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Looking beyond the horizon: Inherited tectonic frameworks and ore deposit localization

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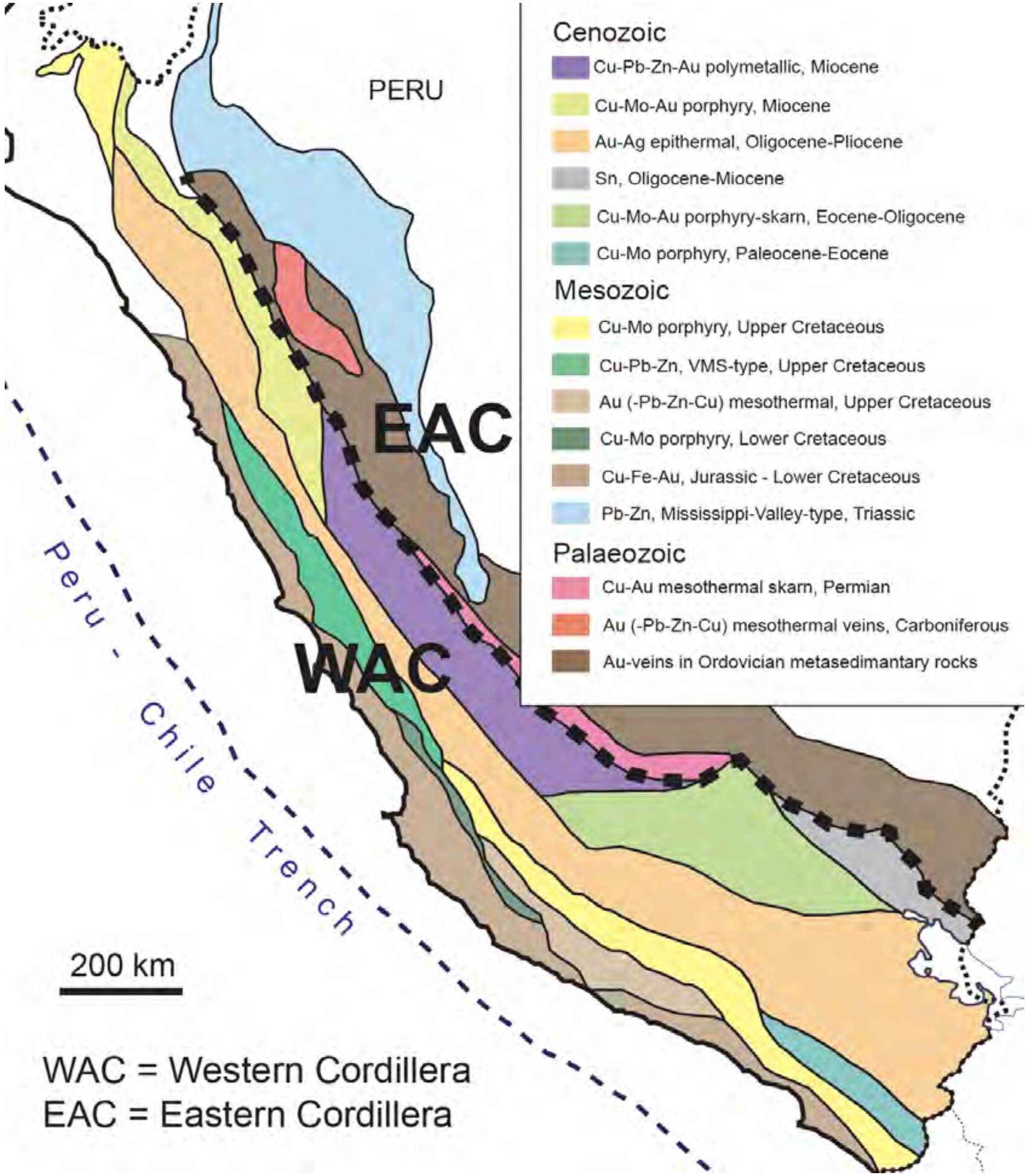
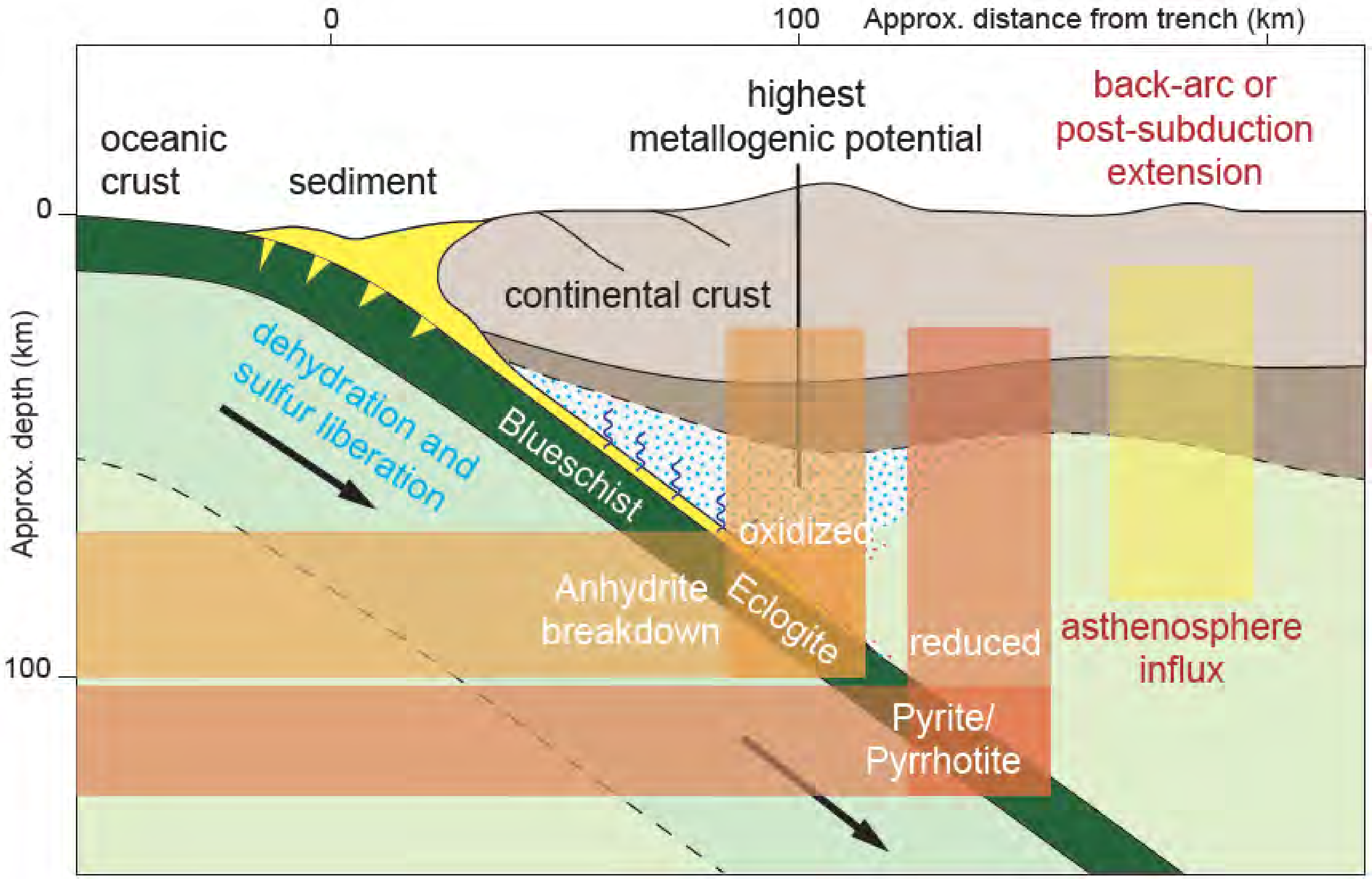
Andean Mineral Belts and Spatial Distribution of Deposits



