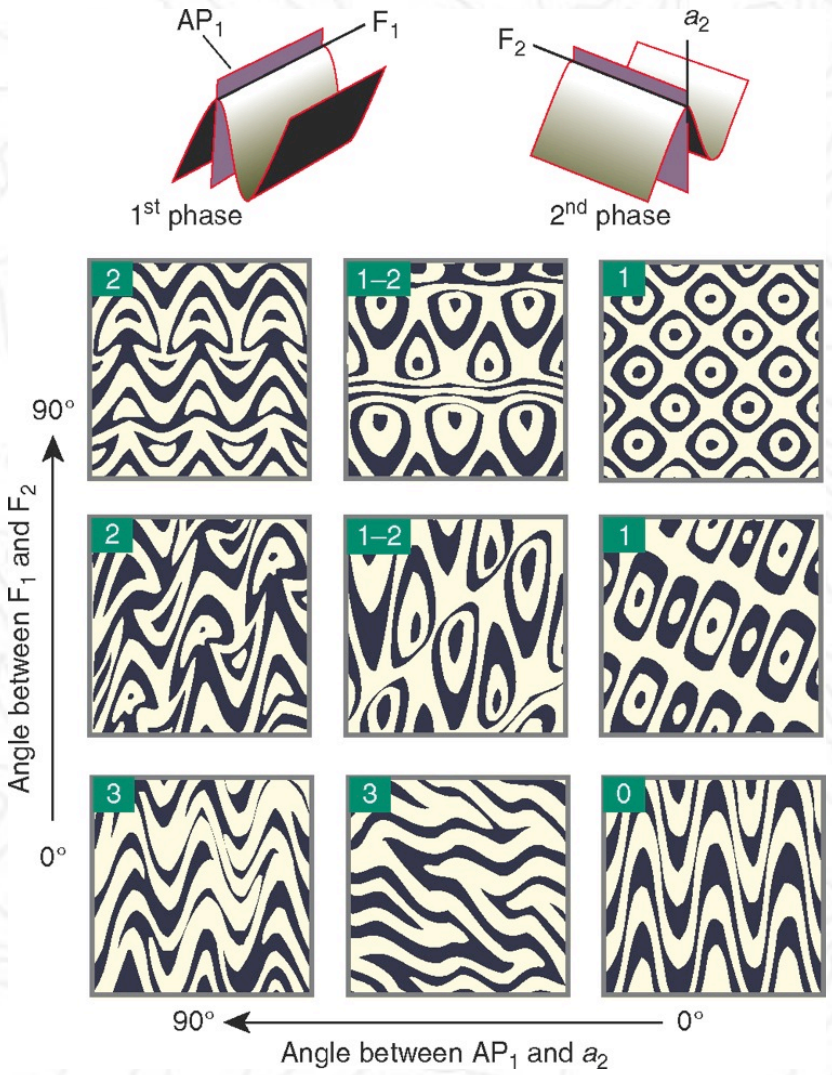
IGGC12
Georgetown

The Role of Polyphase Folding in the Distribution of Gold: Insights from the Guiana Shield

B. Lacroix, **P.J. Hainque**, A. Hauteville, D. Lahondès, E. Le Goff, D. Fournier, C. Bertoni, S. Taravella, K. Robo, M. de Witasse

GEXPLORE SERVICES GÉOLOGIQUES ET GÉOPHYSIQUES
KANSAS STATE UNIVERSITY
Reunion Gold
AMG Auplata Mining Group
SAS Gaïa

INTRODUCTION

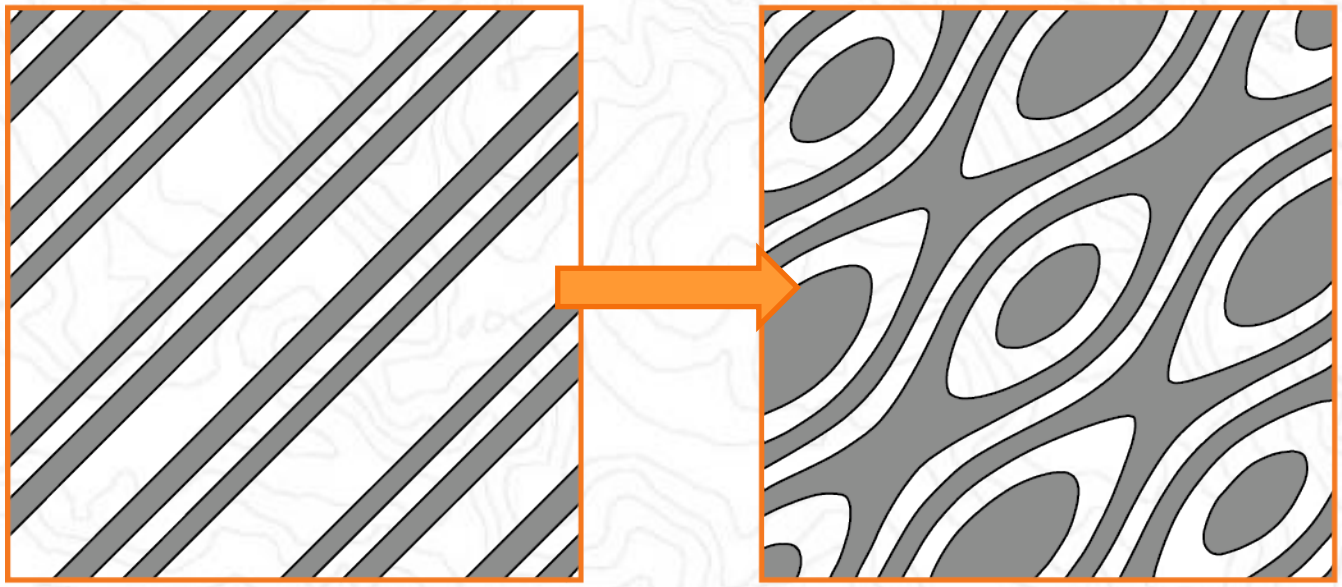


Fossen (2016) Modified from Ramsay (1967)

Combes et al. (2021)

INTRODUCTION

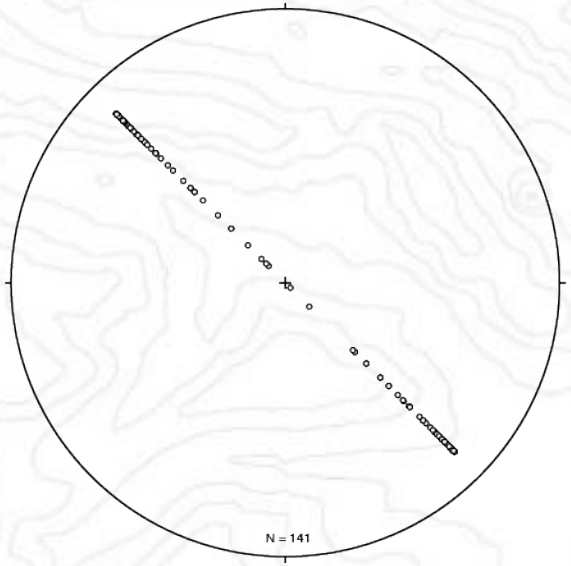
Map view



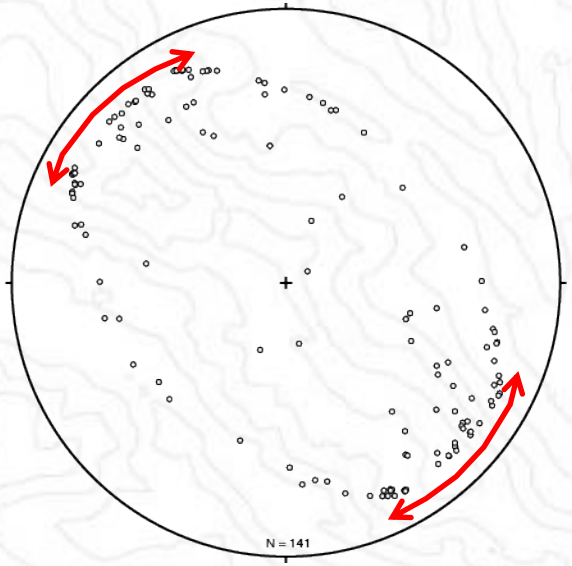
Distribution of poles controlled by:

