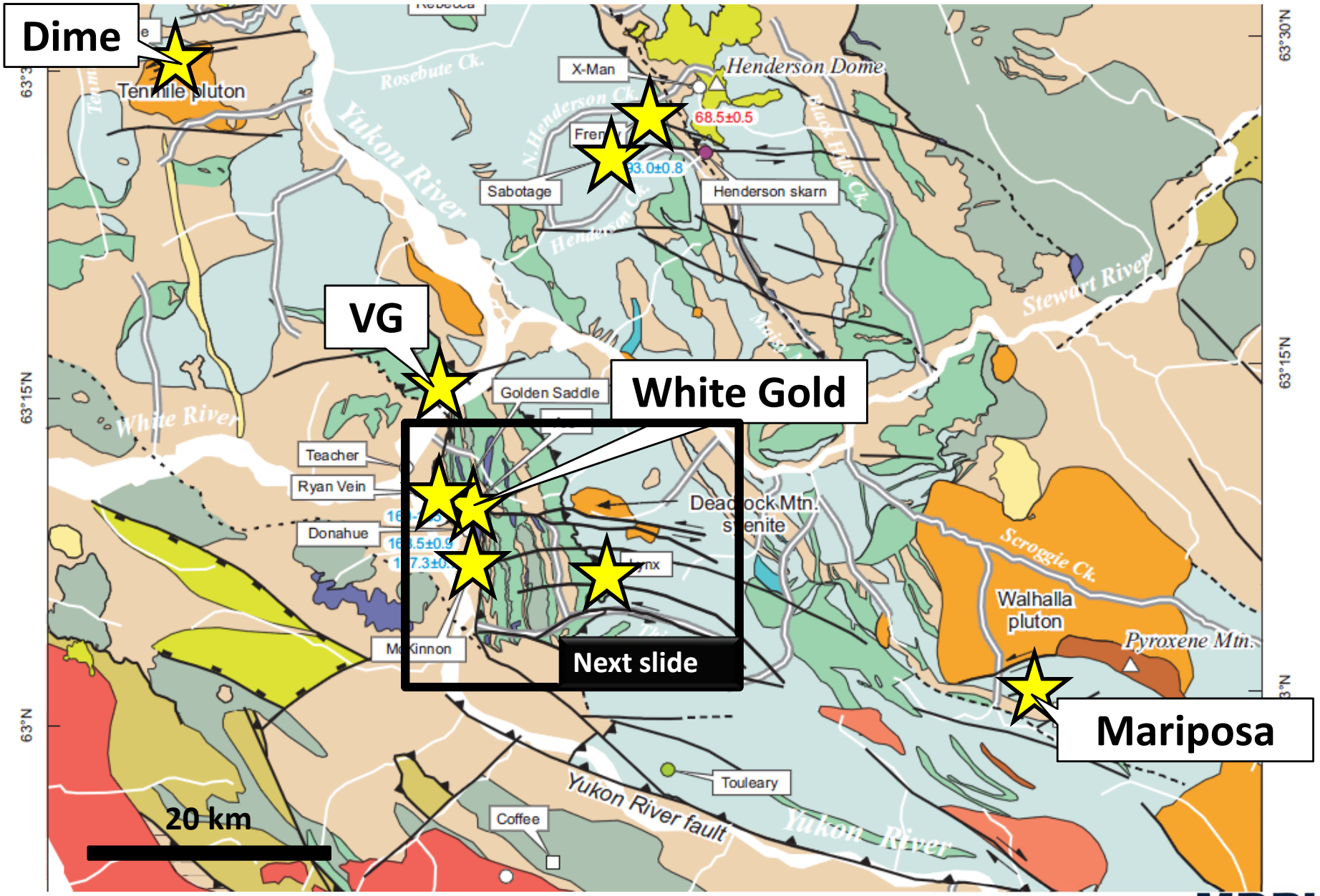
White Gold district- Structural Controls



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Allan et al., SEG SP17, 2013 and references therein

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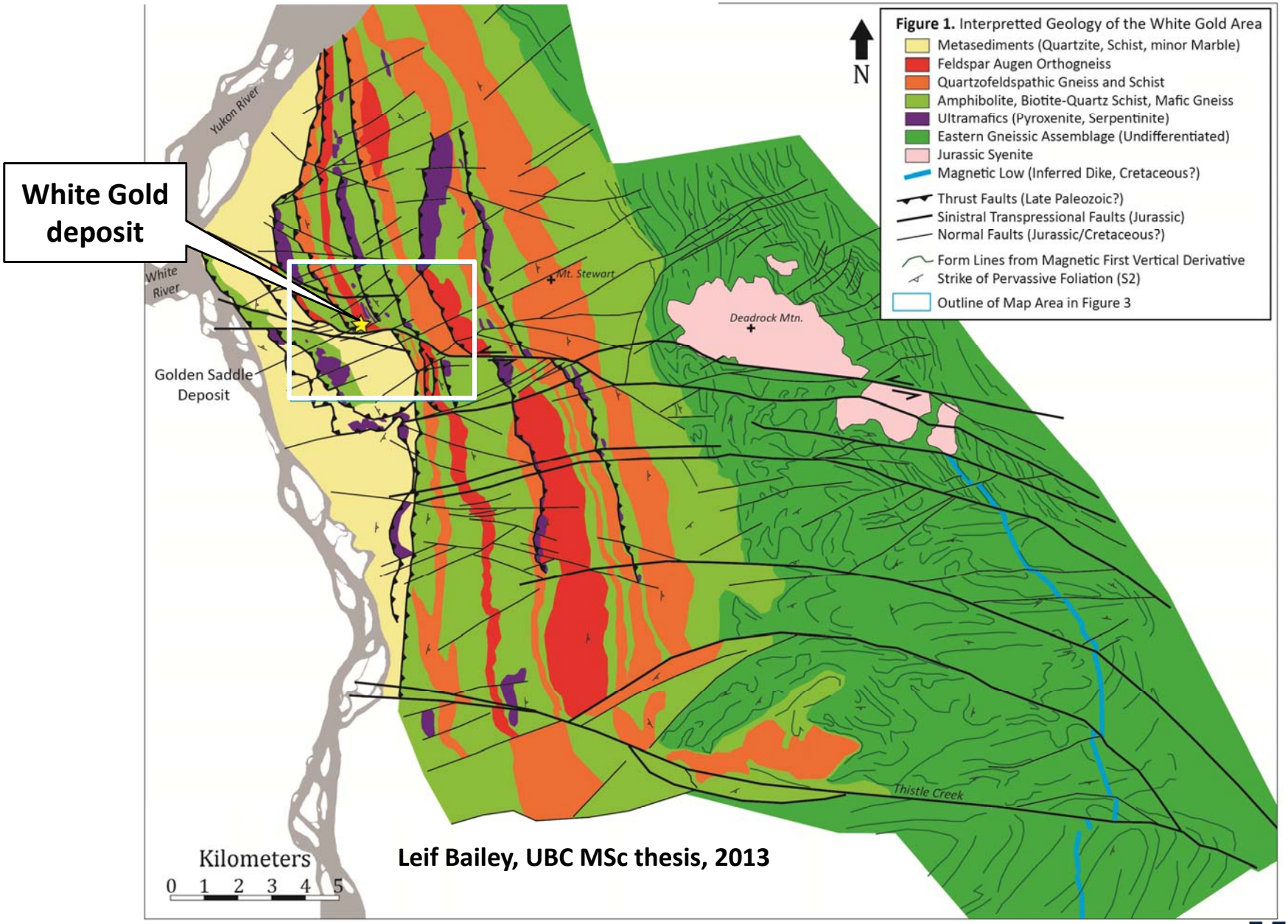
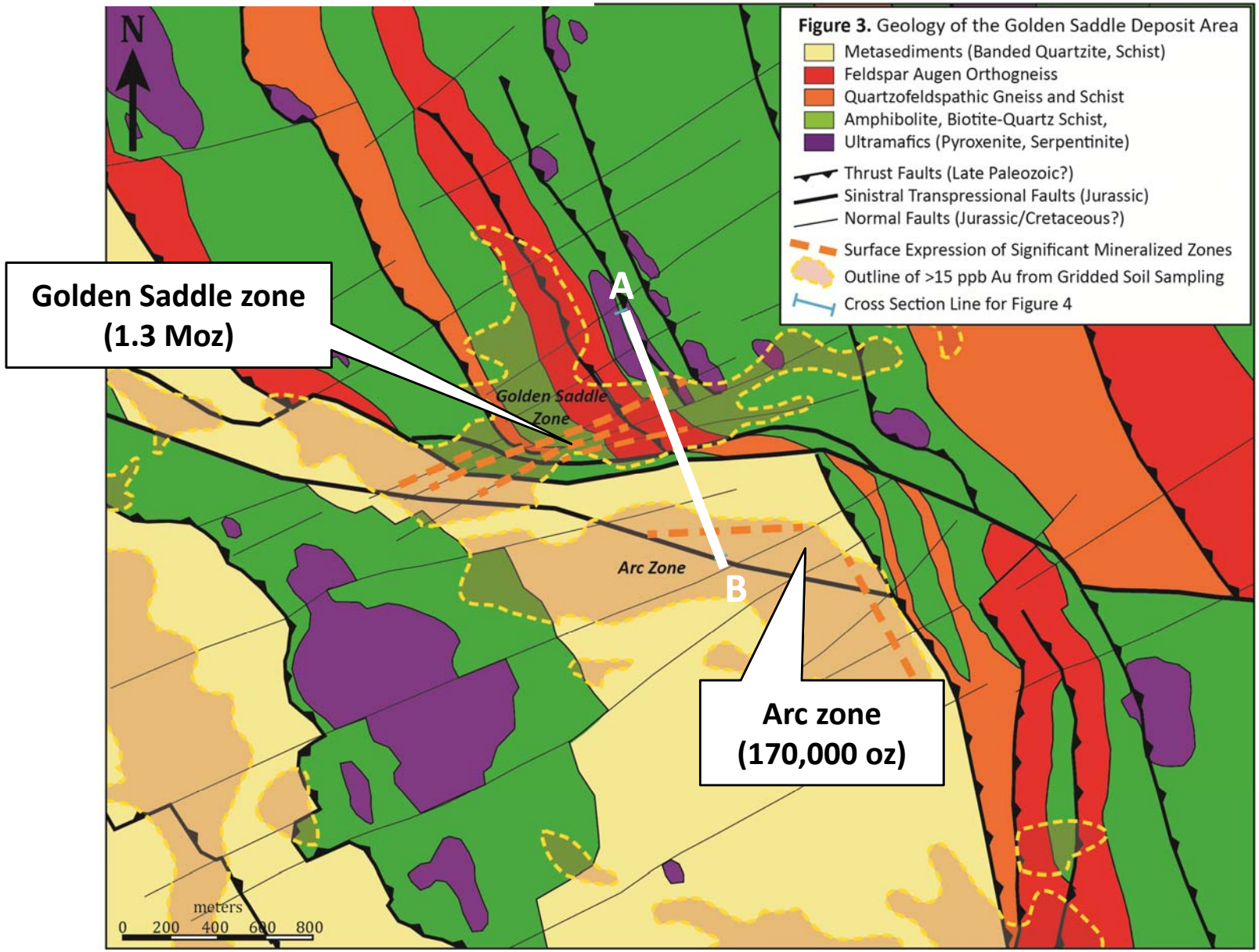
White Gold Property Geology