WAC = Western Cordillera
EAC = Eastern Cordillera

Formation of Mineral Belts

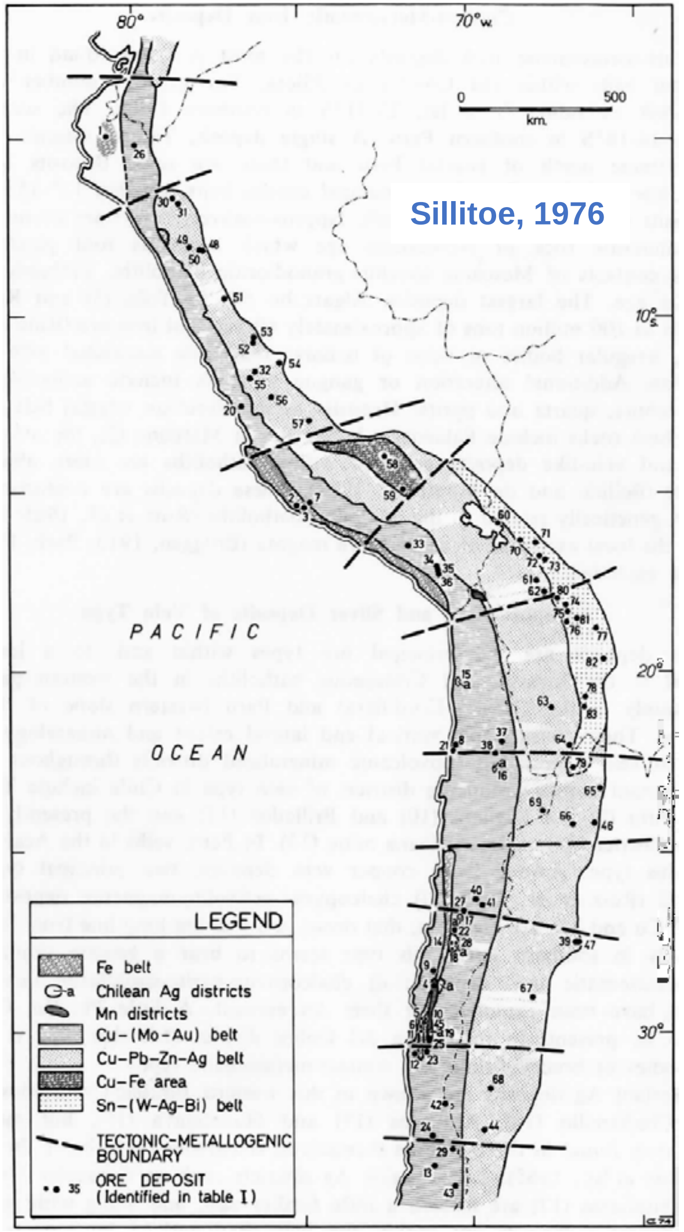


D. Wiemer, based on e.g., Sillitoe, 1976; Tomkins & Evans, 2015; Li et al., 2020

Andean Mineral Belts and Spatial Distribution of Deposits

1. <u>Along-strike orogenic segmentation</u>

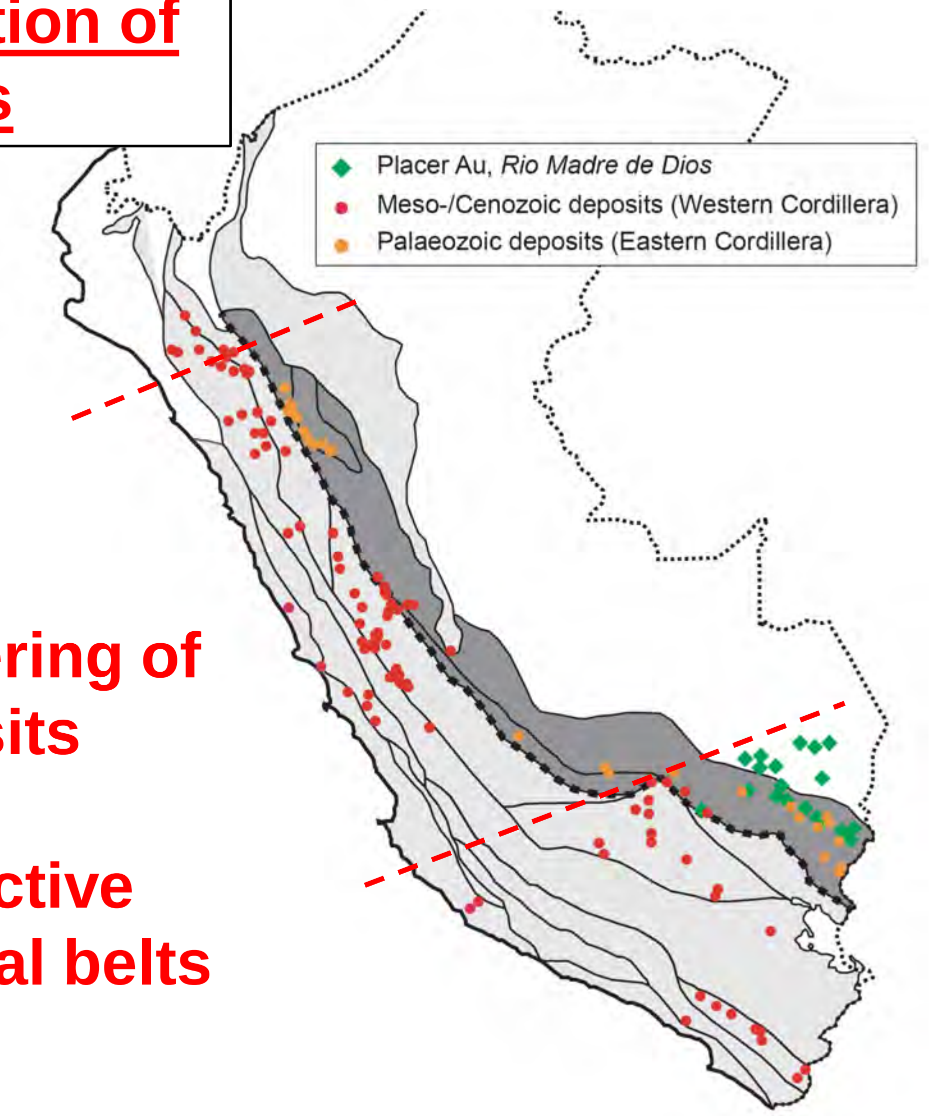
changes in geology and mineral endowments



Sillitoe, 1976

2. <u>Punctuated distribution of deposits</u>

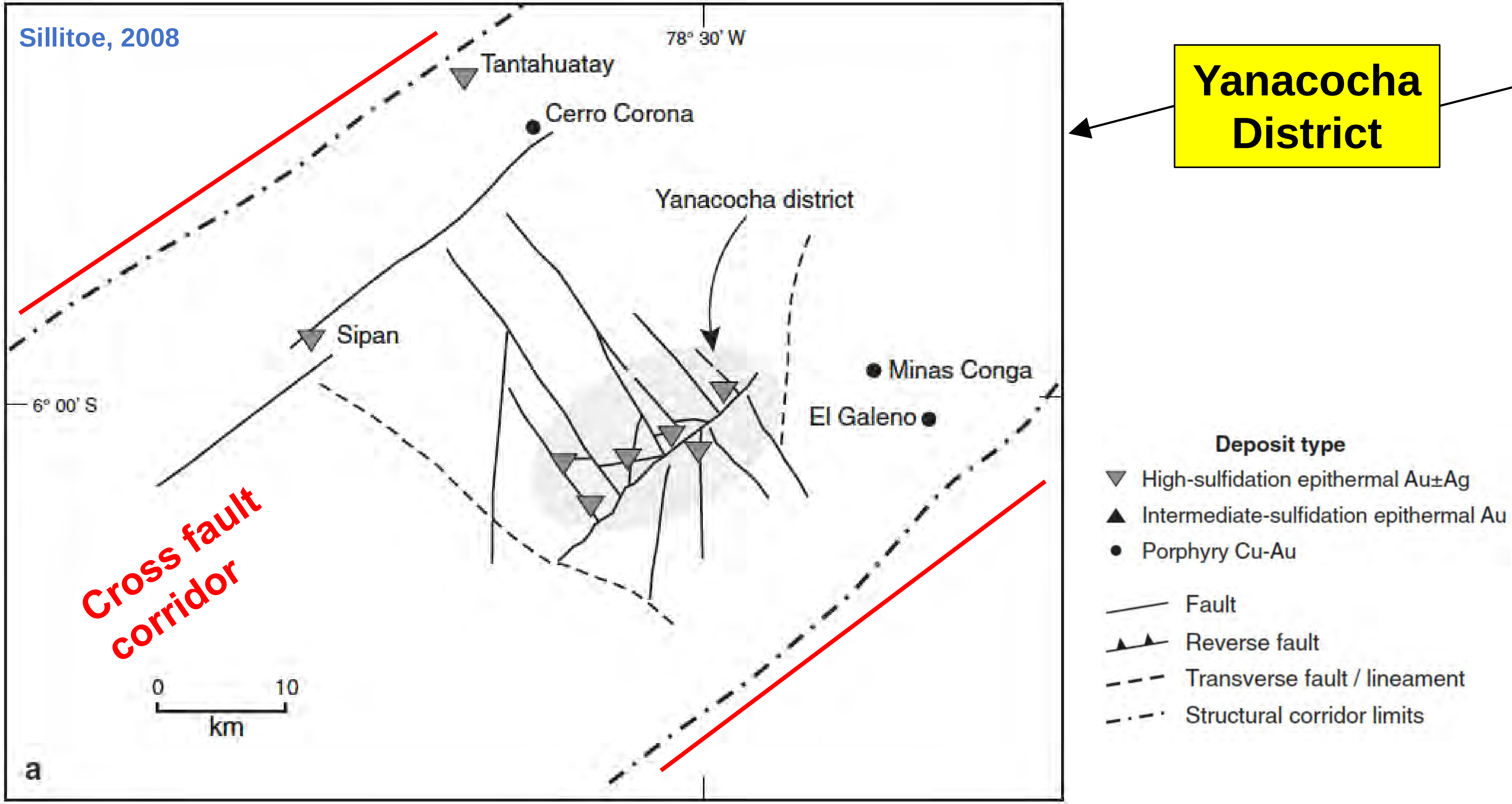
D. Wiemer, compiled from multiple sources



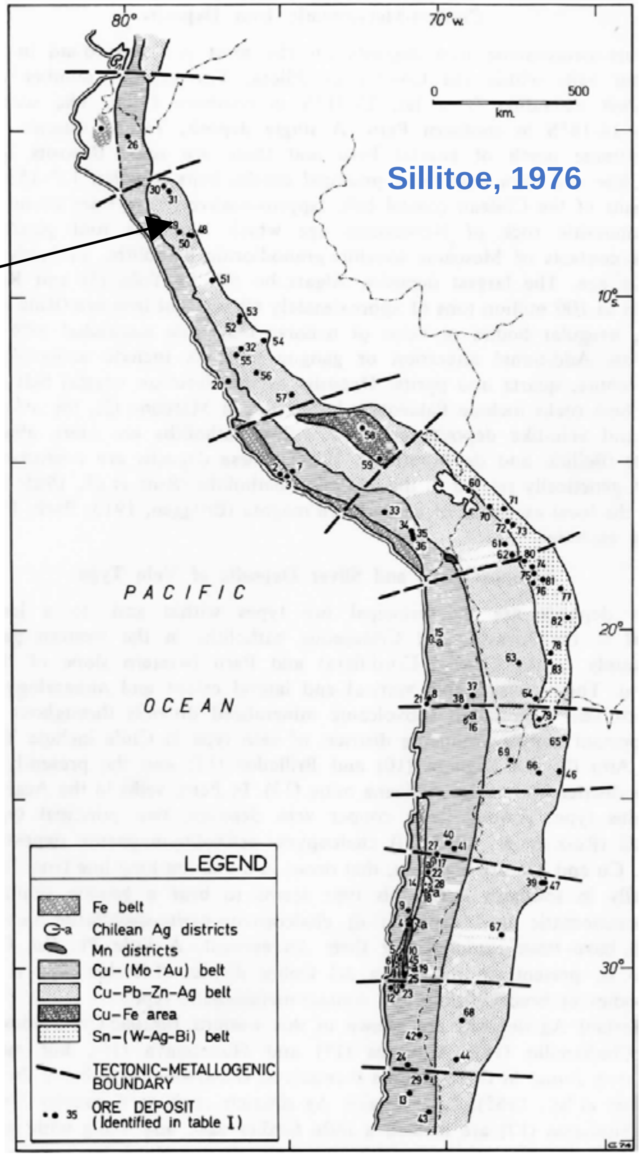
clustering of deposits *within* respective mineral belts

Current Model – Syn-Arc Cross Faults

- Strike-normal cross structures associated with first-order faults
- Sub-parallel to along-strike orogenic segmentation
- Control sites of mineralization



Yanacocha District



Current Model – Syn-Arc Cross Faults

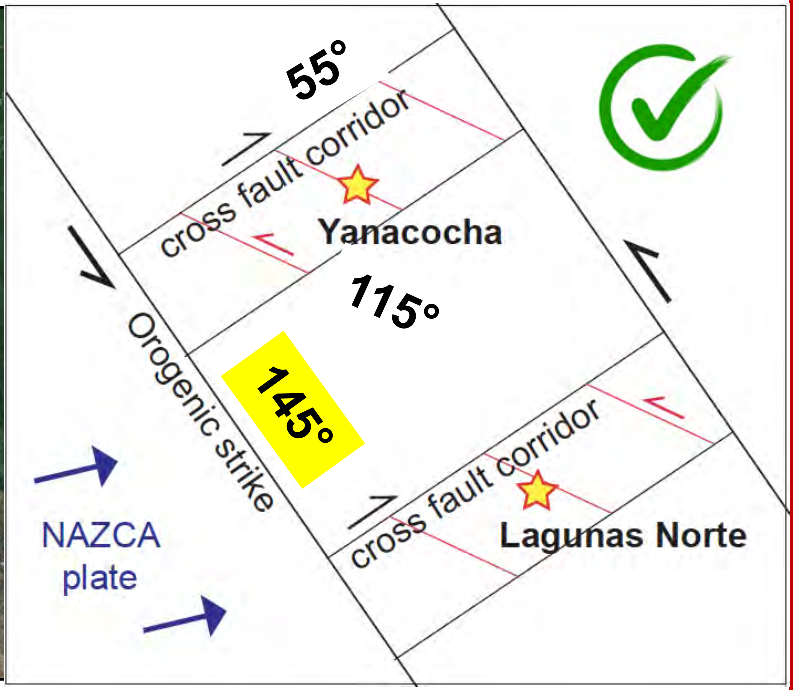
Testing - Case: Yanacocha and Lagunas Norte:

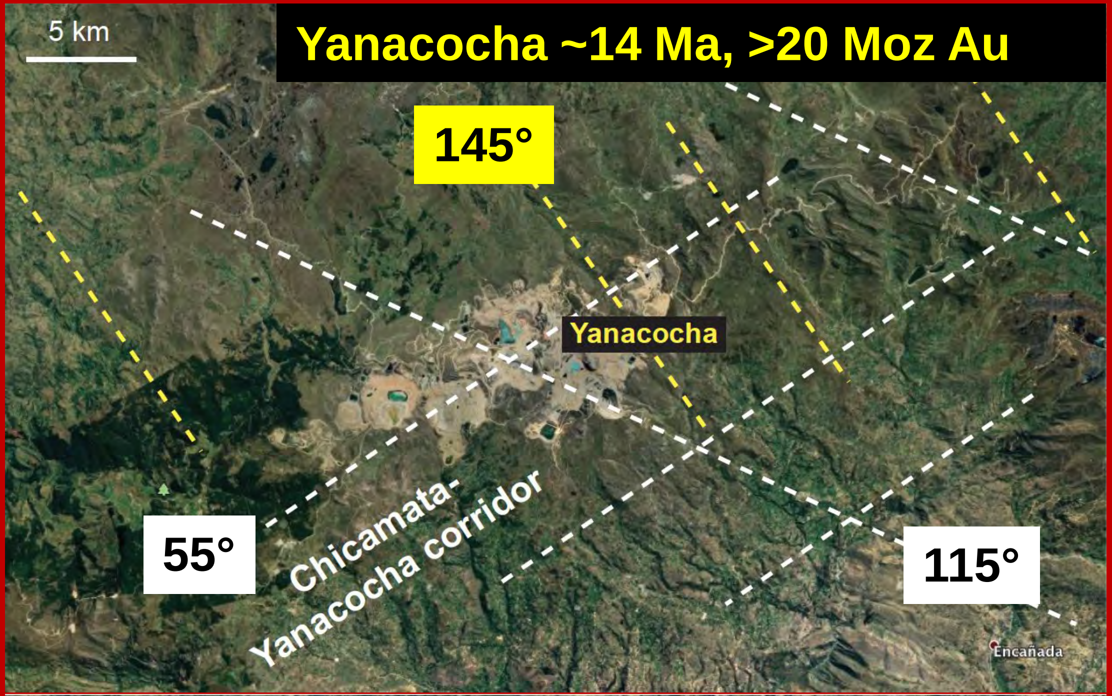
- 145°-striking 1st-order "Andean strike"
- 55°-striking 2nd-order "Cross fault corridors"
- 115° -striking 2nd/3rd-order transverse structures

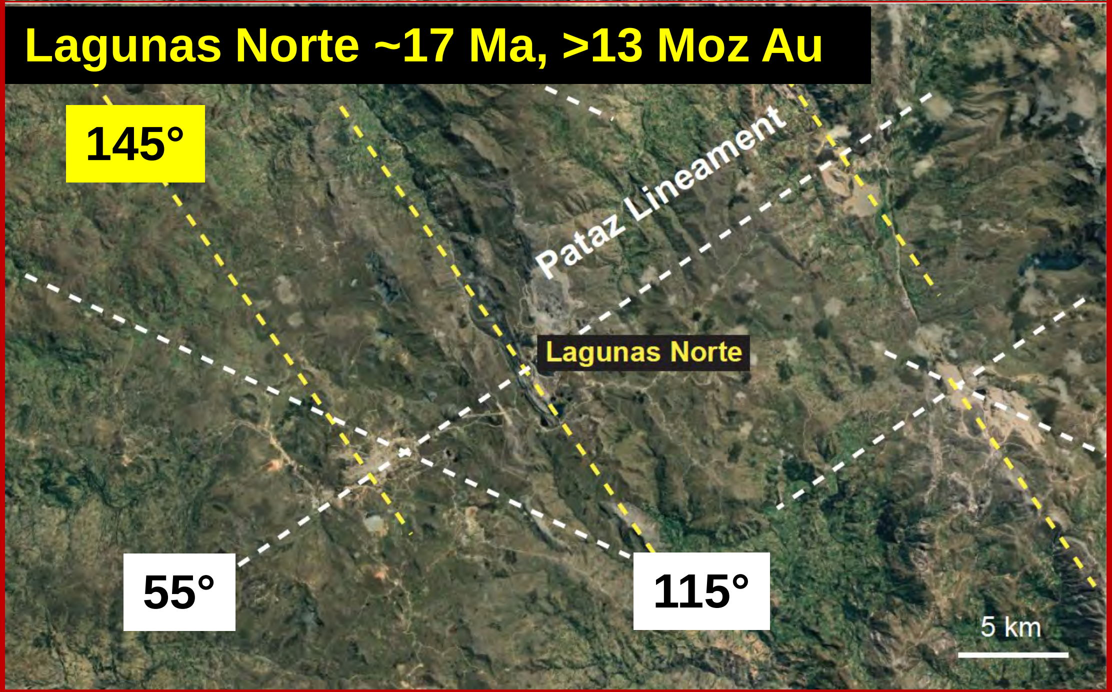
→ **Reasonable kinematic framework!**

→ **Deposits focus on structural intersections!**

→ **Commonly observed spacing (~100 km)**







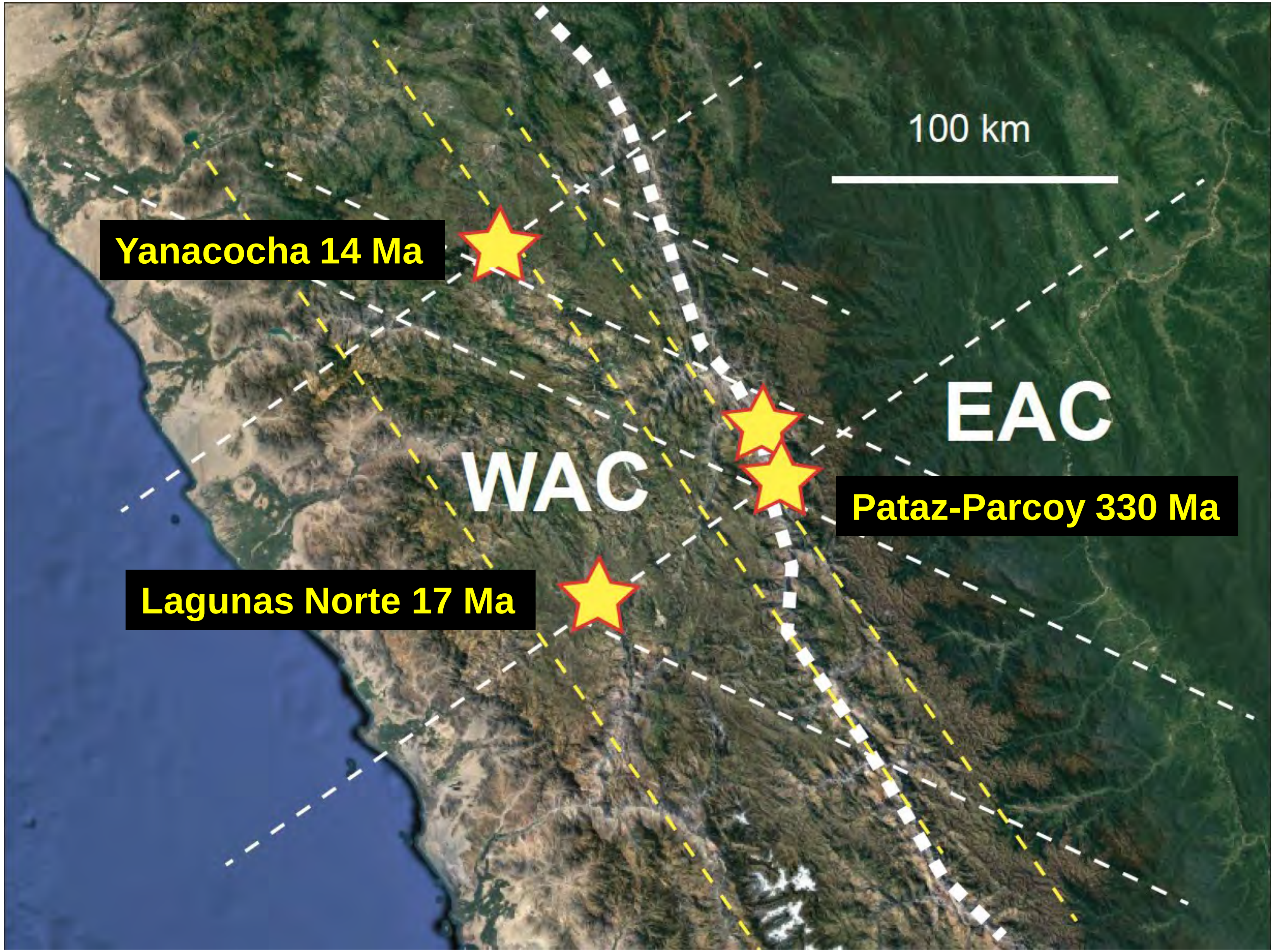
Current Model – Syn-Arc Cross Faults

...HOWEVER:

PATAZ-PARCOY:

- Same structural trends: 55°, 145° and 115°
- Formed >300 Myrs earlier (distinct accretionary event!)

→ We must consider <u>structural inheritance</u> from the older continent to the east!