- Orientation of axial surface F1/F2
- Interlimb angles F1/F2
- Fold vergence

Stereoplots



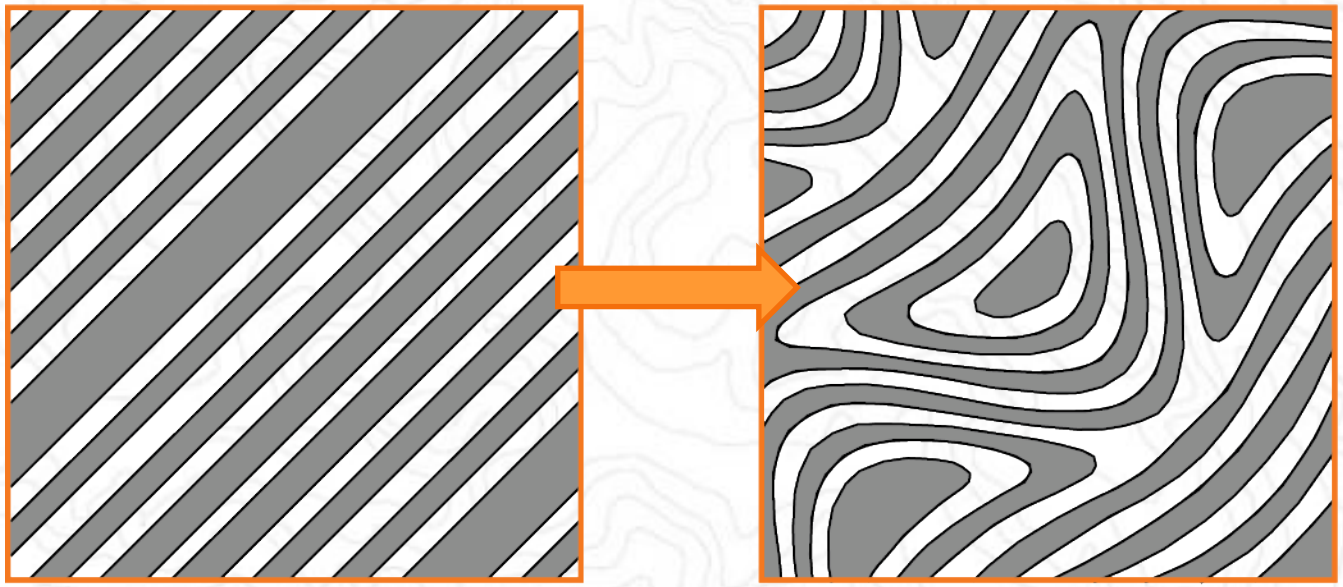
D1



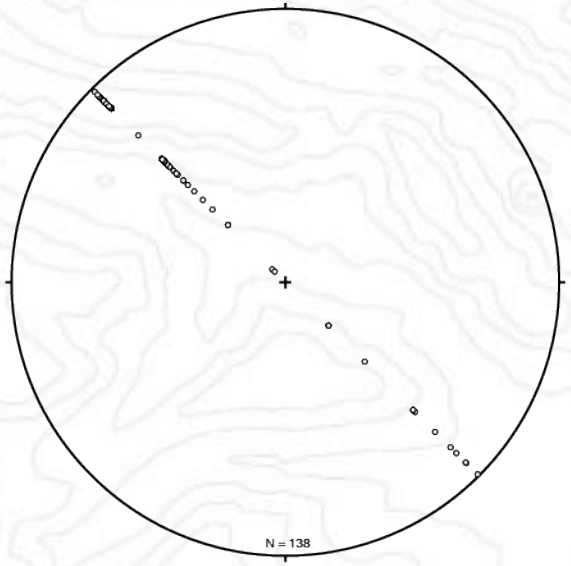
D2

INTRODUCTION

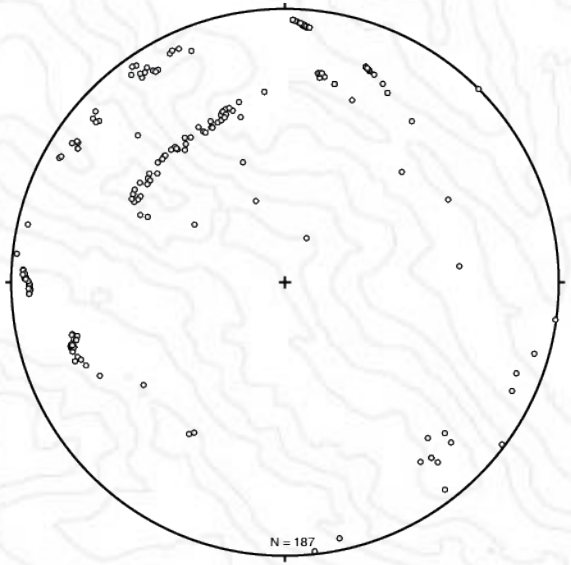
Map view



Stereoplots



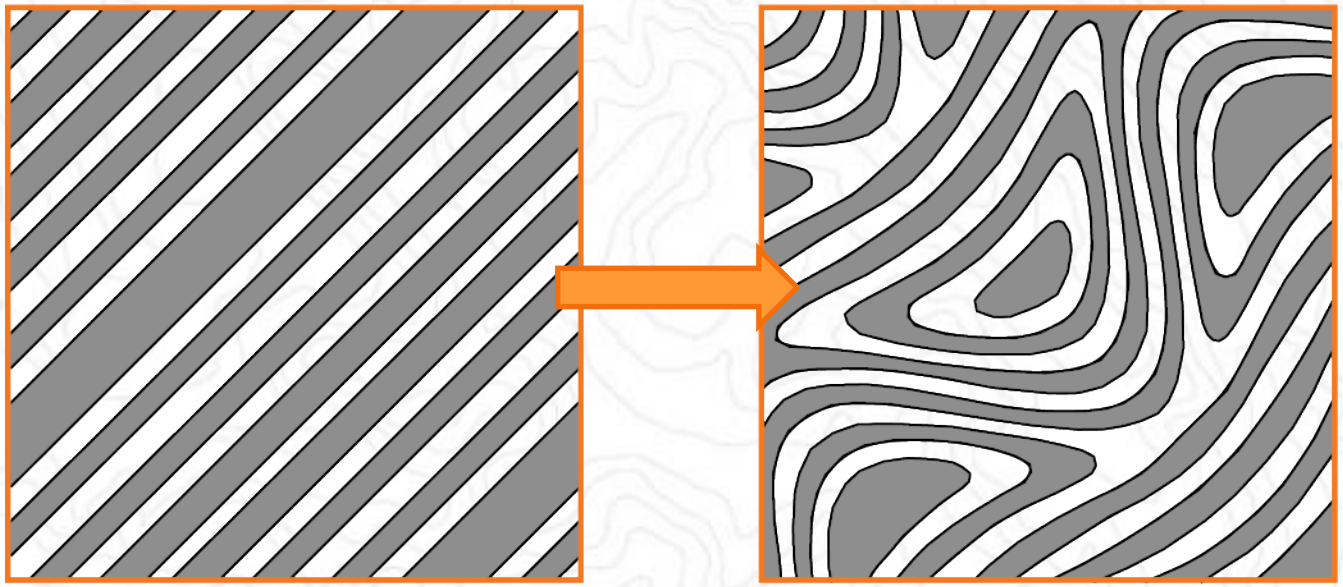
D1



D2

INTRODUCTION

Map view



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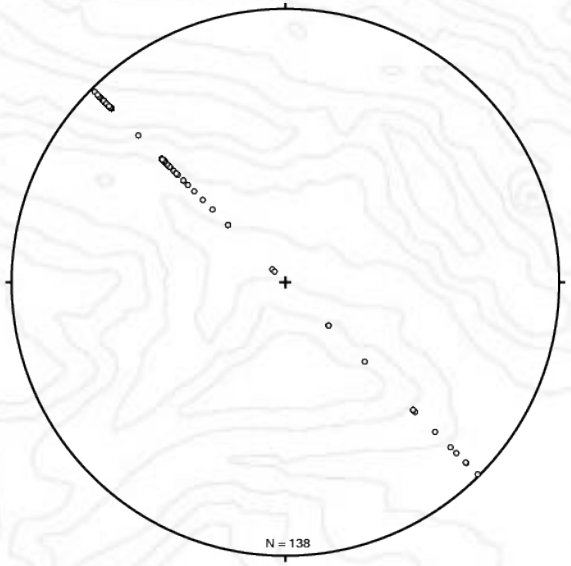
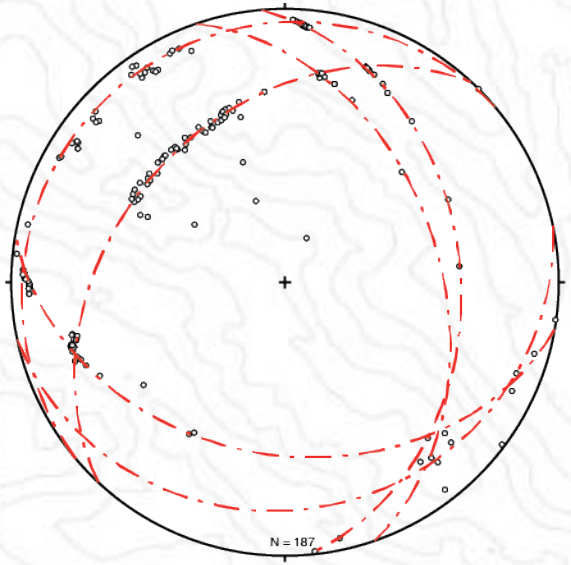
Stereoplots