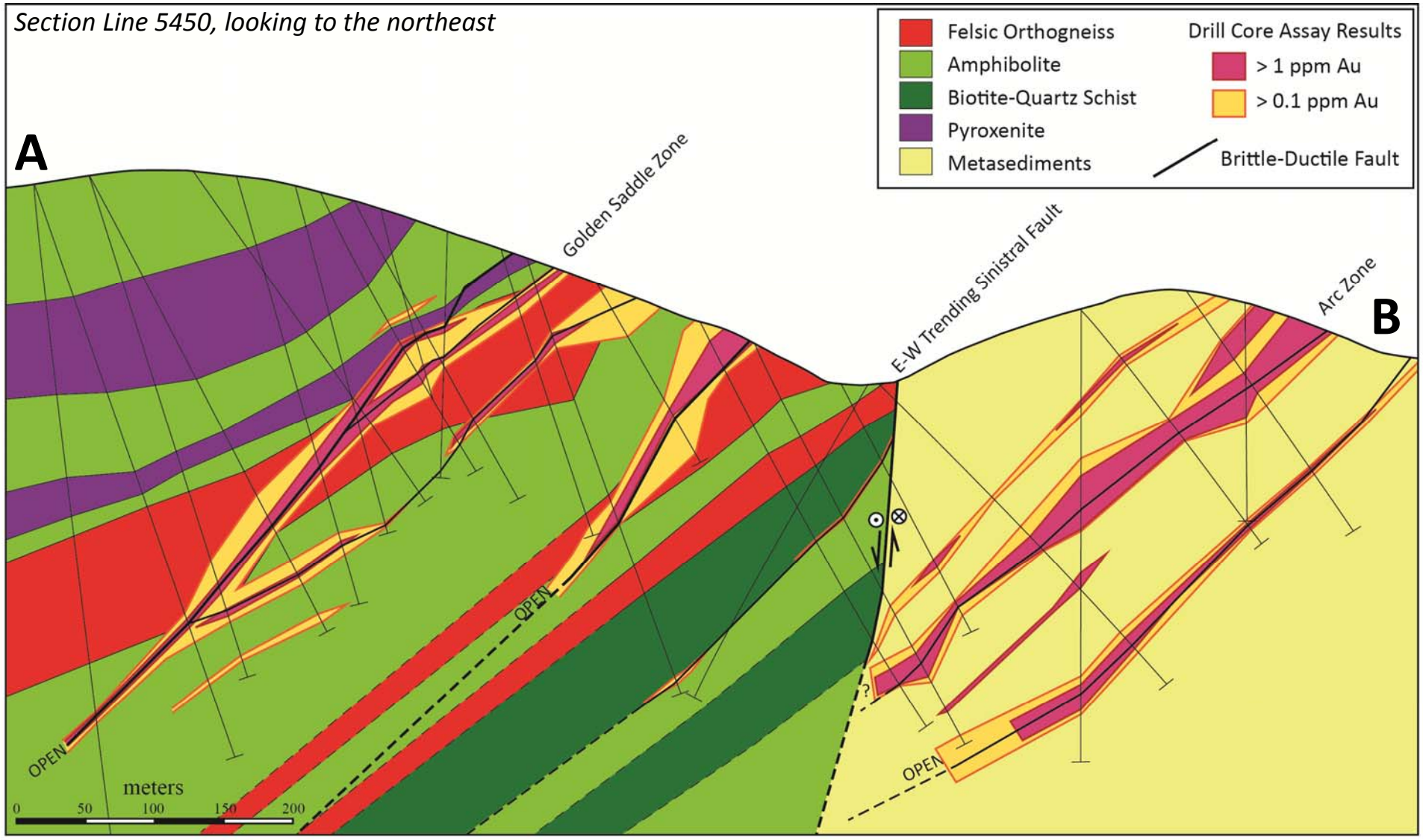
Leif Bailey, UBC MSc thesis, 2013

White Gold Deposit Area



Leif Bailey, UBC MSc thesis, 2013

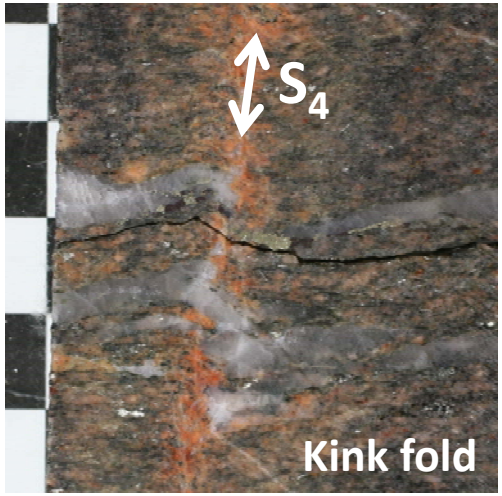
White Gold Deposit: cross-section



Leif Bailey, UBC MSc thesis, 2013

White Gold: paragenetic relationships

Pre-mineralization



Au Stage

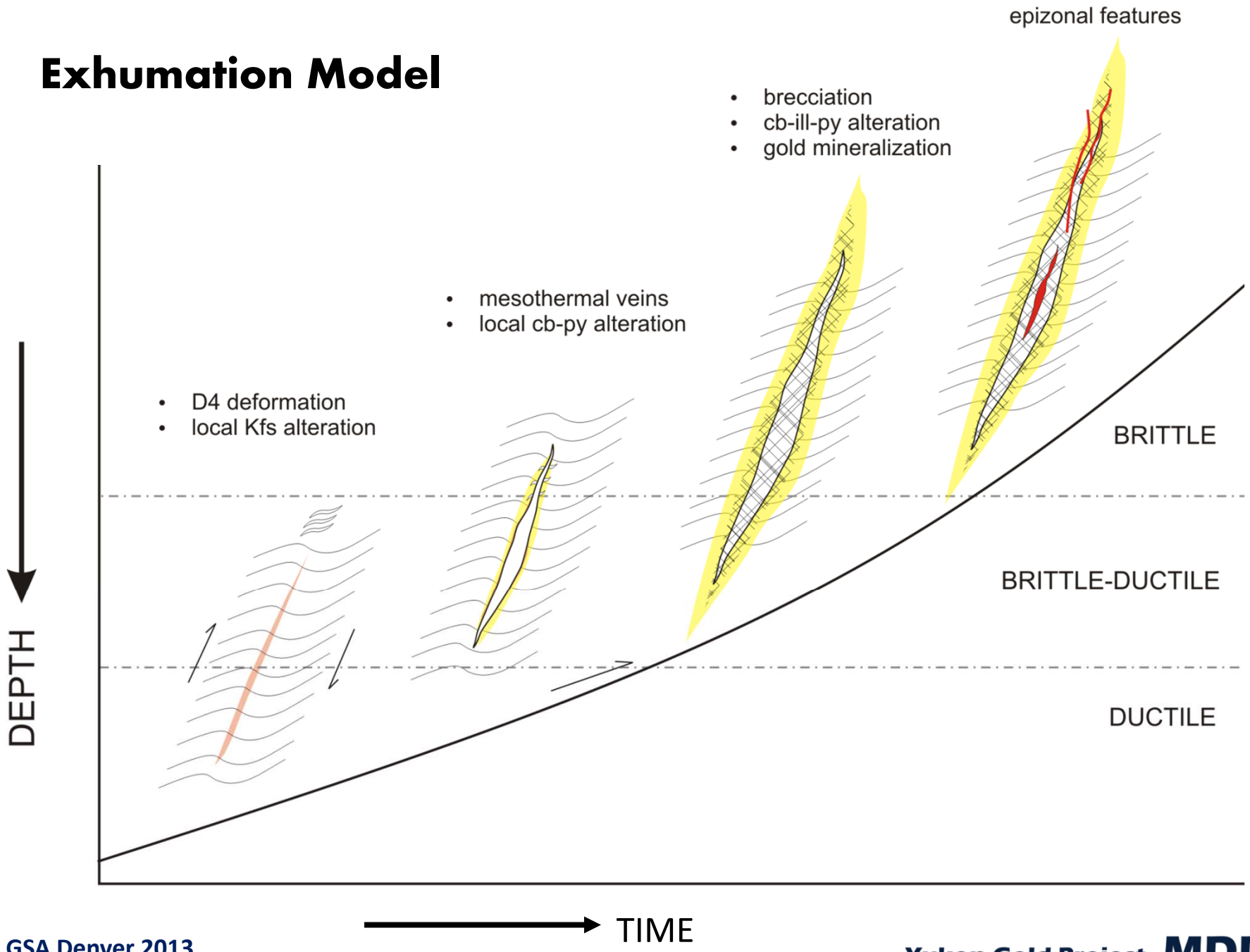
Post-mineralization

Increasing aH^+/aK^+

DUCTILE → **BRITTLE**

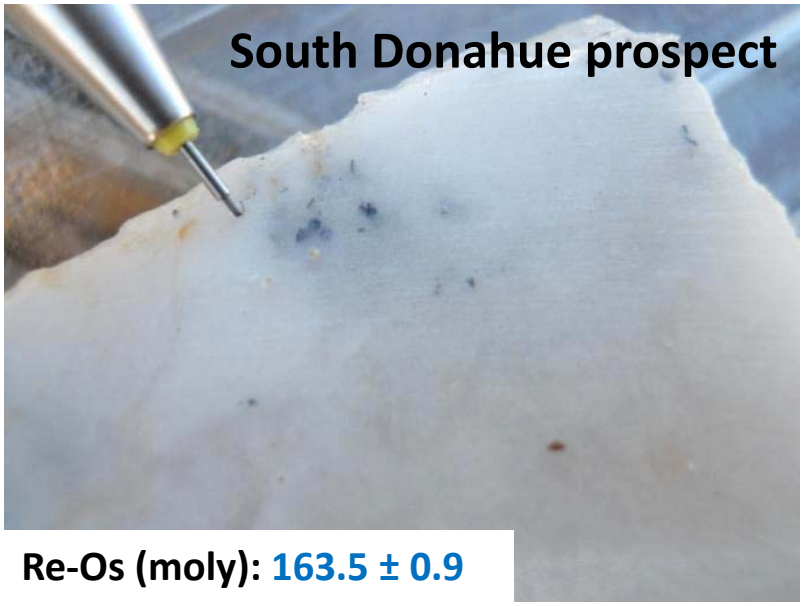
Decreasing T

Exhumation Model

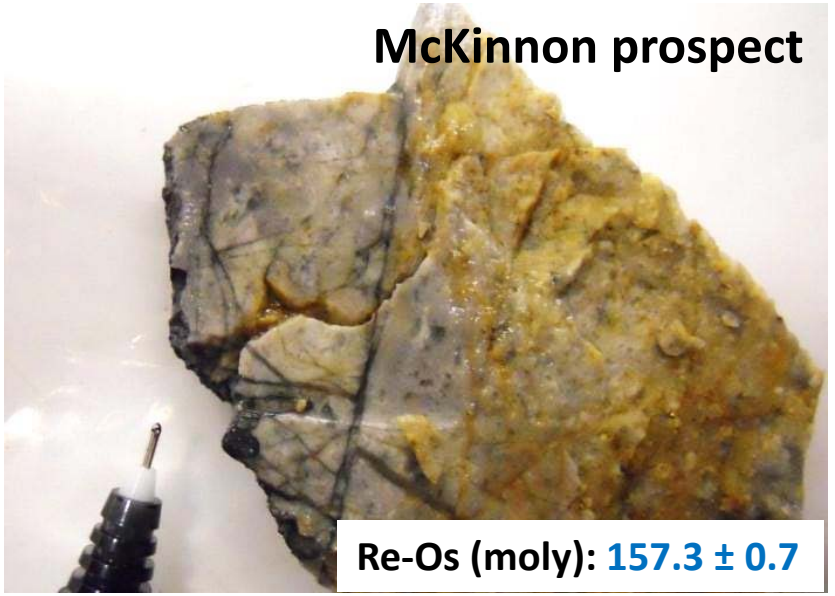


White Gold: Age Constraints

Re-Os (moly): 159.3 ± 0.7
Re-Os (moly): 155.6 ± 0.7

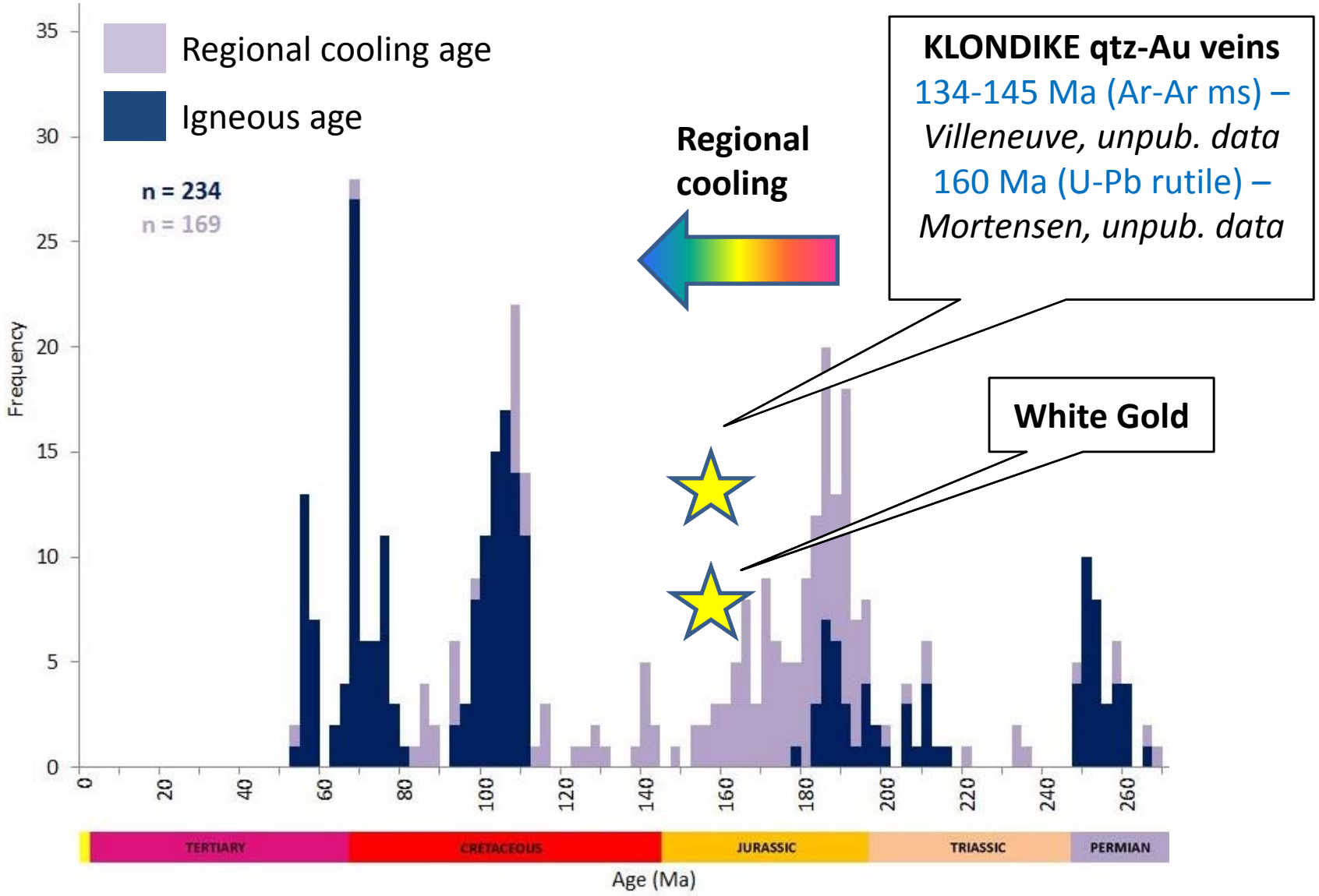