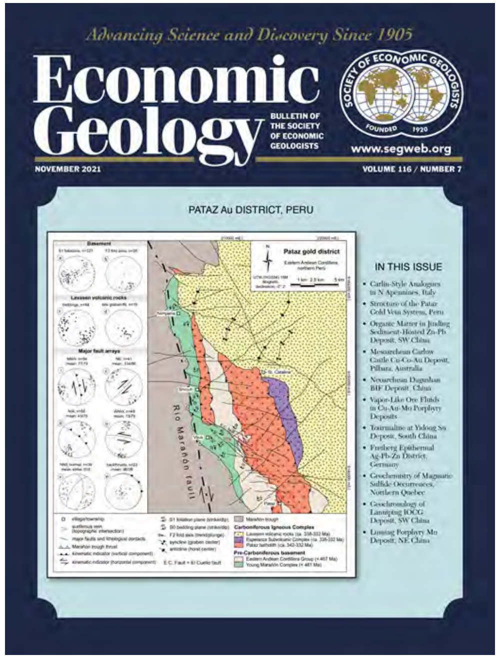


Inheritance – Pataz (>12 Moz Au) – District to deposit scale

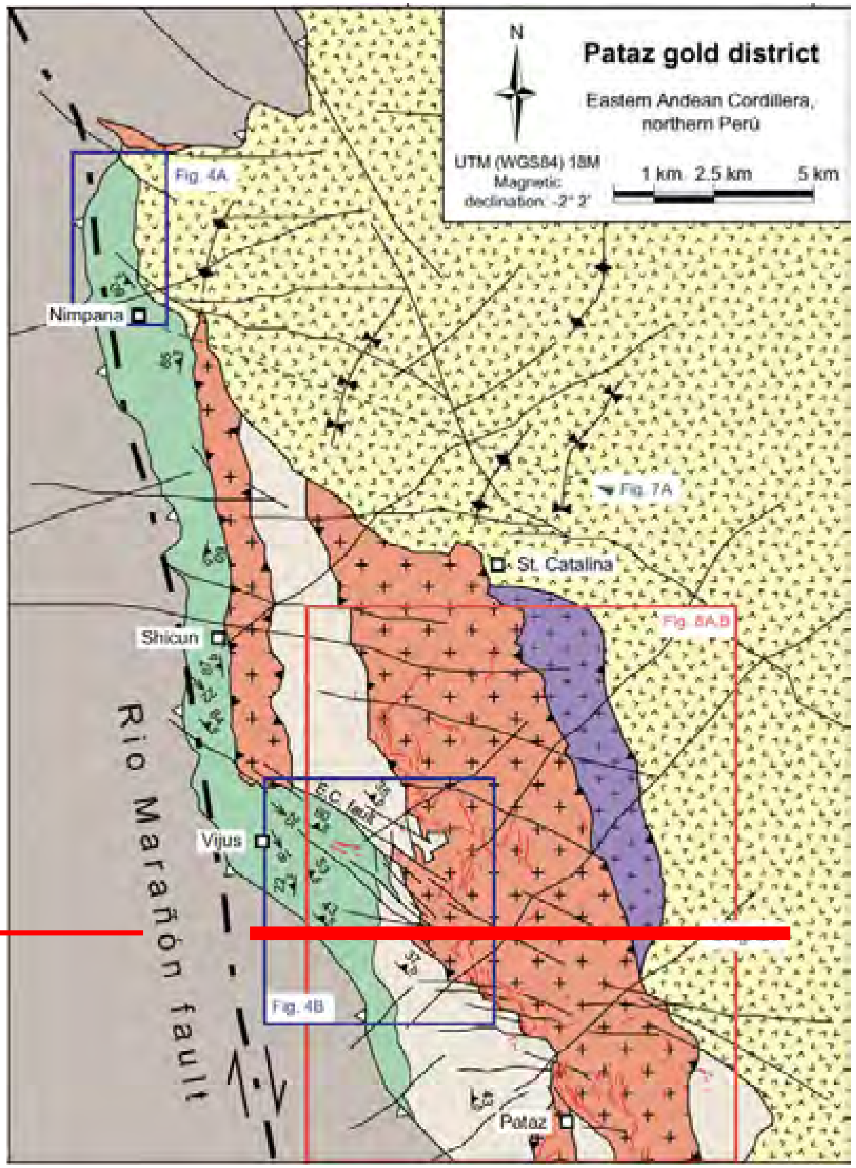
→ Two main paragenetic stages
I: Qz-Py, II: Qz-Py-Sp-Gn

→ Same structural-hydrothermal vein system architecture-geometry

→ Veins follow pre-existing weak-zones within the Pataz Batholith

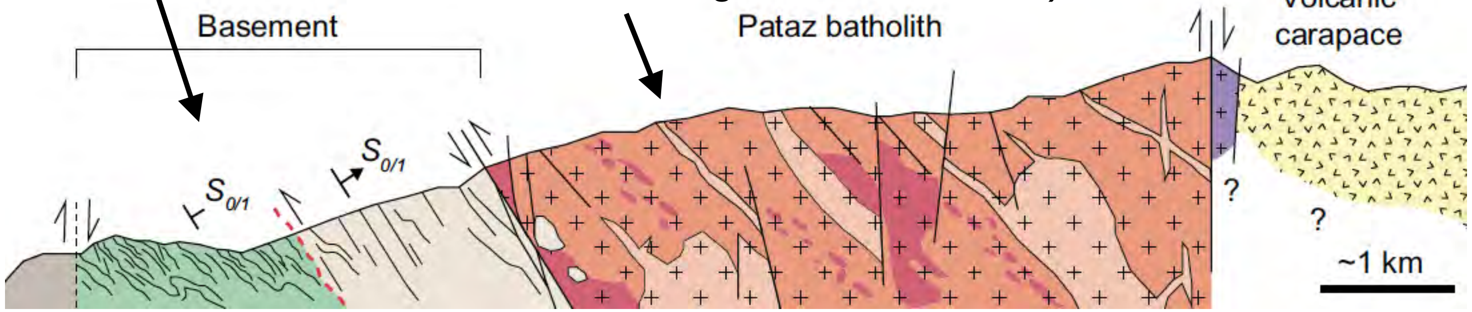


Wiemer et al., 2021



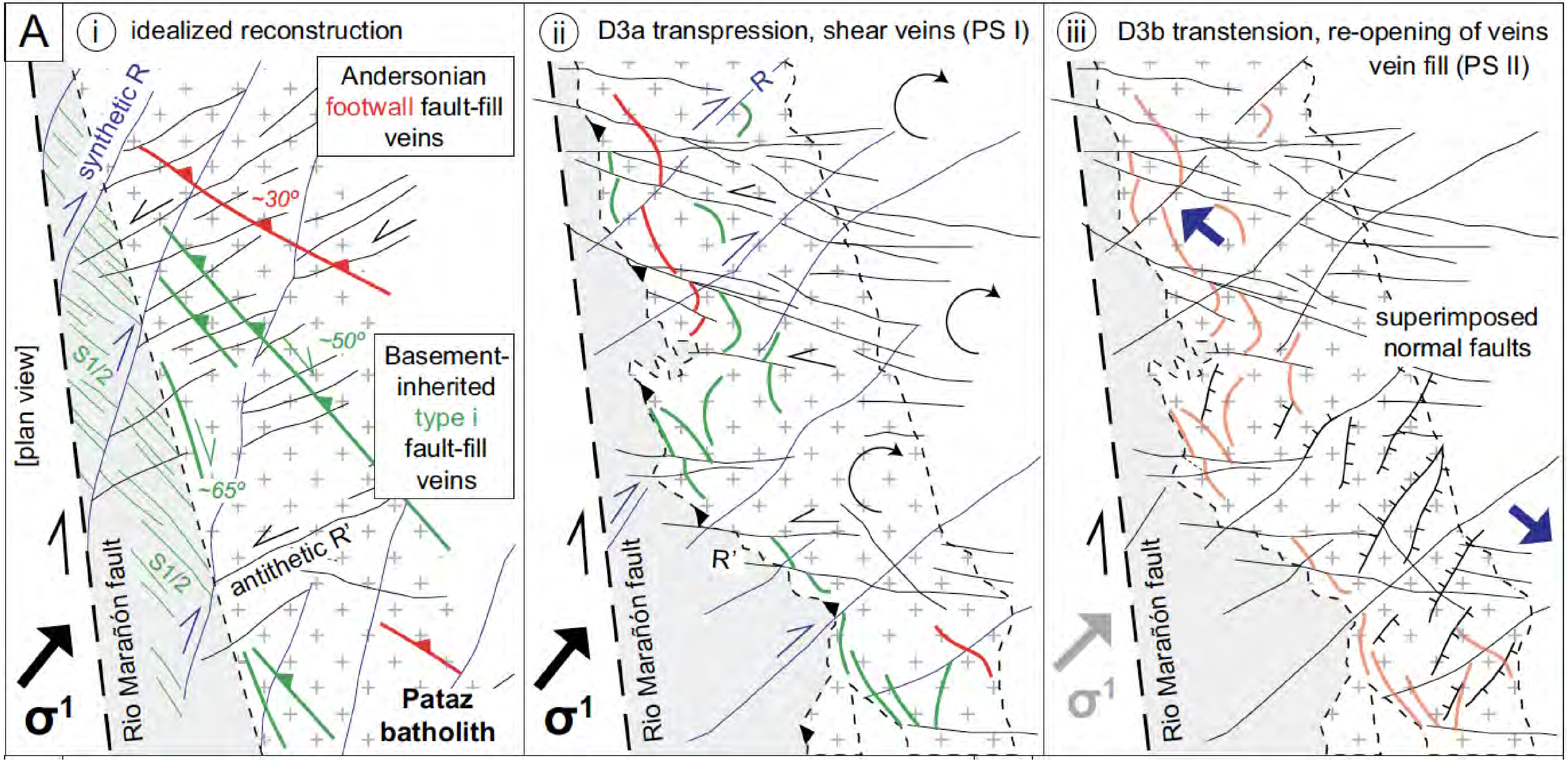
D$_2$ -basement structures

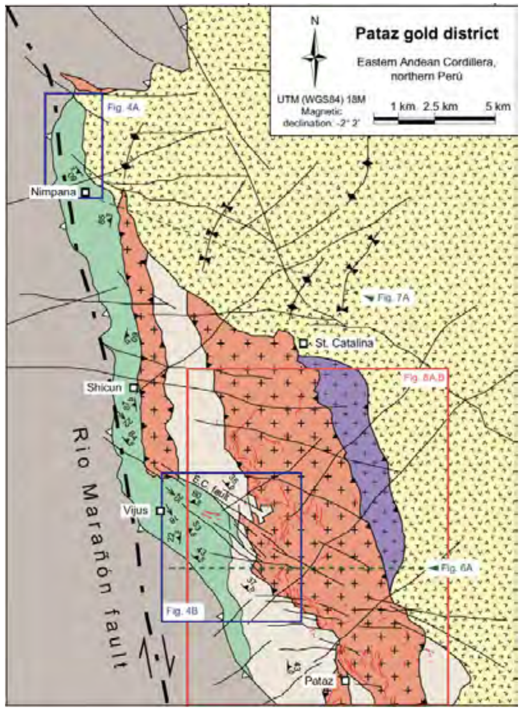
Inherited weak-zones
(intrusive contacts, supra-solidus magmatic flow zones)



Inheritance – Pataz (>12 Moz Au) – District to deposit scale

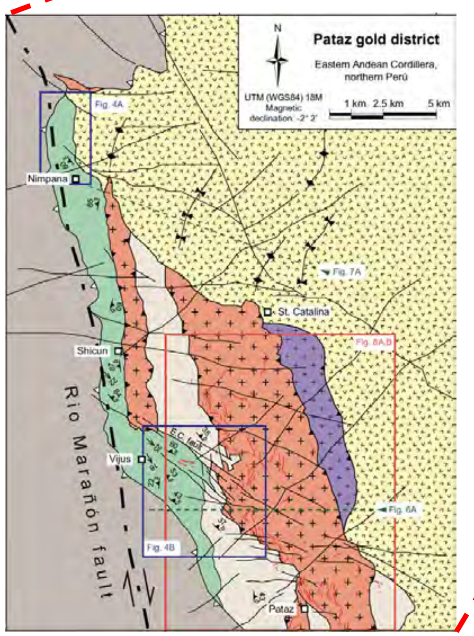
District-deposit-vein scale kinematic framework and evolution
– Critical at respective scale!
i.e., where to put the next drill core, considering vein geometry and displacements