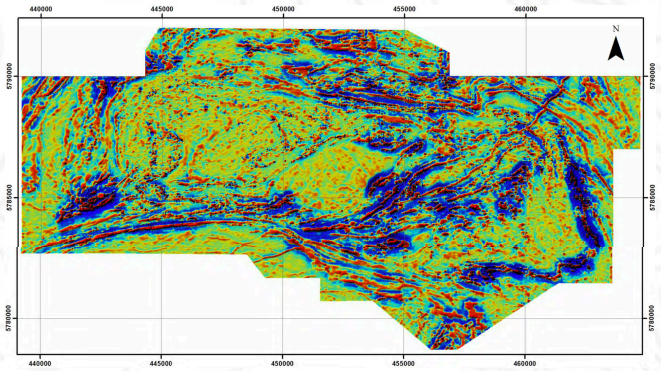
D1



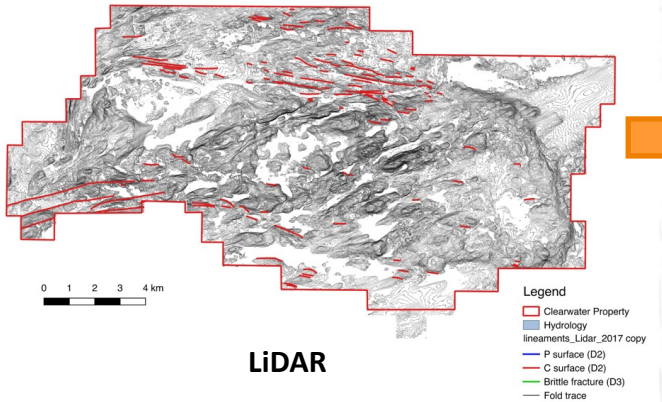
D2

MULTSCALE INTEGRATION

Integration of different datasets

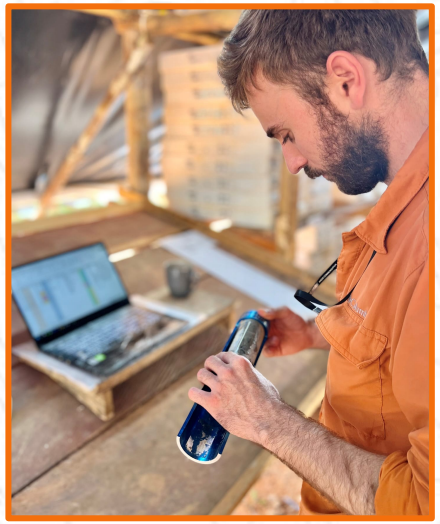


Aeromagnetic survey

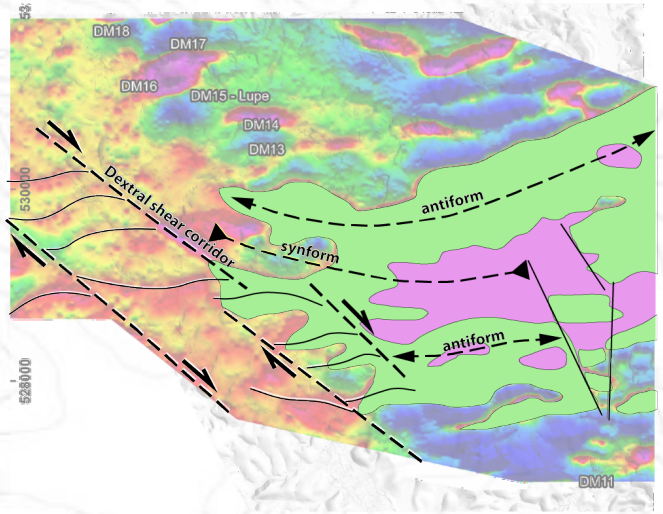


LiDAR

Field work



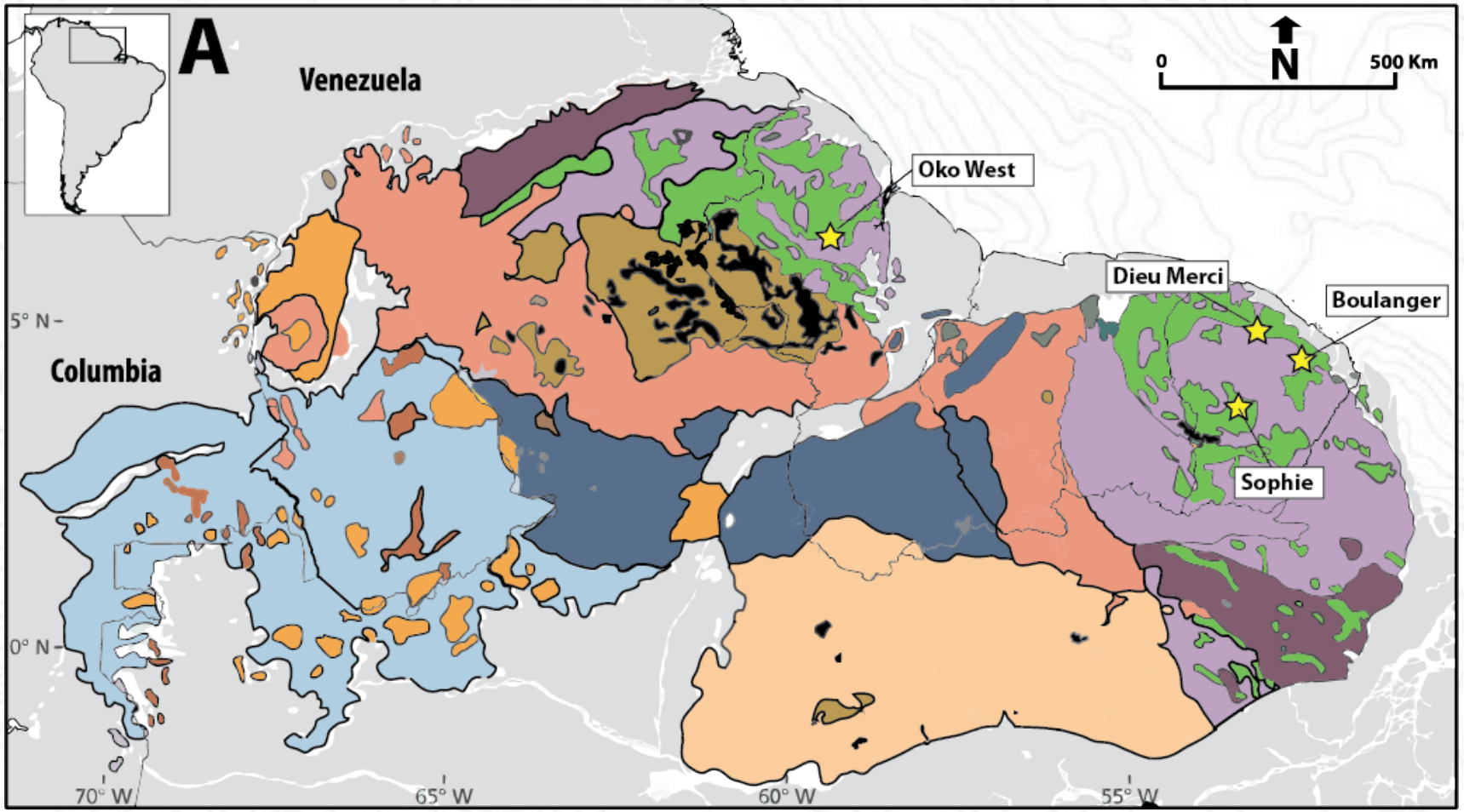
Structural analysis



Structural and geological maps

Identification of Exploration Targets

LOCATIONS

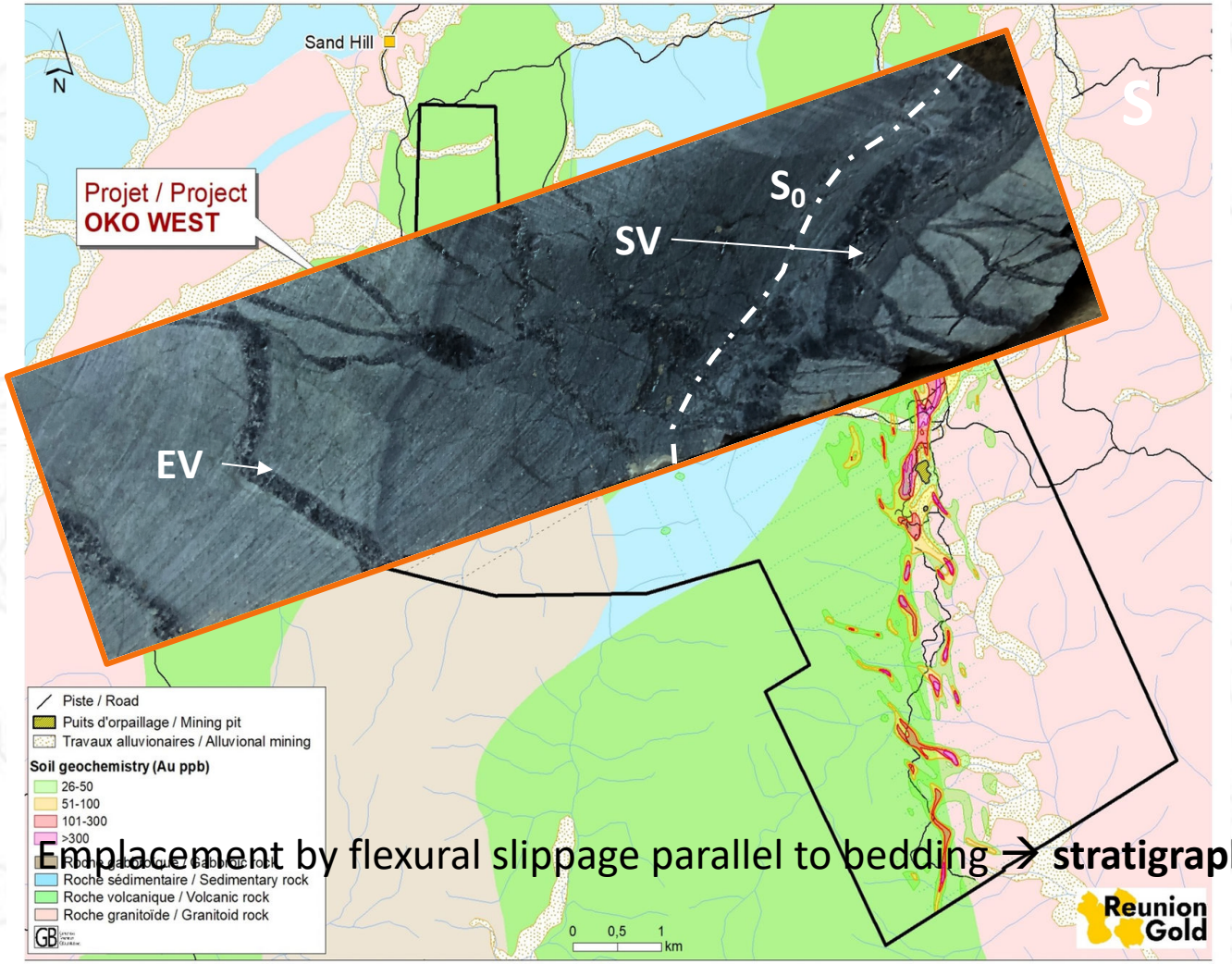


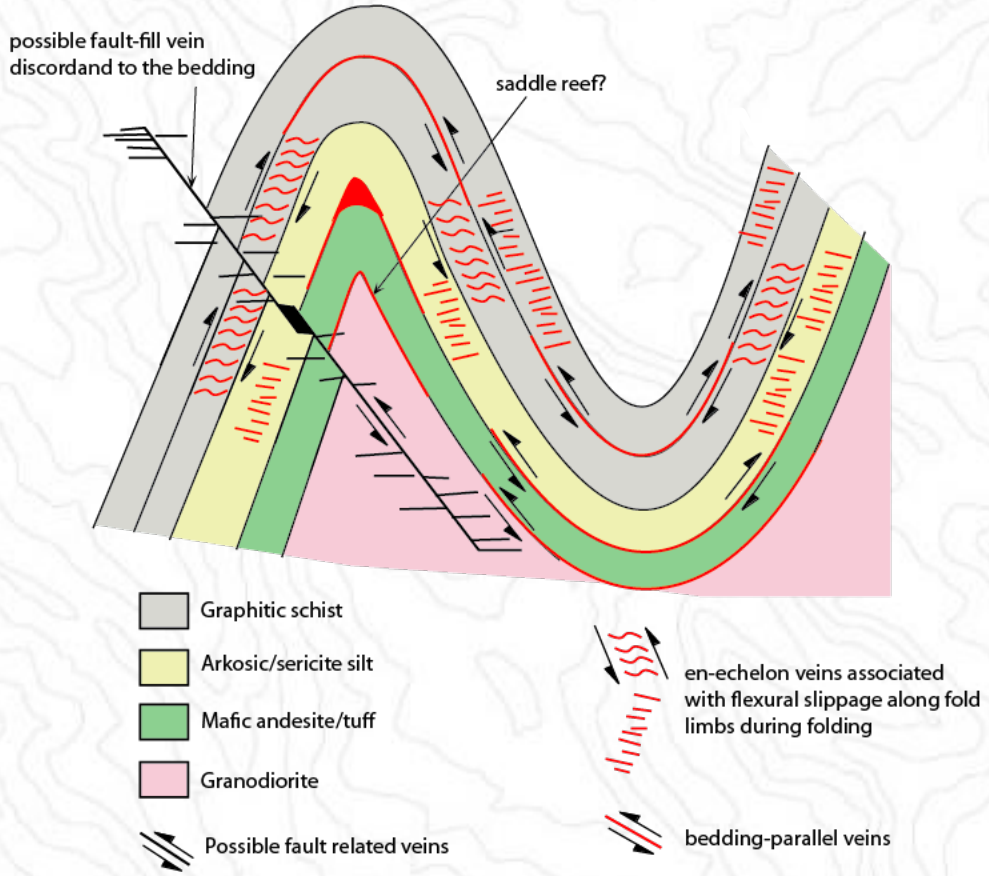
- **Younger Platform Covers, 1.3-1.2 Ga**