Re-Os (moly): 163.5 ± 0.9

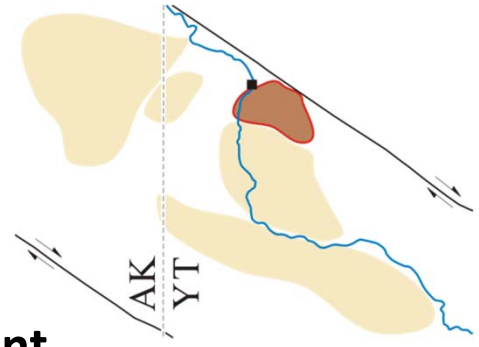


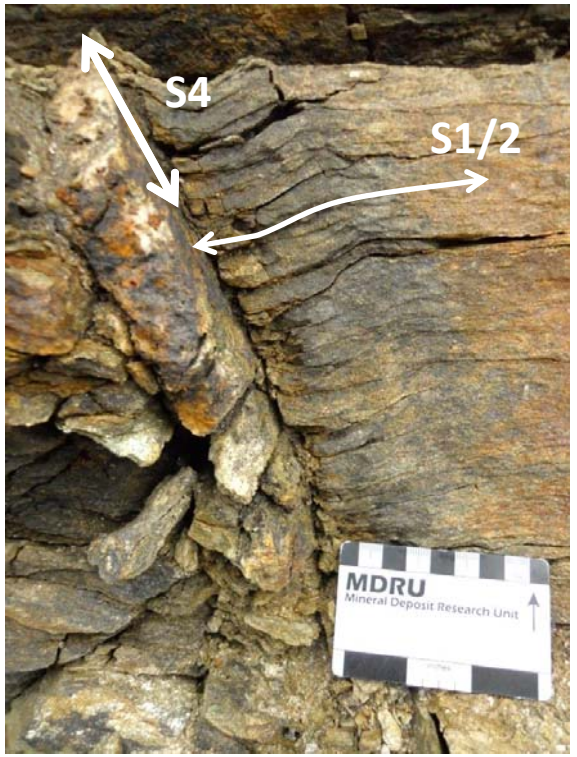
Re-Os (moly): 157.3 ± 0.7

White Gold: Age framework



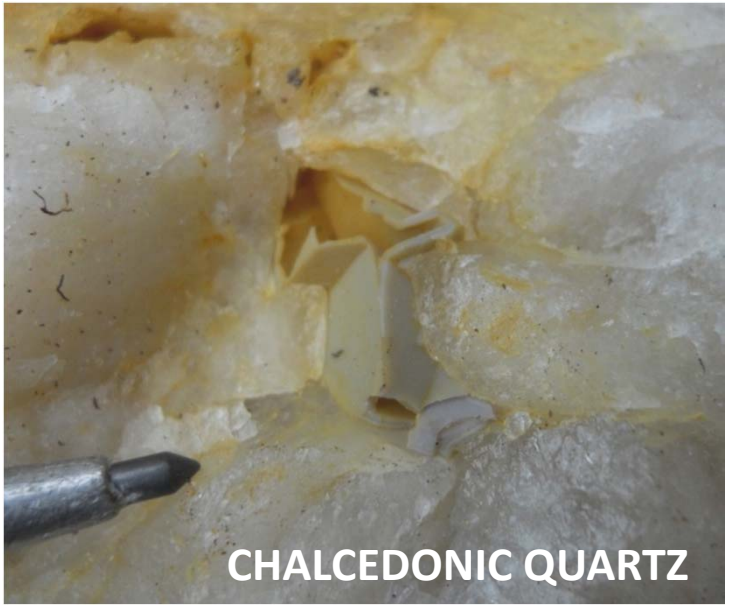
Klondike District – Current Understanding





- Gold associated with discordant quartz veins occupying brittle-ductile deformation zones
- Late Permian Klondike assemblage host rocks w/ "background" VMS-style mineralization (elevated Au, Pb, Cu, Ba)
- pyrite-Fe carbonate alteration
- dilute H_2O-CO_2-NaCl fluids, 300-350C; 1.6 – 3.0 kbar; typical "mesothermal" fluids *(Rushton et al., 1993)*
- <u>Consistent with orogenic gold model</u>