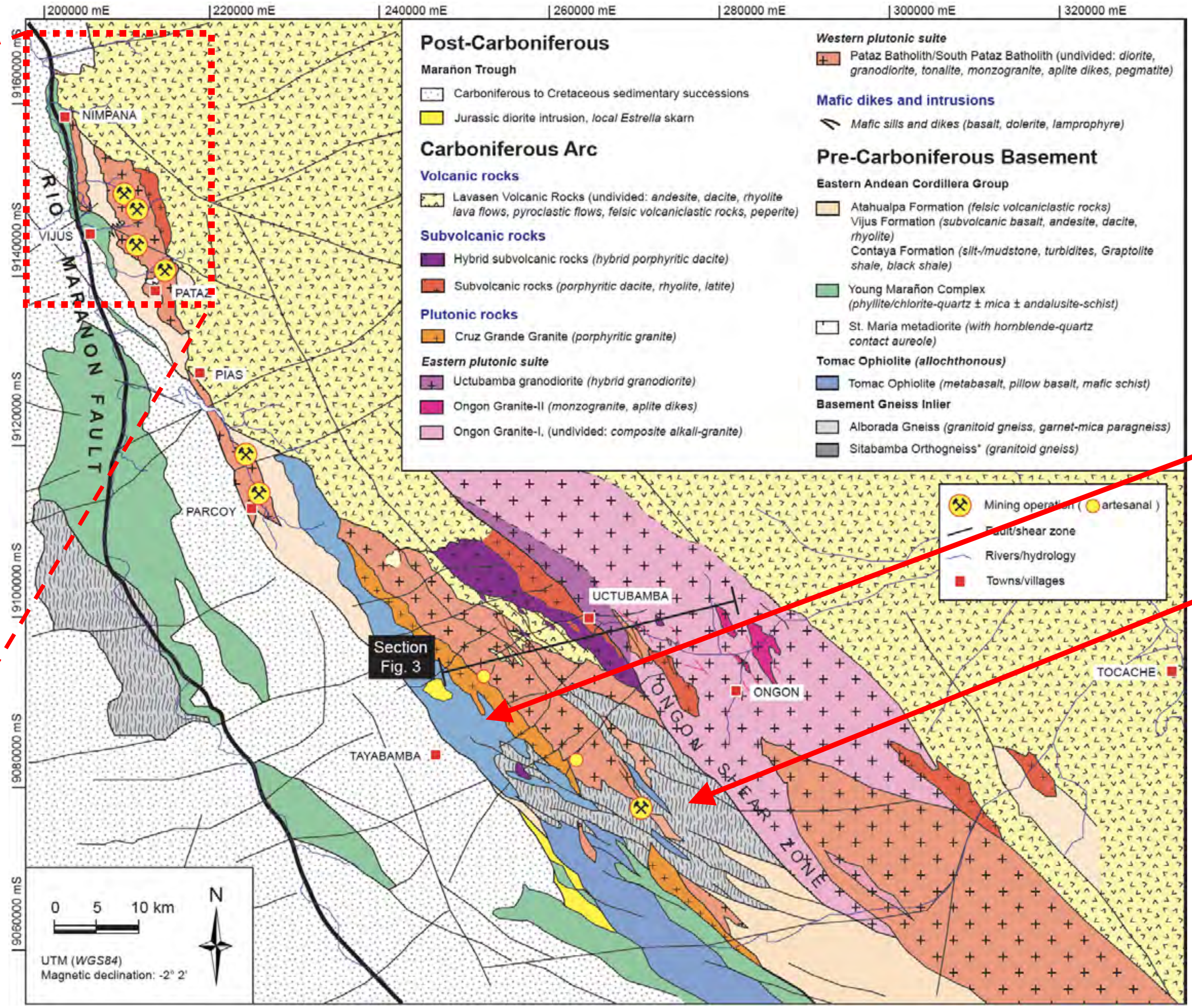


Wiemer et al., 2021

Inheritance – Pataz – Regional Scale



Wiemer et al., 2021



Pre-Carboniferous basement components

Tomac Ophiolite

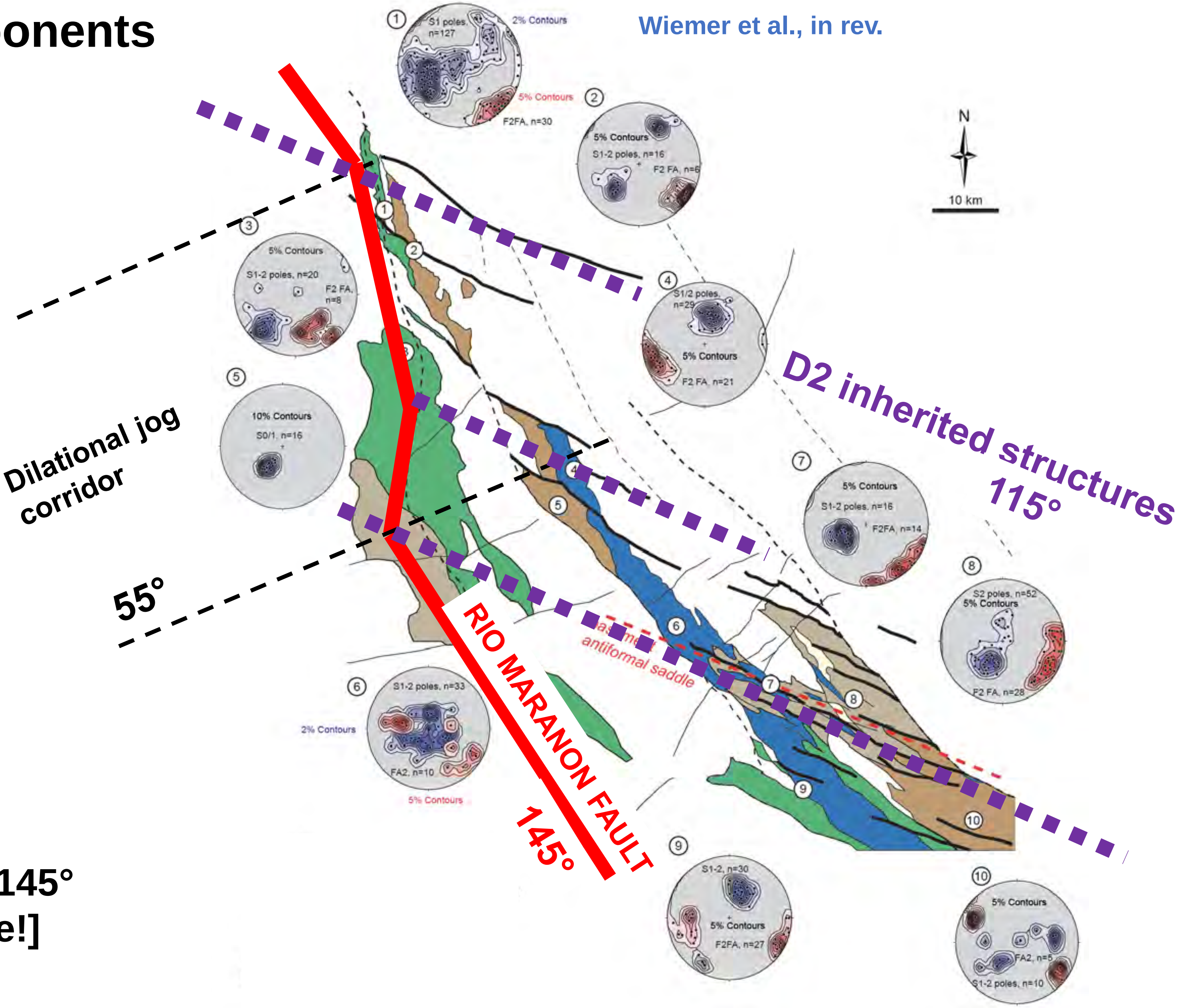
High-grade gneiss

Wiemer et al., in rev.

Inheritance – Pataz – Regional Scale

Pre-Carboniferous basement components

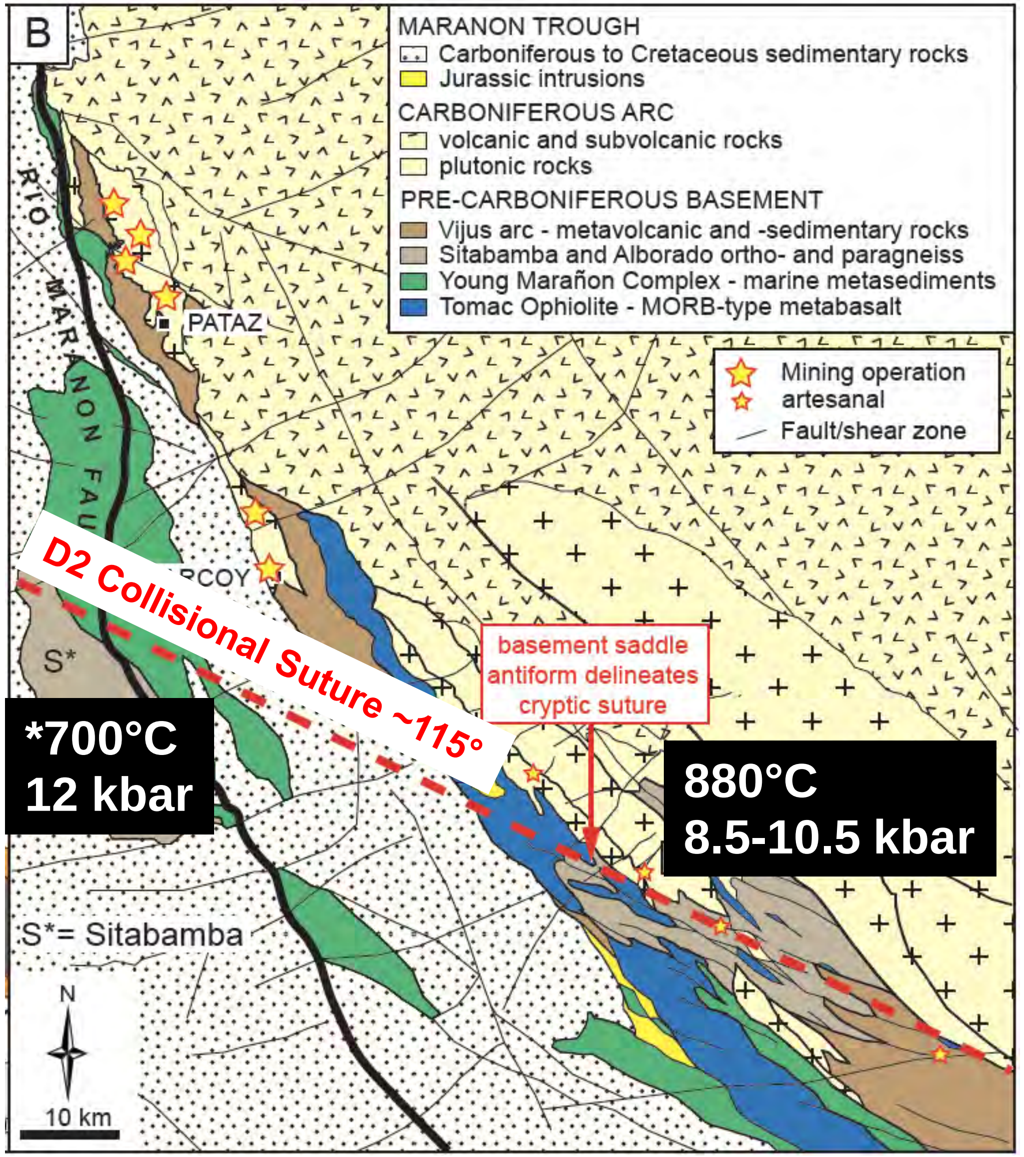
- Uplifted and exposed along Andean orogen strike-parallel structures (145°)
- *But:* distinct internal D2 structural grain
- Controlling regional-scale Carboniferous jog-geometry