- **Mesoproterozoic intrusives, 1.59-1.51 Ga**
- **Mafic Intrusives, 1.79 Ga and younger**
  Avanavero dolerite and other Proterozoic mafic and alkaline intrusives
- **Rio Negro Belt, 1.86-1.72 Ga**
- **Older platform cover, ~1.87 Ga**
  Roraima (Super)Group sandstones, conglomerates, ash-fall tuffs
- **Younger felsic volcanic and granitoid belt, "Iricoumé " 1.89-1.81 Ga**
- **Older felsic volcanic and granitoid belt "Orocaima" 1.99-1.95 Ga**
- **High grade metamorphic belts, 2.08-2.02 (-1.98) Ga**
- **Trans-Amazonian Province, 2.26-2.09 Ga**
- "Younger Granites" (2.11-2.08 Ga)
- TTG, diapiric tonalite-trondhjemite-granodiorite intrusions; gneisses (2.18-2.13 Ga)
- Greenstones Belts (2.18-2.11 Ga)
- **Archean >2.5 Ga**

Tedeschi et al. (2020)
Kroonenberg et a. (2016)

OKO WEST - GUYANA

Most of the high-grade intersection seem to be controlled by bedding-parallel vein system occurring during D_1 folding



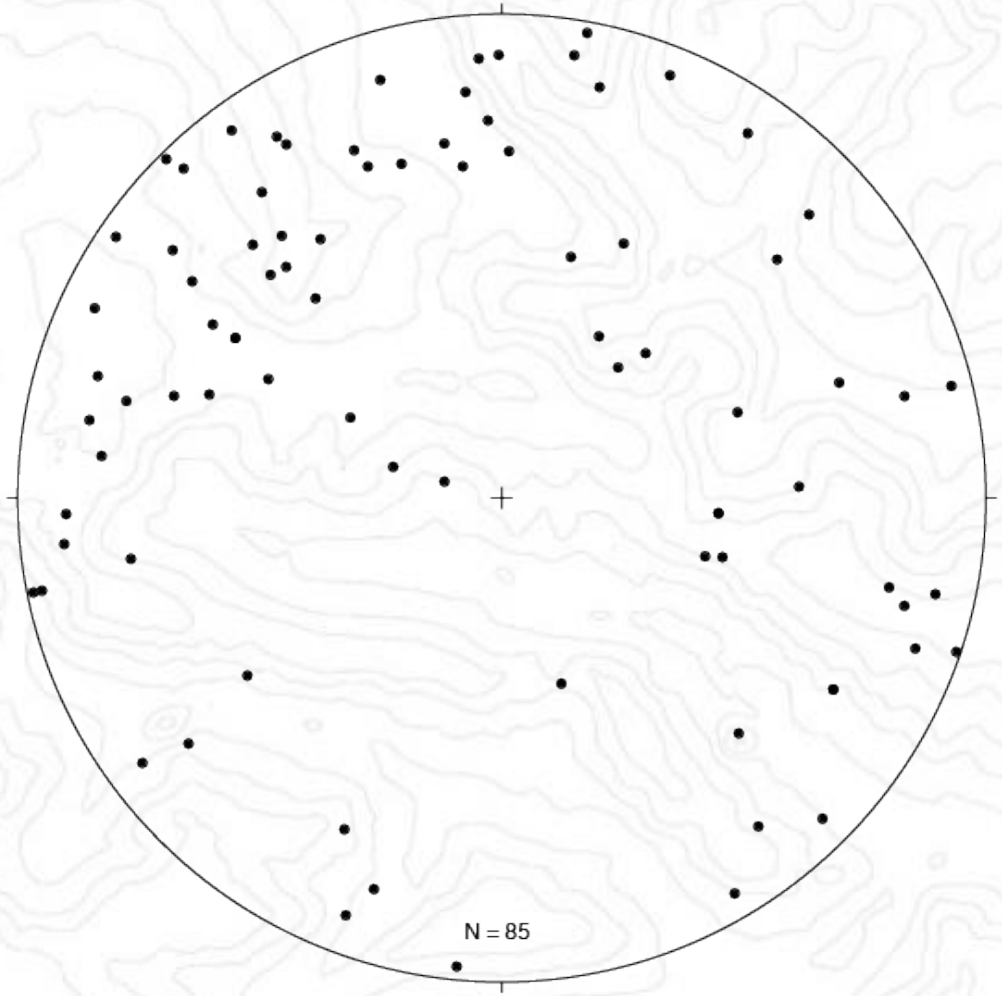


Emplacement by flexural slippage parallel to bedding → **stratigraphic contact is the key**