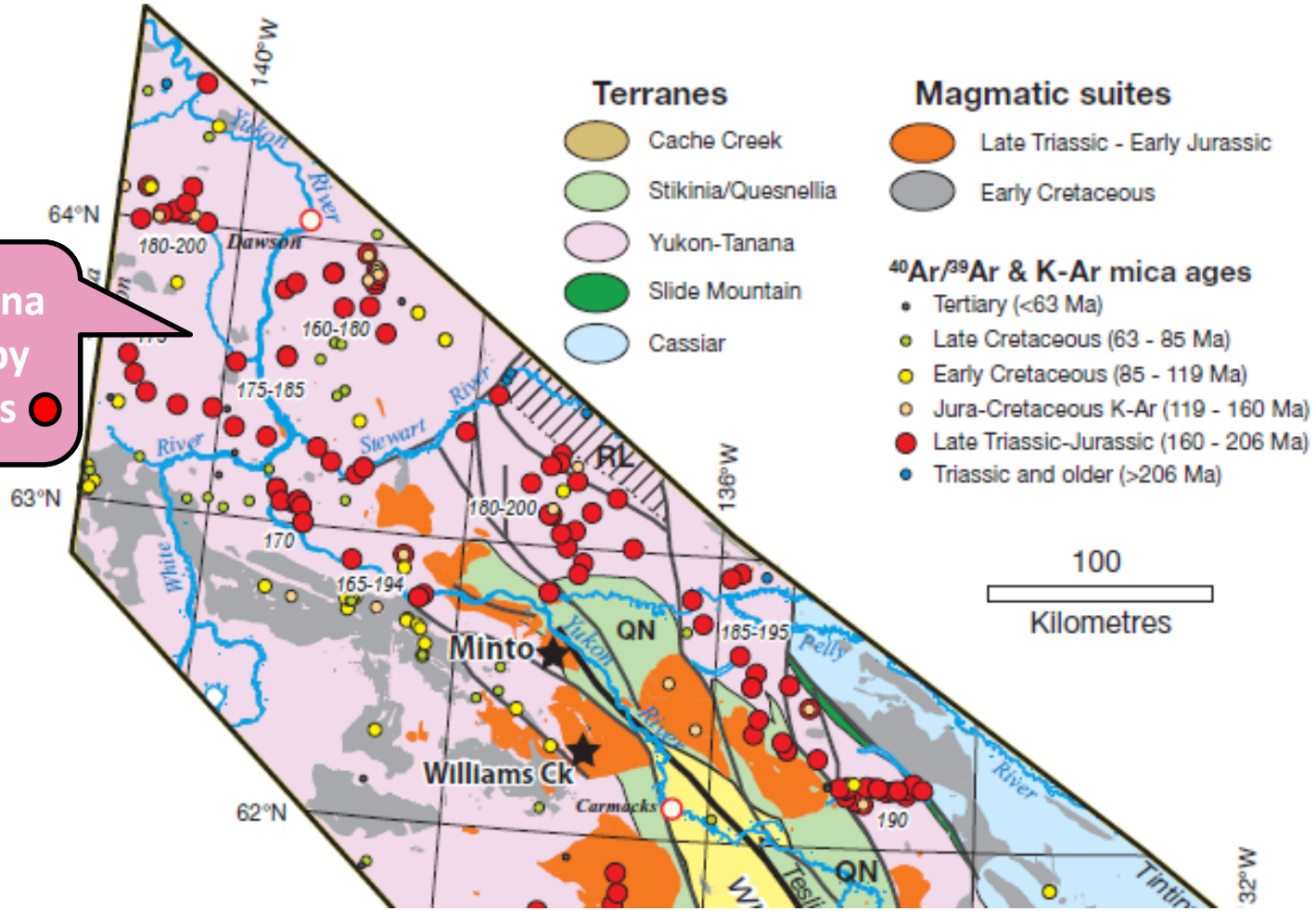
Klondike District – late epizonal features



Evidence for a continuum of crustal conditions preserved in a single vein structure…consistent with White Gold exhumation model