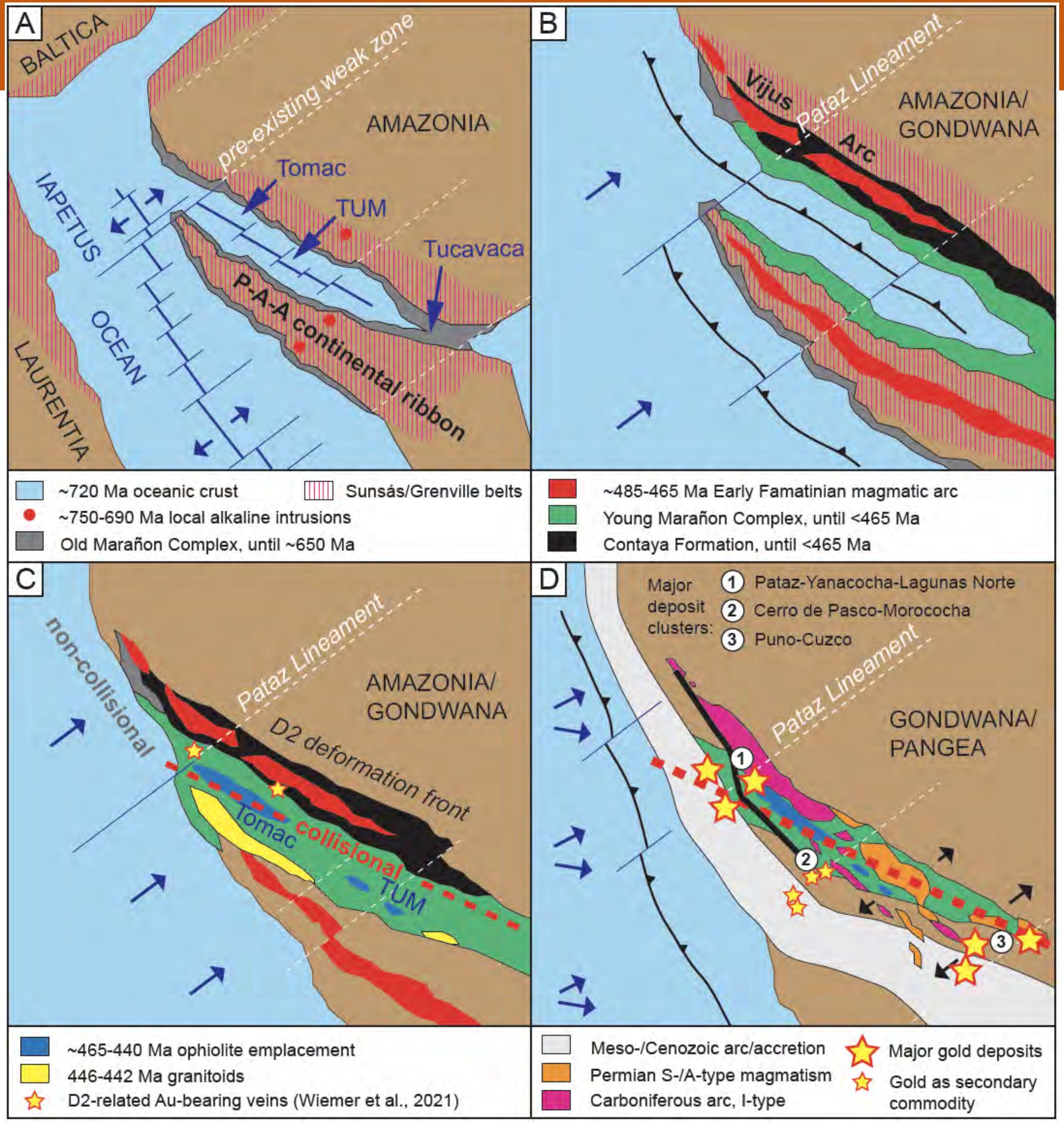


[Note: main structural trends: 55°, 115°, 145°
→ Remember: Yanacocha/Lagunas Norte!]

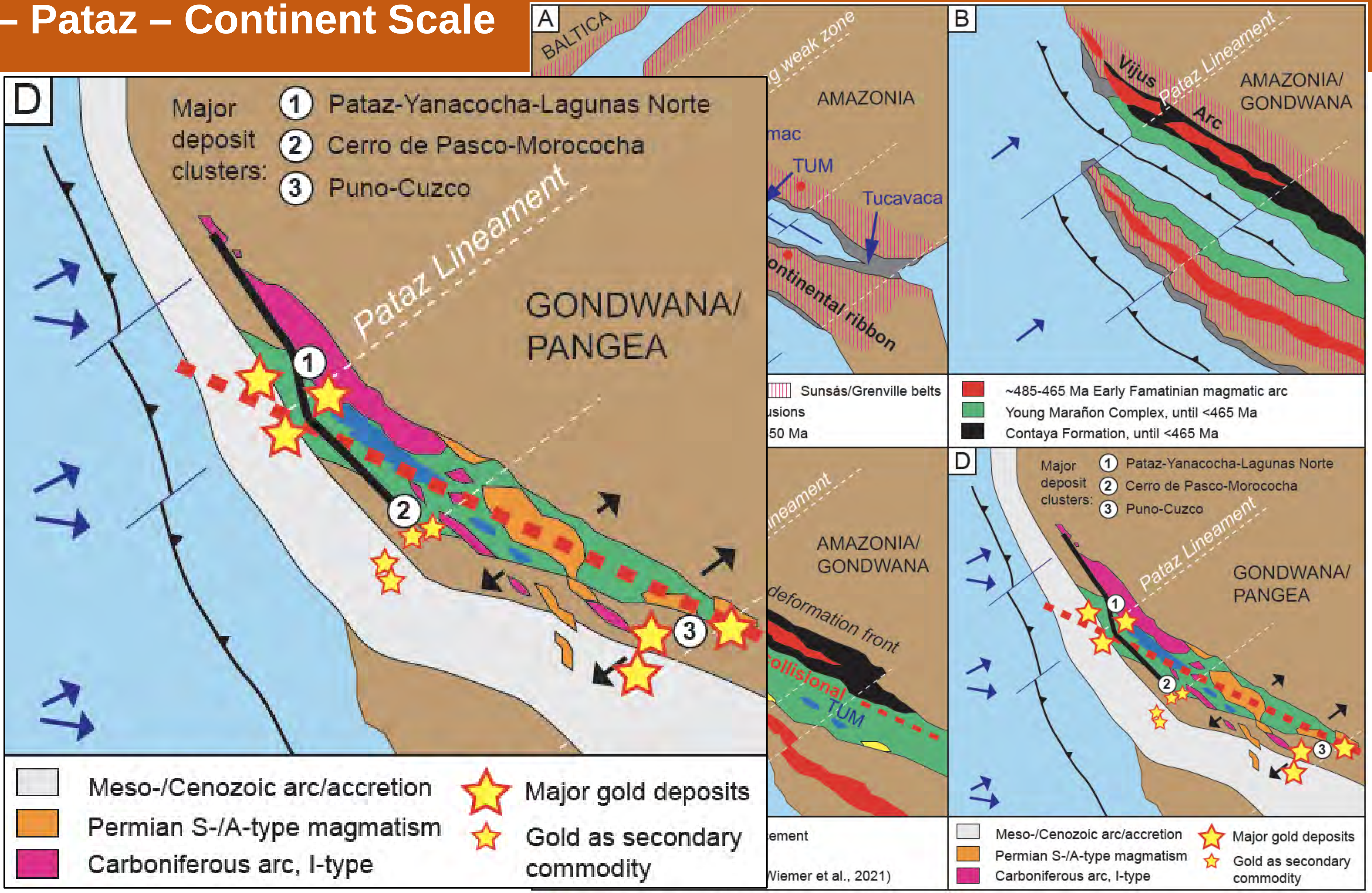
Inheritance – Pataz – Continent Scale

Wiemer et al., in rev.