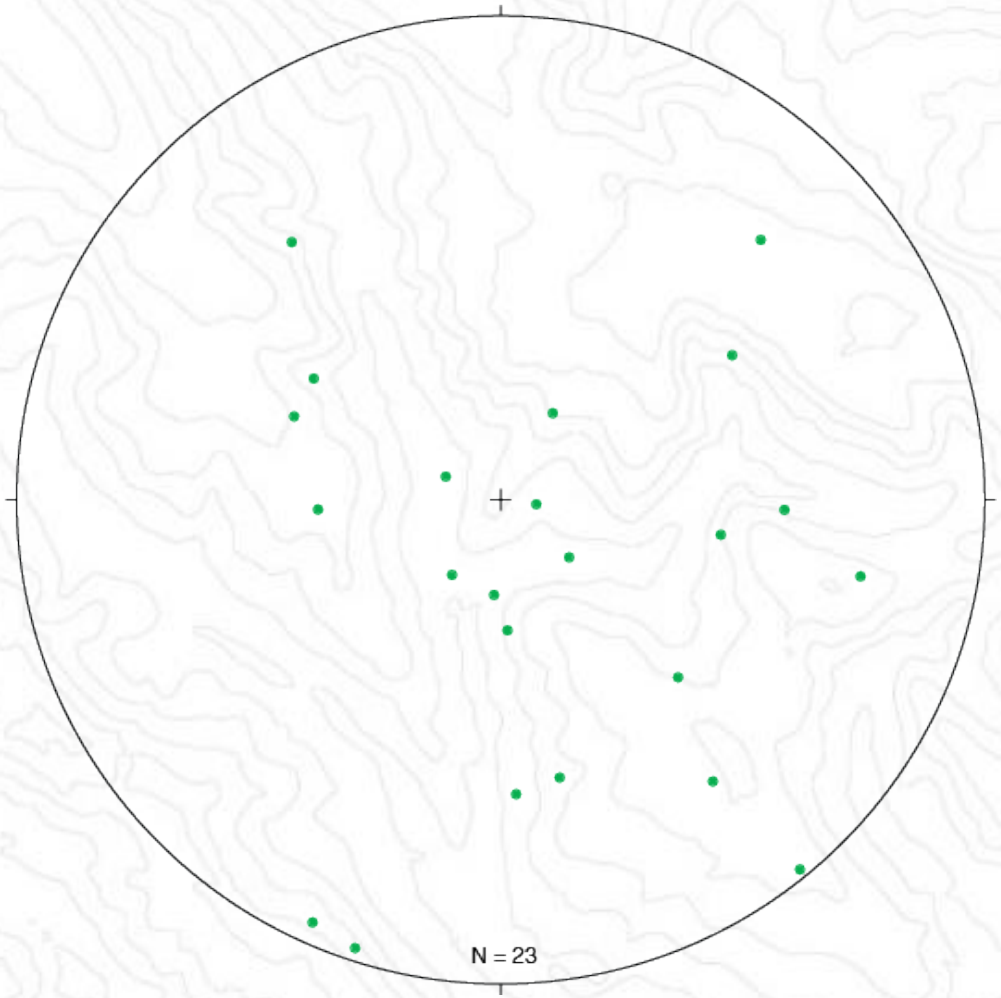
Presentation – Bertoni et al. (Today at 3:30 PM)

OKO WEST - GUYANA

Bedding poles distibution



Fold axes distibution



OKO WEST - GUYANA

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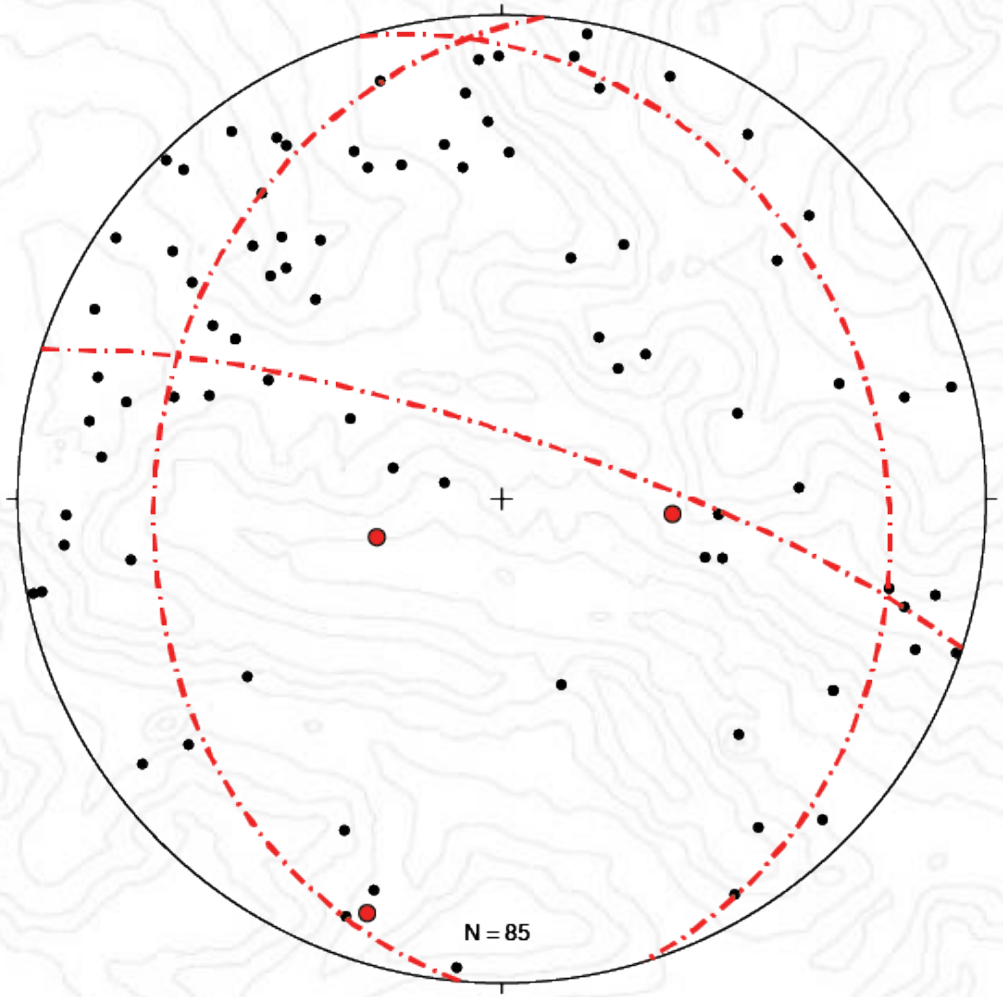