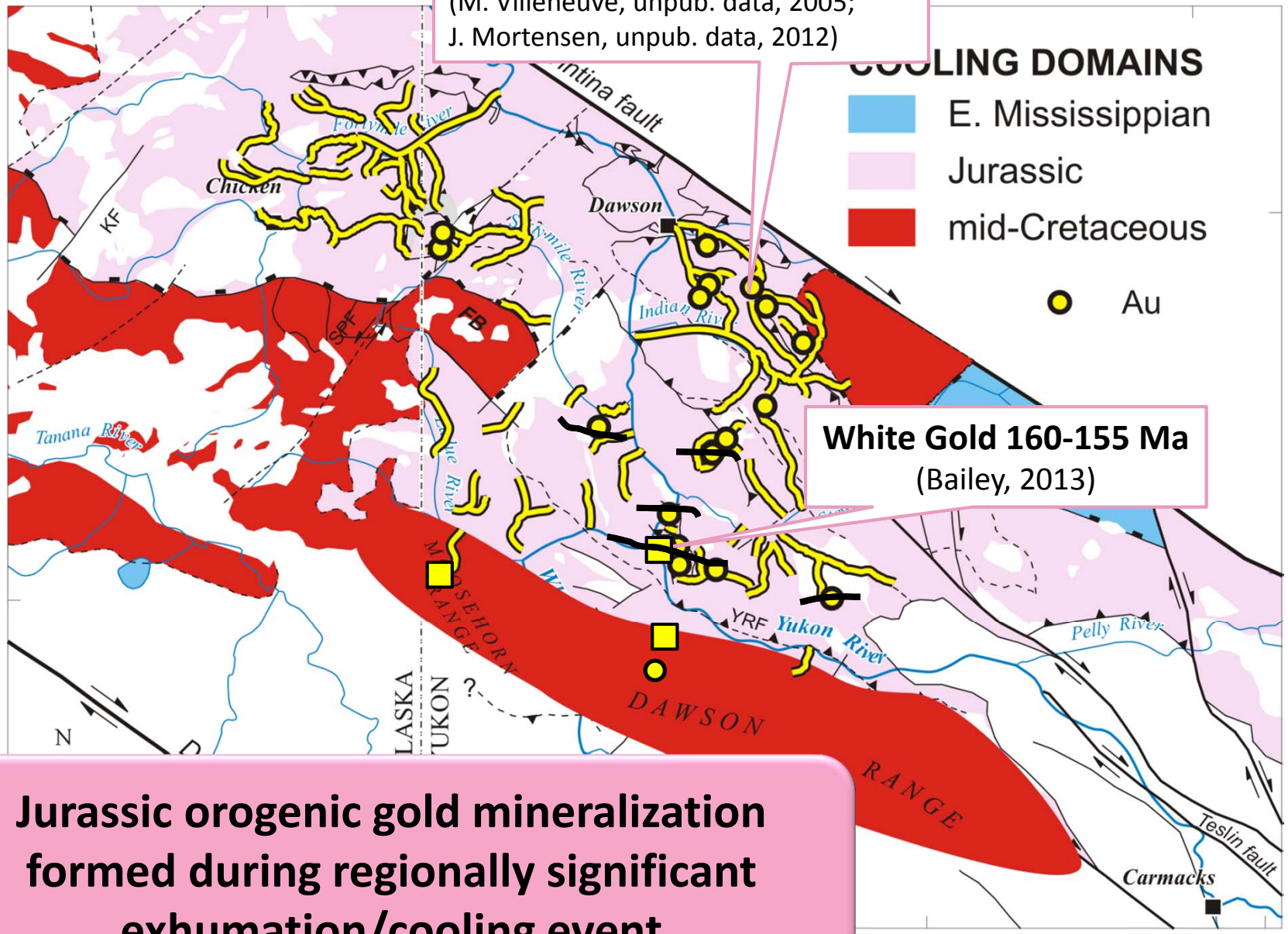
Regional Cooling

northern Yukon-Tanana terrane dominated by Jurassic cooling ages



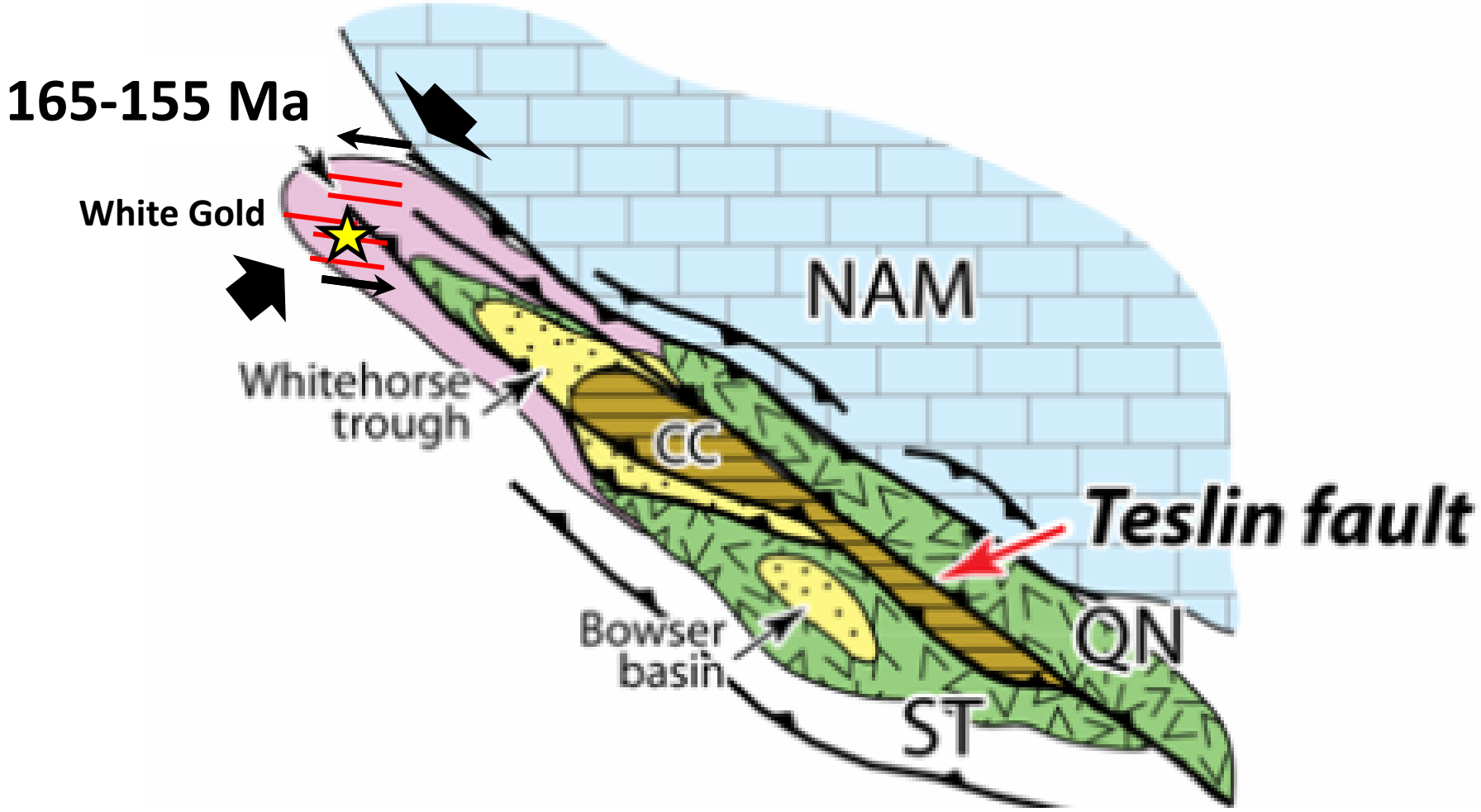
Nelson et al., 2013
SEG Special Publication 17

Age Constraints



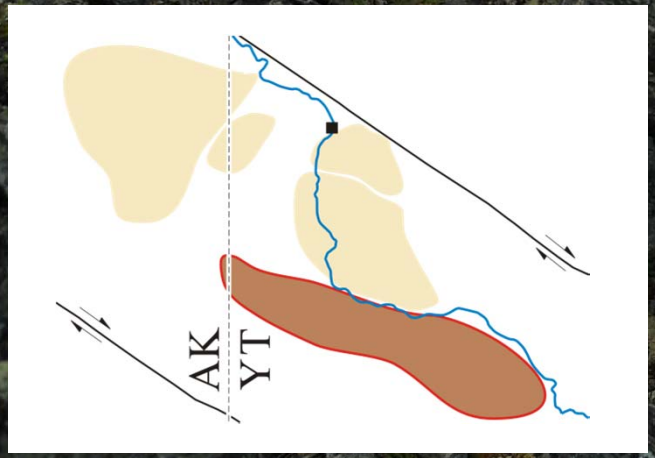
Jurassic orogenic gold mineralization formed during regionally significant exhumation/cooling event