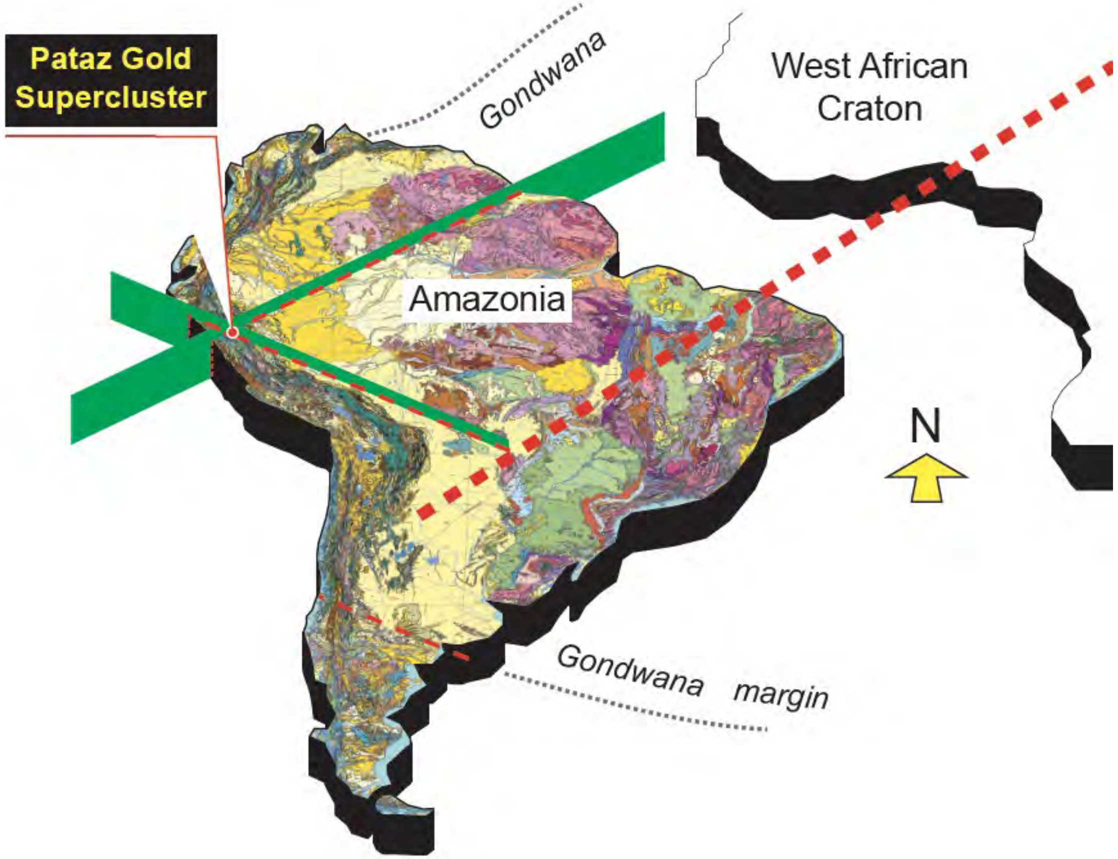


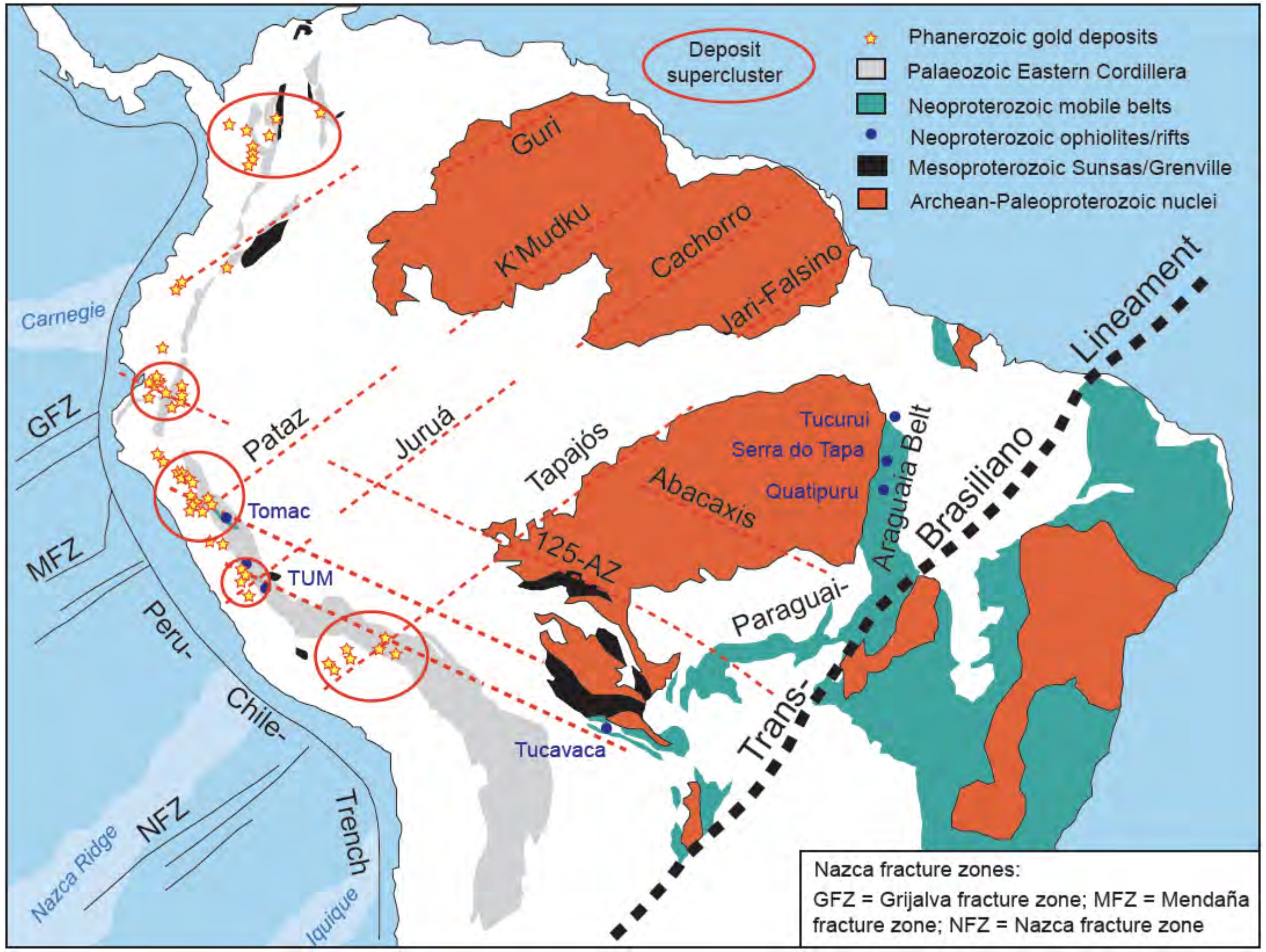
Inheritance – Pataz – Continent Scale



Inheritance – Continent Scale – Identification of Deposit SUPERCLUSTER

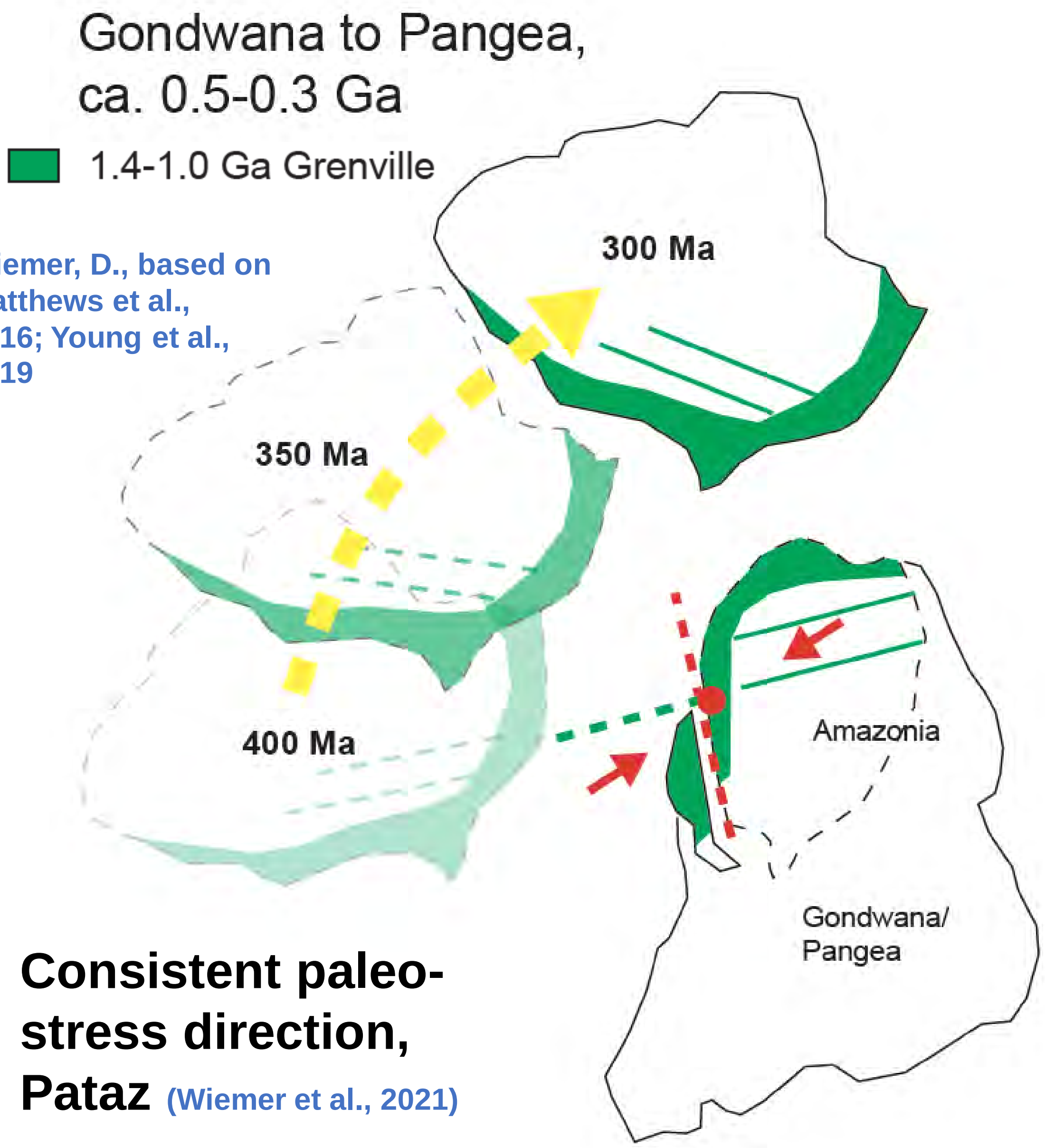
Intersections of inherited trans-lithospheric structures





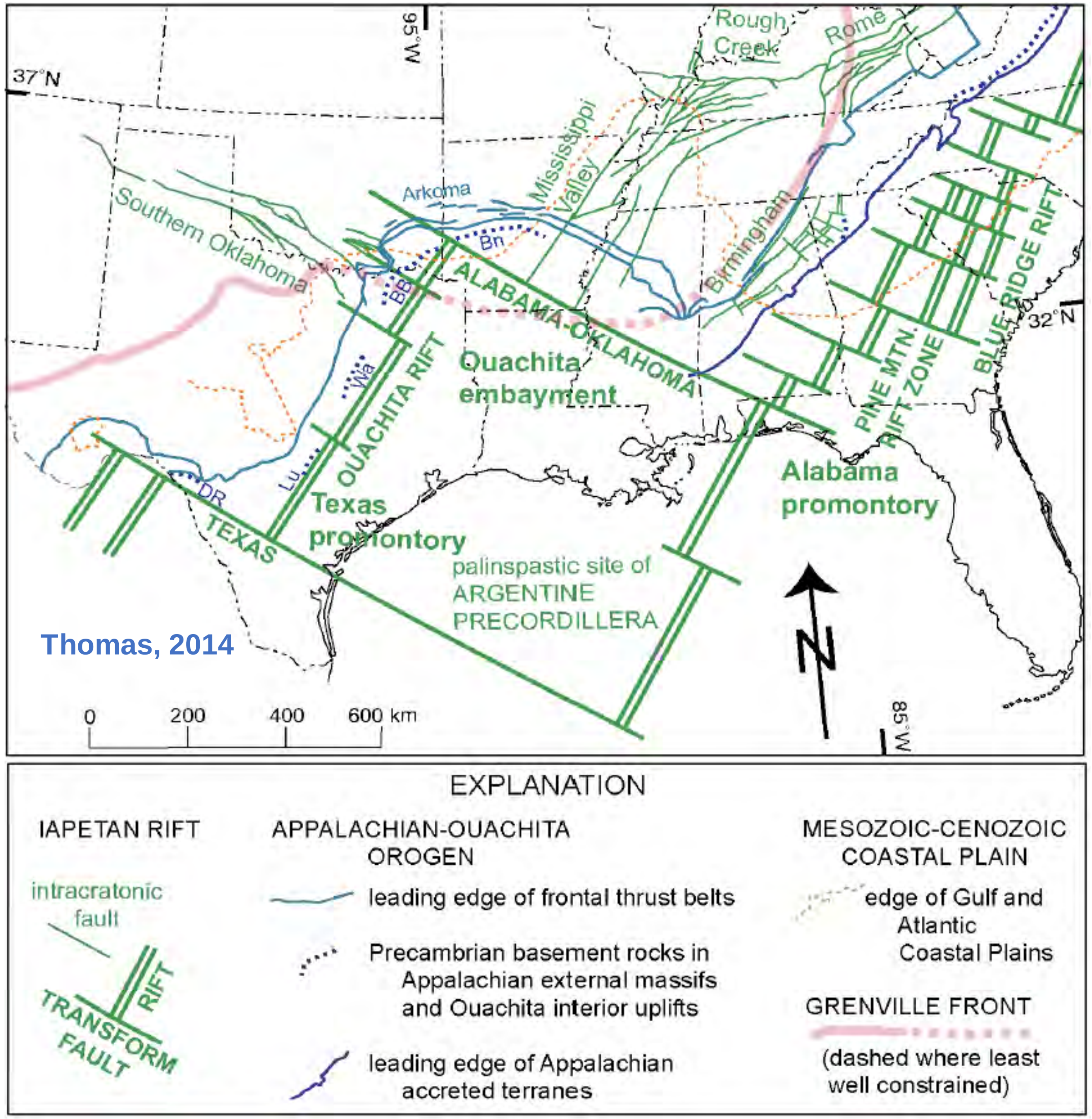
Wiemer et al., in rev.