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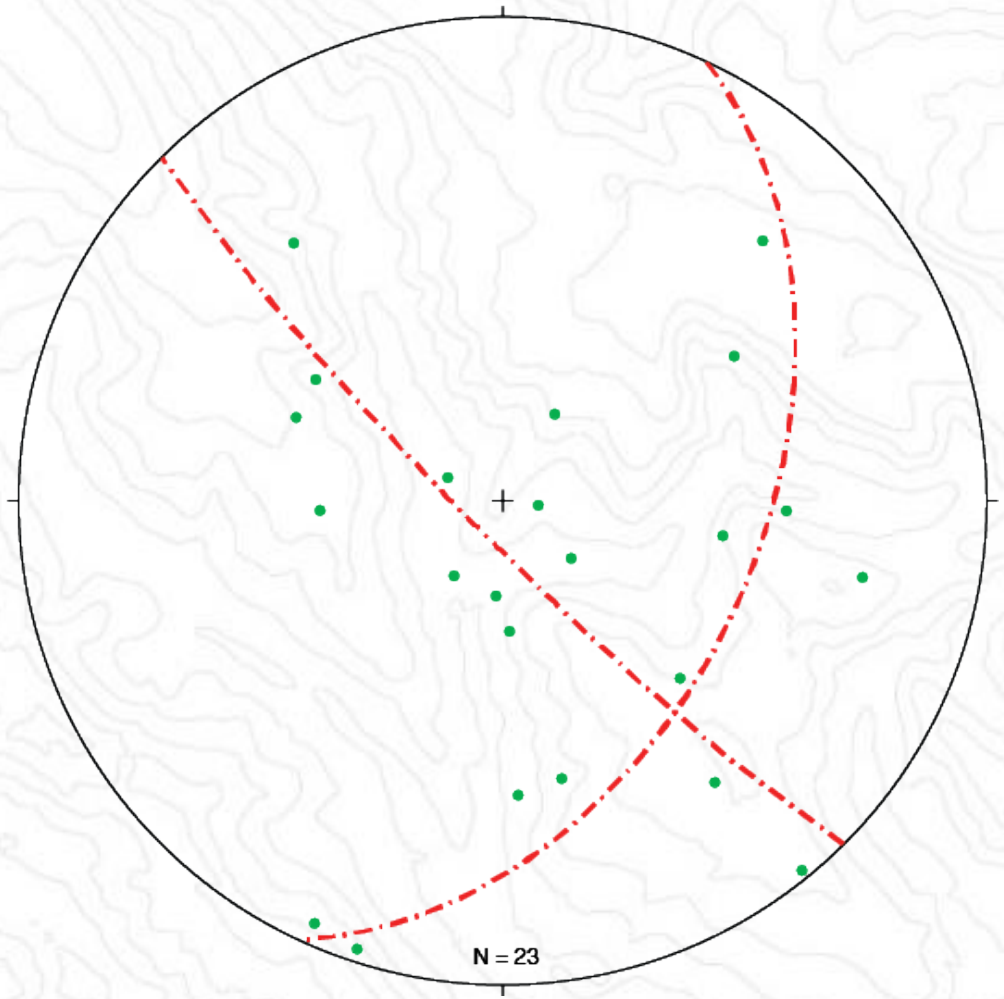
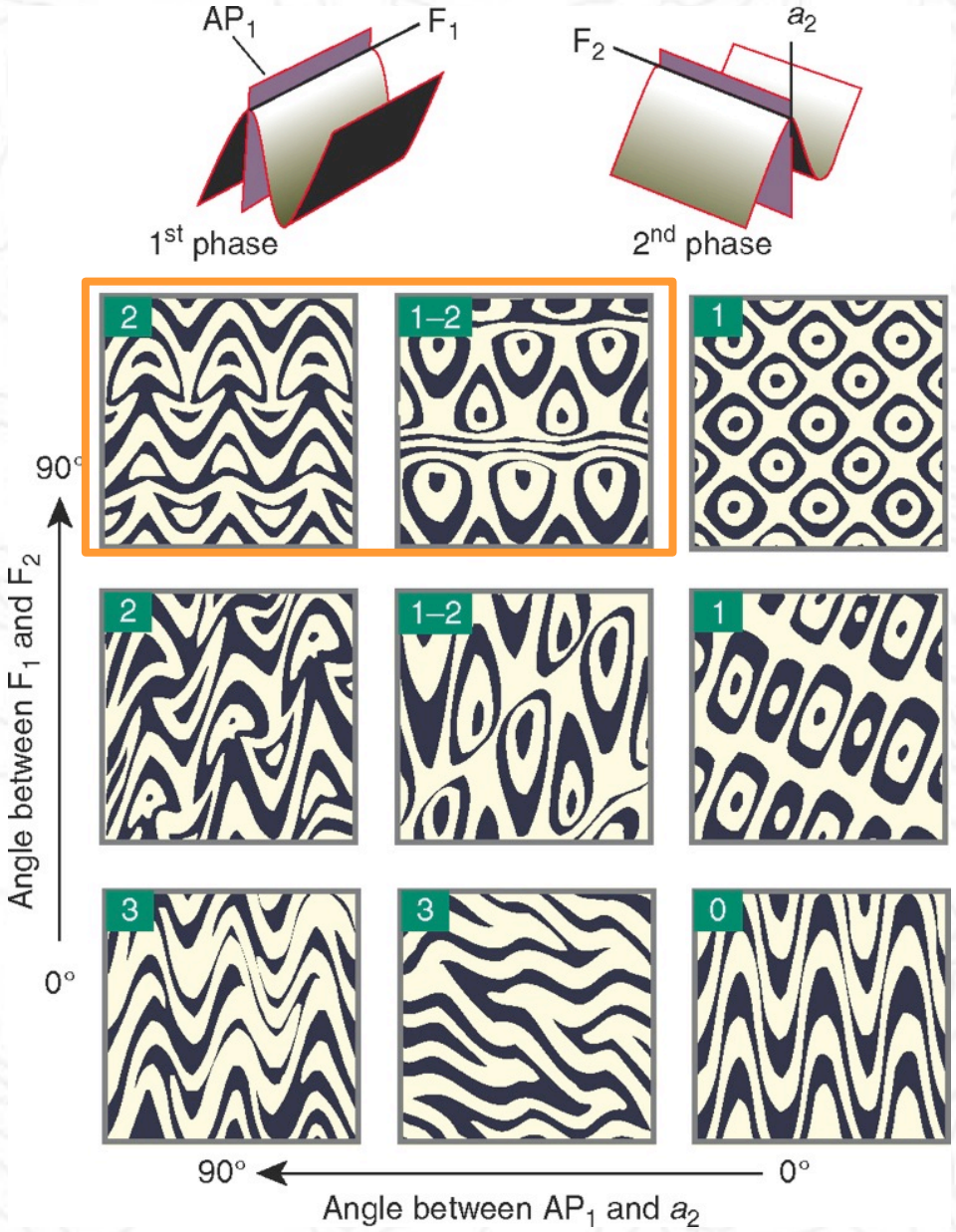
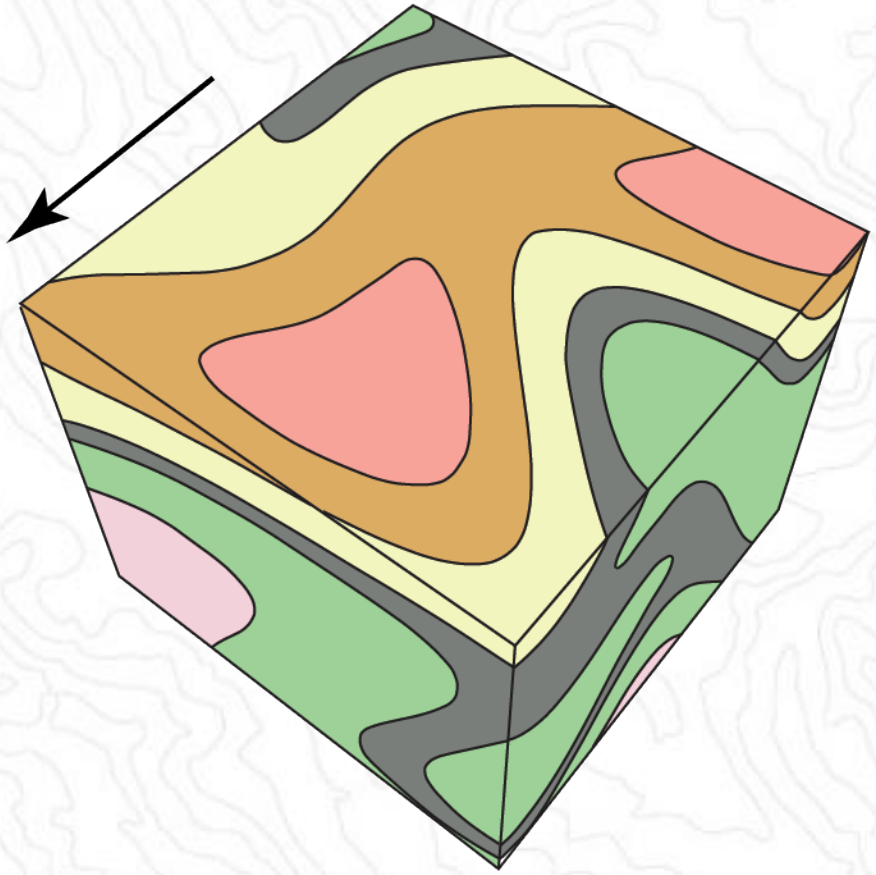