White Gold & related prospects formed during weak regional shortening & sinistral transpression



Modified after Colpron and Bennett, 2010

Metallogenic Framework: Dawson Range District



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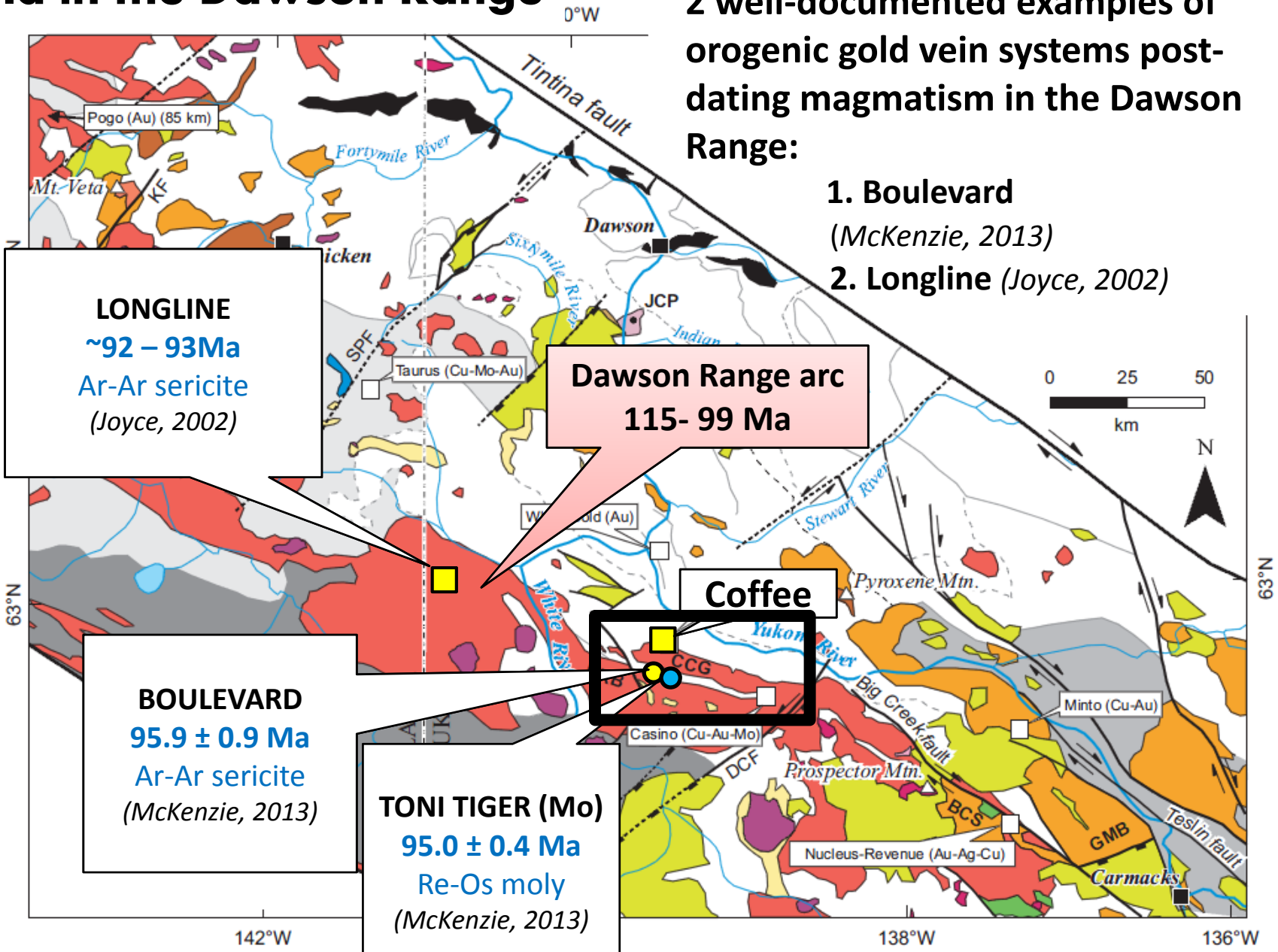
Gold in the Dawson Range