TEST – 1: IF ancient inheritance true, structures must also cut Laurentia



Wiemer, D., based on Matthews et al., 2016; Young et al., 2019

Consistent paleo-stress direction, Pataz (Wiemer et al., 2021)

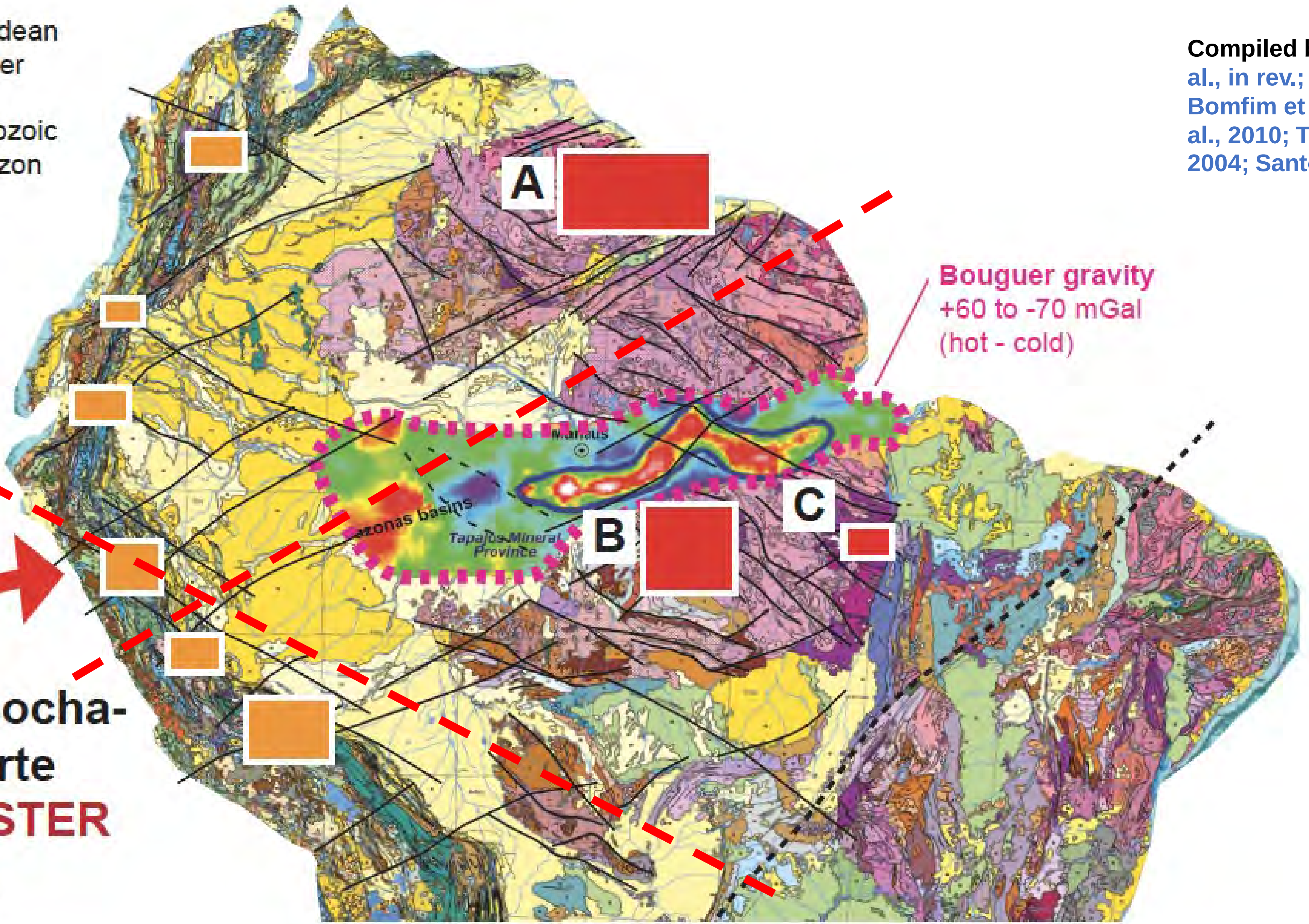


Thomas, 2014

TEST – 2: Same structures / trends and gold clusters in the Amazon Craton?

Phanerozoic Andean Gold Supercluster

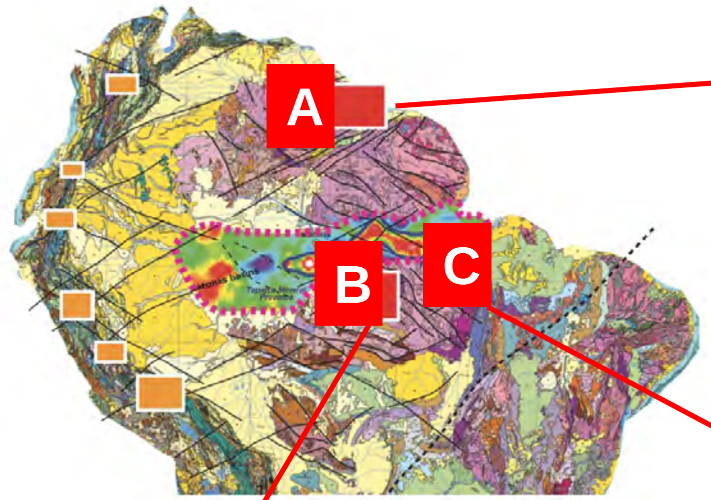
Archean-Proterozoic Examples, Amazon Craton



Compiled based on: Wiemer et al., in rev.; Juliani et al., 2021; Bomfim et al., 2013; Cordani et al., 2010; Tessinari & Macambira, 2004; Santos et al., 2000;

Pataz-Yanacocha-Lagunas Norte SUPERCLUSTER >50 Moz Au

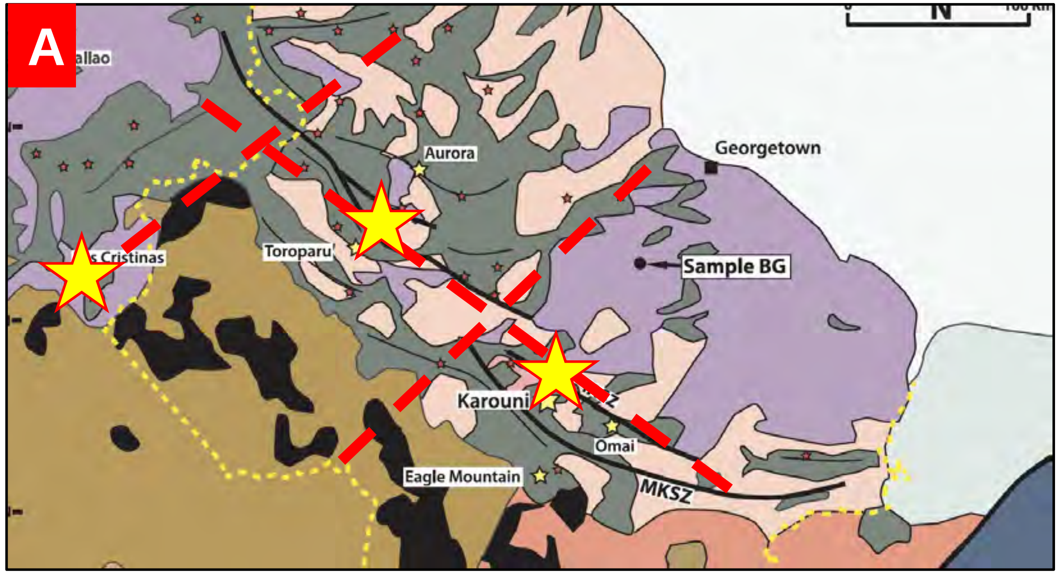
TEST – 2: Same structures / trends and gold clusters in the Amazon Craton?

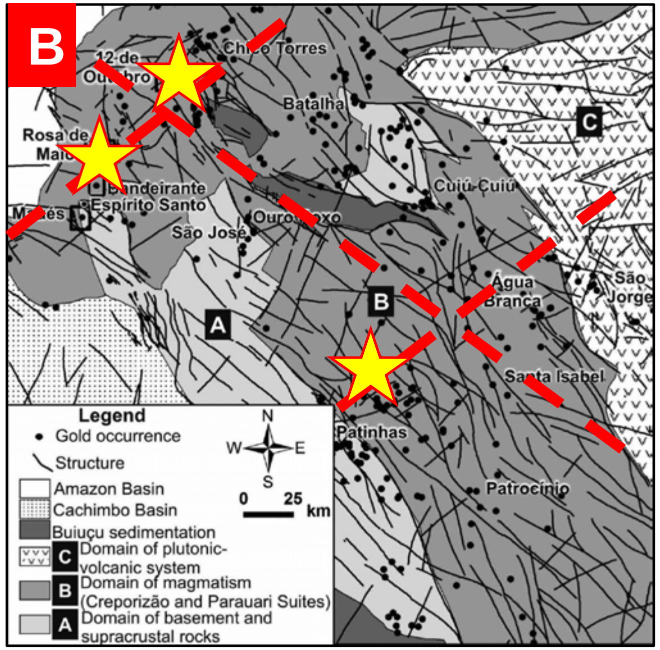


Karouni Gold district, Guyana

Gold: 2.1-2.0 Ga

Tedeschi et al., 2020





Carajas, Brazil

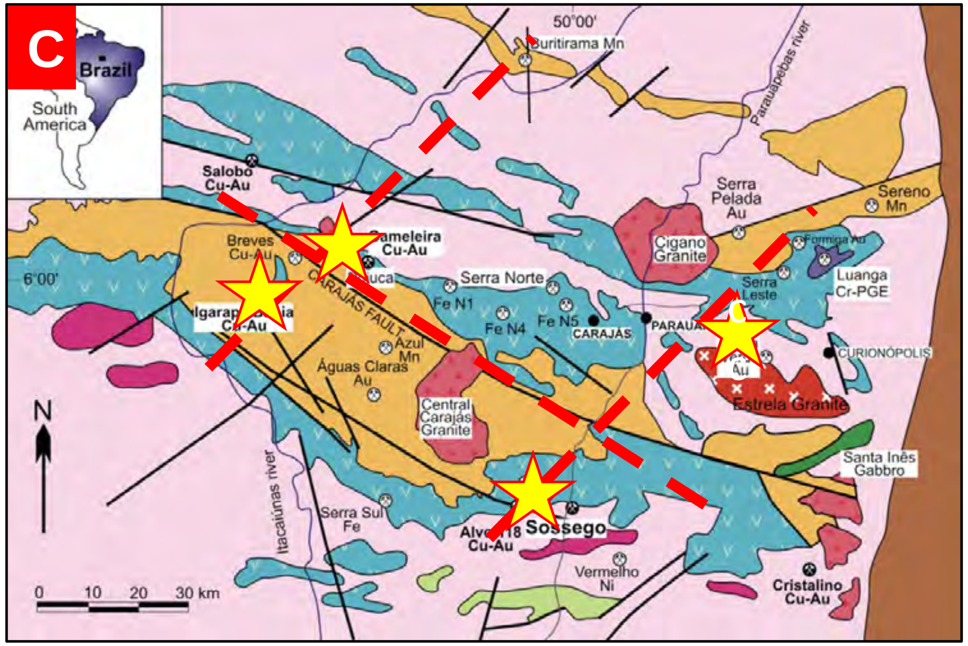
Gold: 2.7-1.9 Ga

Monteiro et al., 2008;
Trunfull et al., 2020

Tapajos Gold province, Brazil

Gold: 1.9-1.0 Ga?

Carrino et al., 2015



Conclusions

1. Multi-scale integration is key

→ **Deposit-scale *VERSUS* continent/lithosphere-scale:**
Are you chasing a vein/drill-core OR the next 'supercluster'?

→ **Start 'asap': Figure out where you are and why you are there!**

2. Major structural intersections (trans-lithospheric) mark zones of enhanced mantle-to-crust permeability (magma and fluid conduits)

→ **Sites of structural intersections and complexity!**

3. Structural/tectonic inheritance

→ **Focus investigation on the basement!**

Further discussion and implications: see Poster...