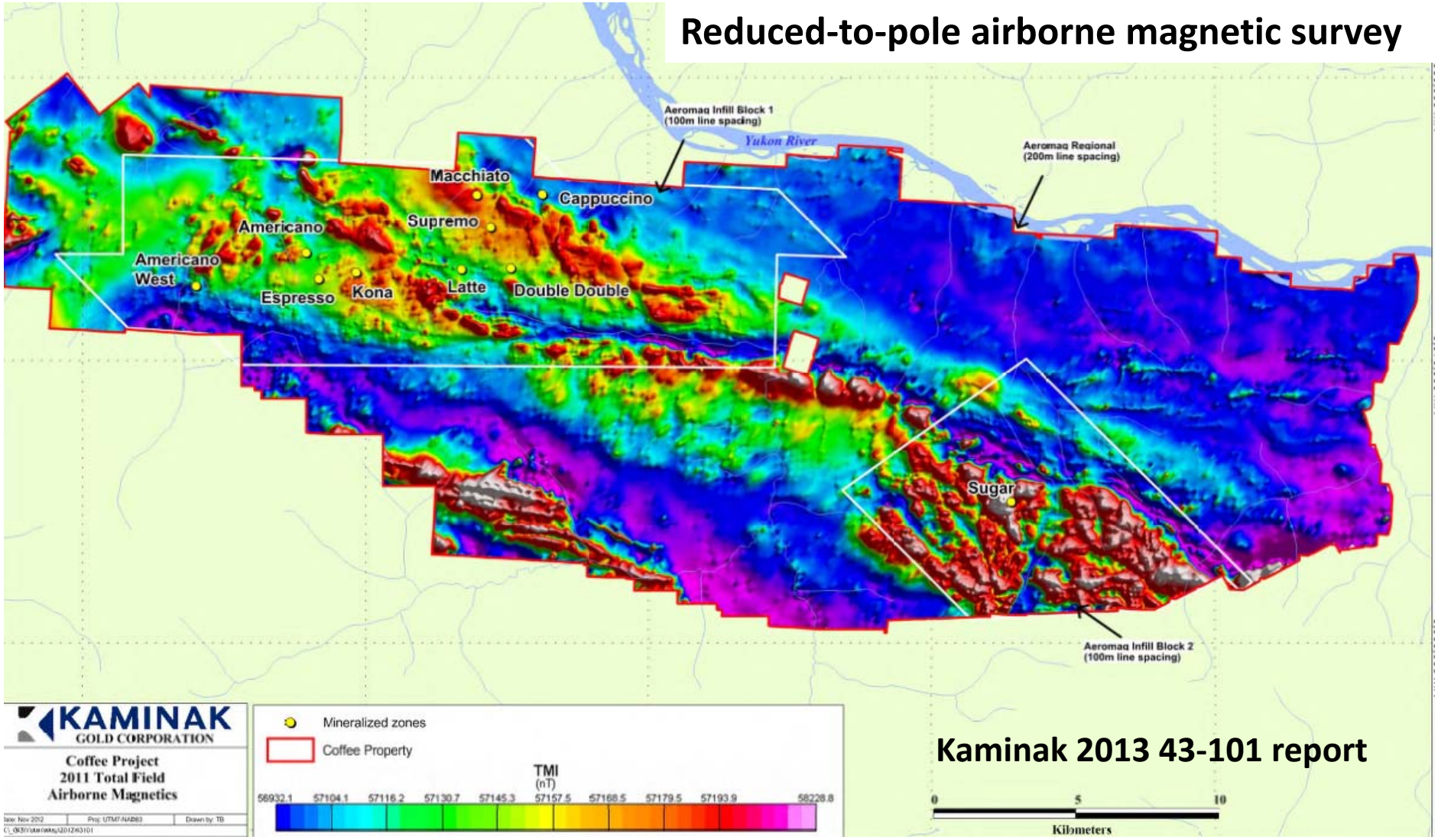
2 well-documented examples of orogenic gold vein systems post-dating magmatism in the Dawson Range:

1. **Boulevard** (*McKenzie, 2013*)
2. **Longline** *(Joyce, 2002)*



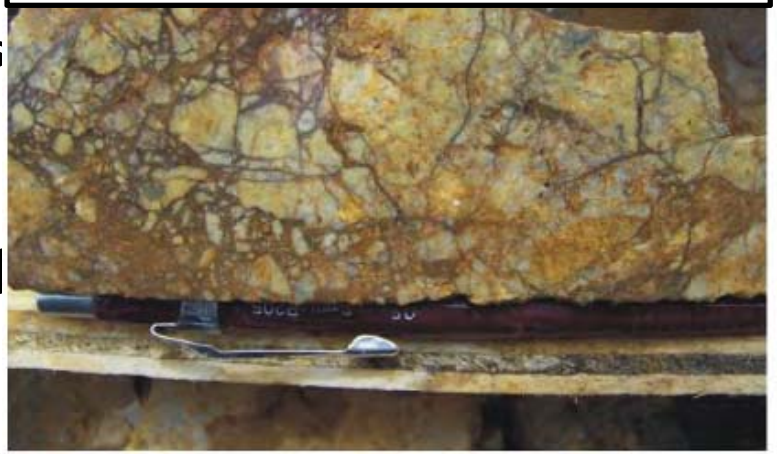
Coffee gold project

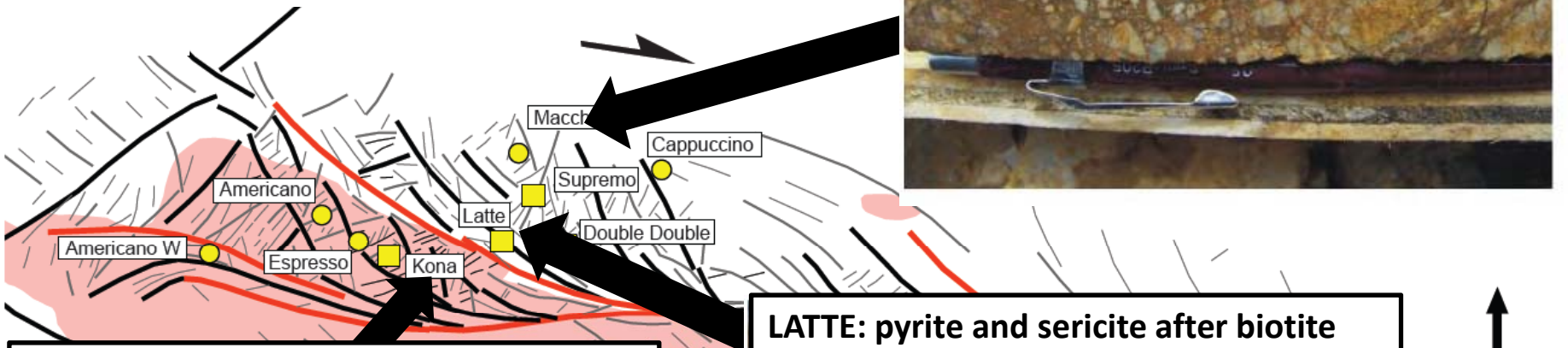
3.24 Moz gold discovery in 2010



- Mineralized structures cut metamorphic rocks and ~99 Ma Coffee Creek pluton
- Mineralization in second/third-order structures within major dextral strike-slip system
- No clear magmatic association

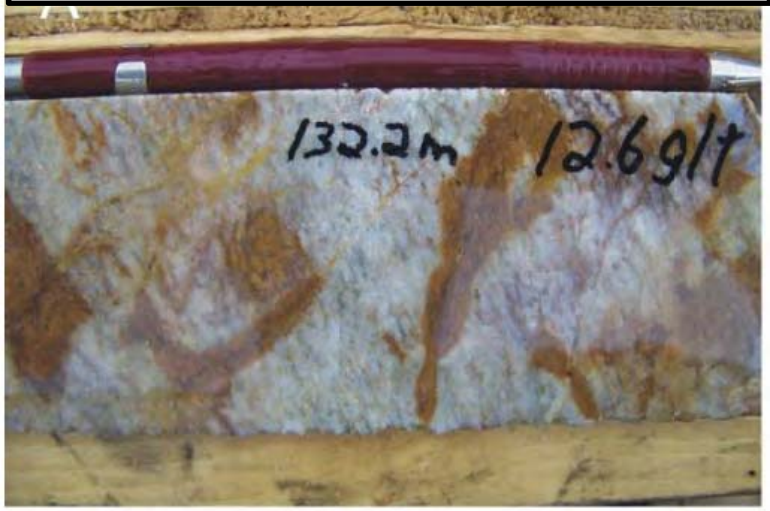
SUPREMO: brecciated gneiss (14.35 g/t Au)





KONA: pyrite after biotite (9.5 g/t Au)

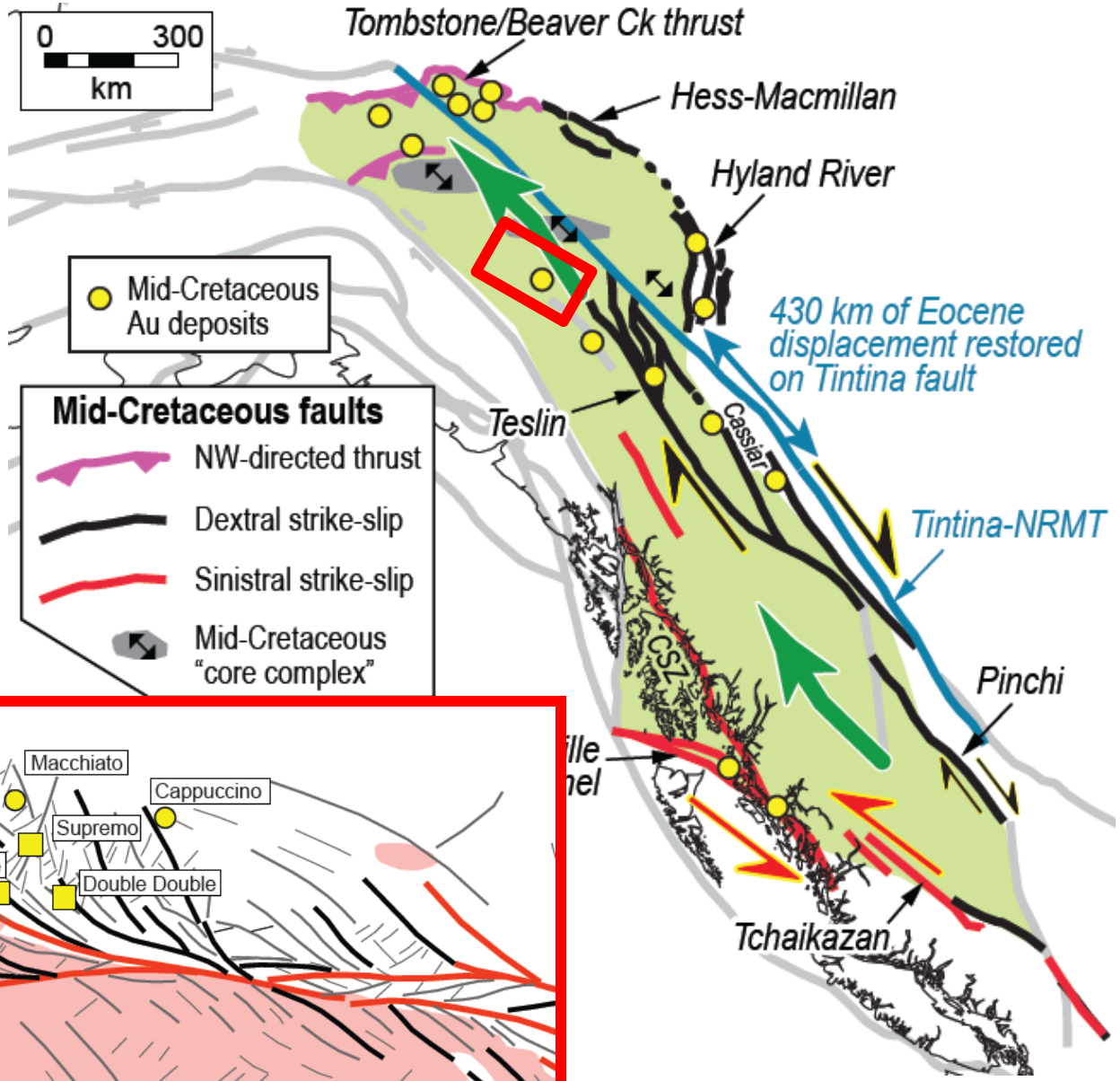
LATTE: pyrite and sericite after biotite

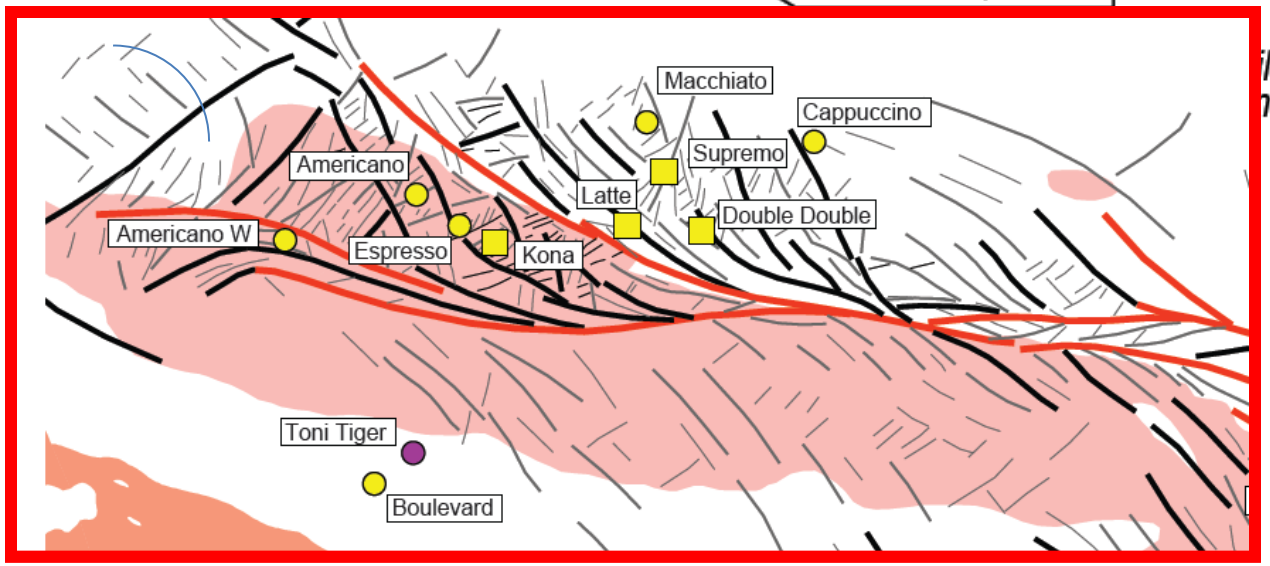


G 2013 P2.27

Nelson et al.,
SEG Special Publication 17

- **Coffee has probable structural and age relationship with major Cretaceous dextral fault systems (e.g., Teslin)**
- **Coffee tentatively interpreted as epizonal, mid-Cretaceous orogenic system**





Sanchez, SEG 2013 P2.27

CONCLUSIONS

White Gold orogenic gold belt:

- Late Jurassic
- Encompasses most of northern YTT
- Timing relationship with regional cooling
- Regionally "diffuse" sinistral transpressive deformation

Dawson Range orogenic gold belt:

- mid-Cretaceous
- confined to southern flank of YTT
- relationship to orogen-parallel dextral fault systems (accomodating exhumation?)