Distribution in agreement with Type-2 fold superposition

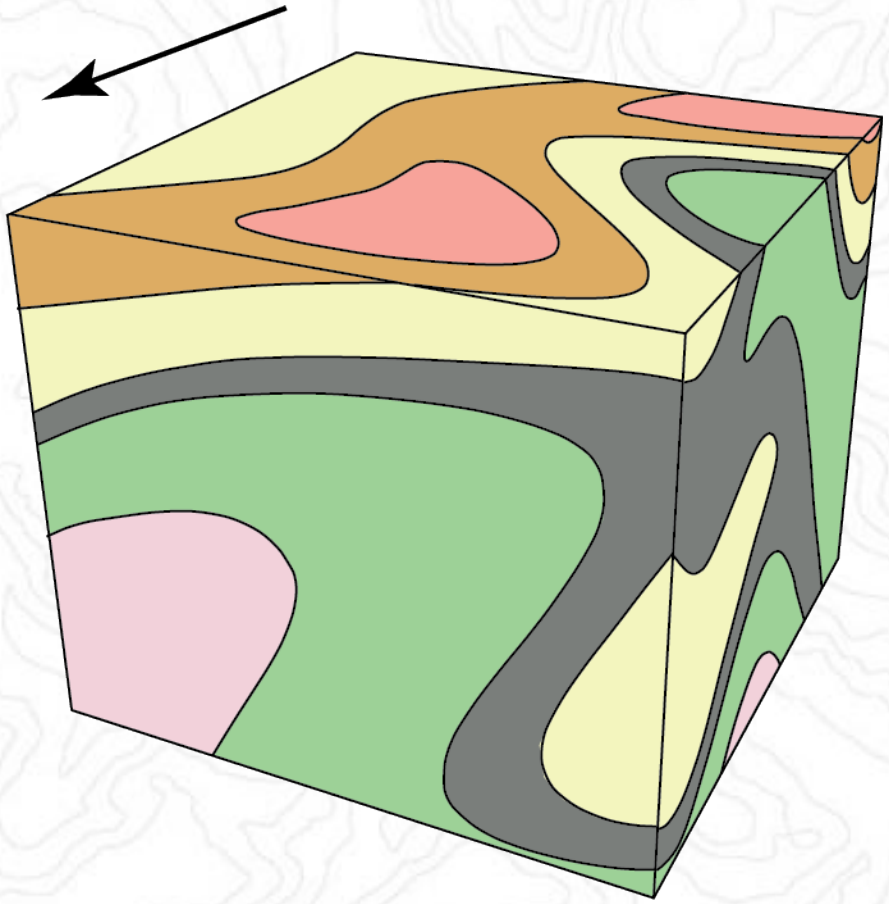
OKO WEST - GUYANA





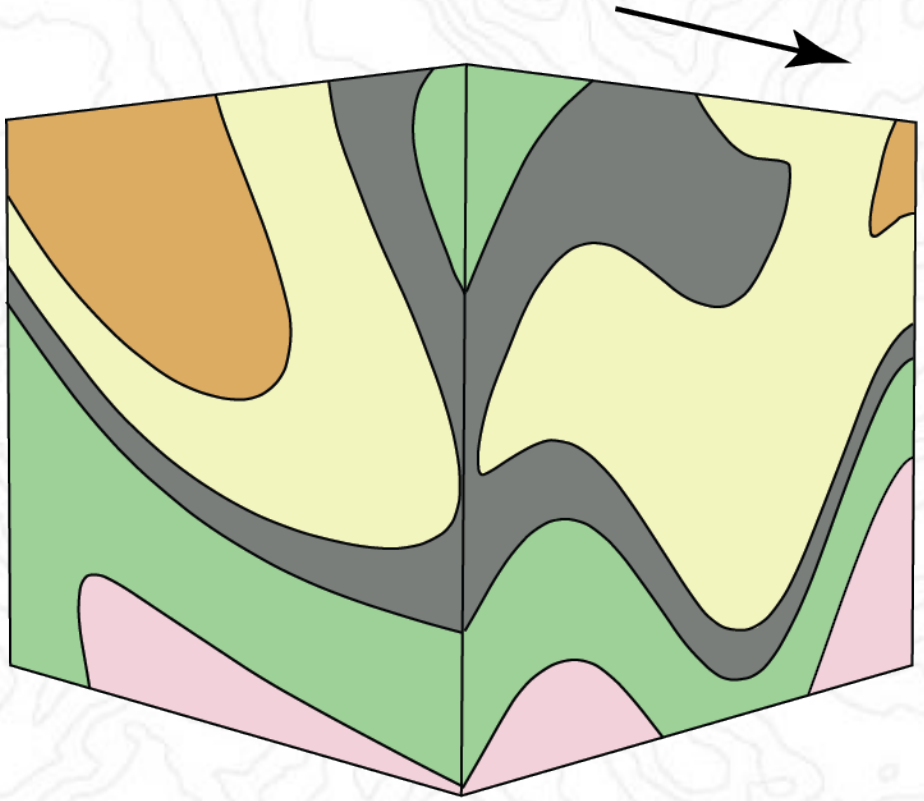
Block diagram model using collected data

OKO WEST - GUYANA



EW sections characterized by simple apparent folded axial plane

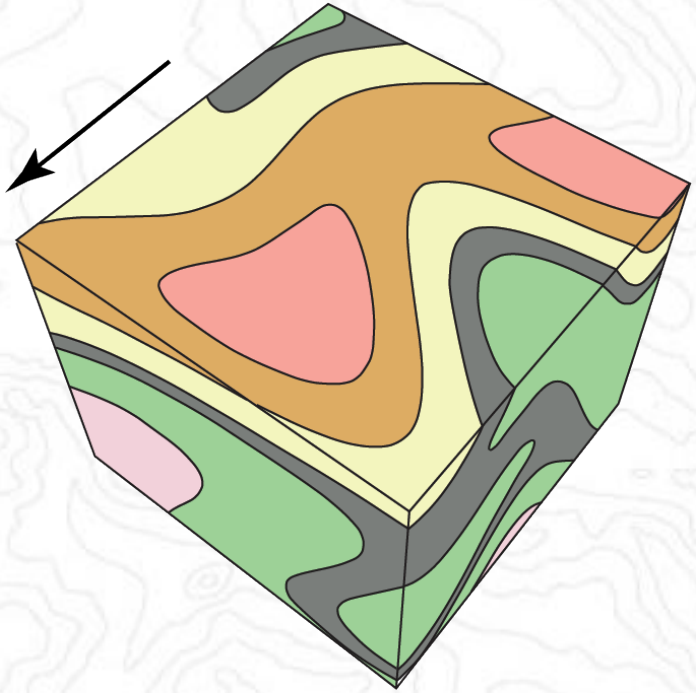
OKO WEST - GUYANA



NS sections characterized by incongruous fold geometry

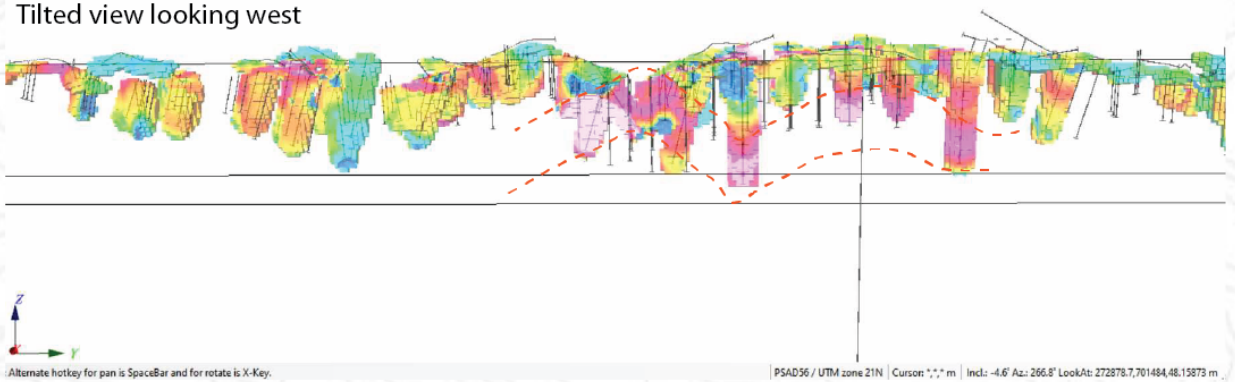
OKO WEST - GUYANA

What about D_2?



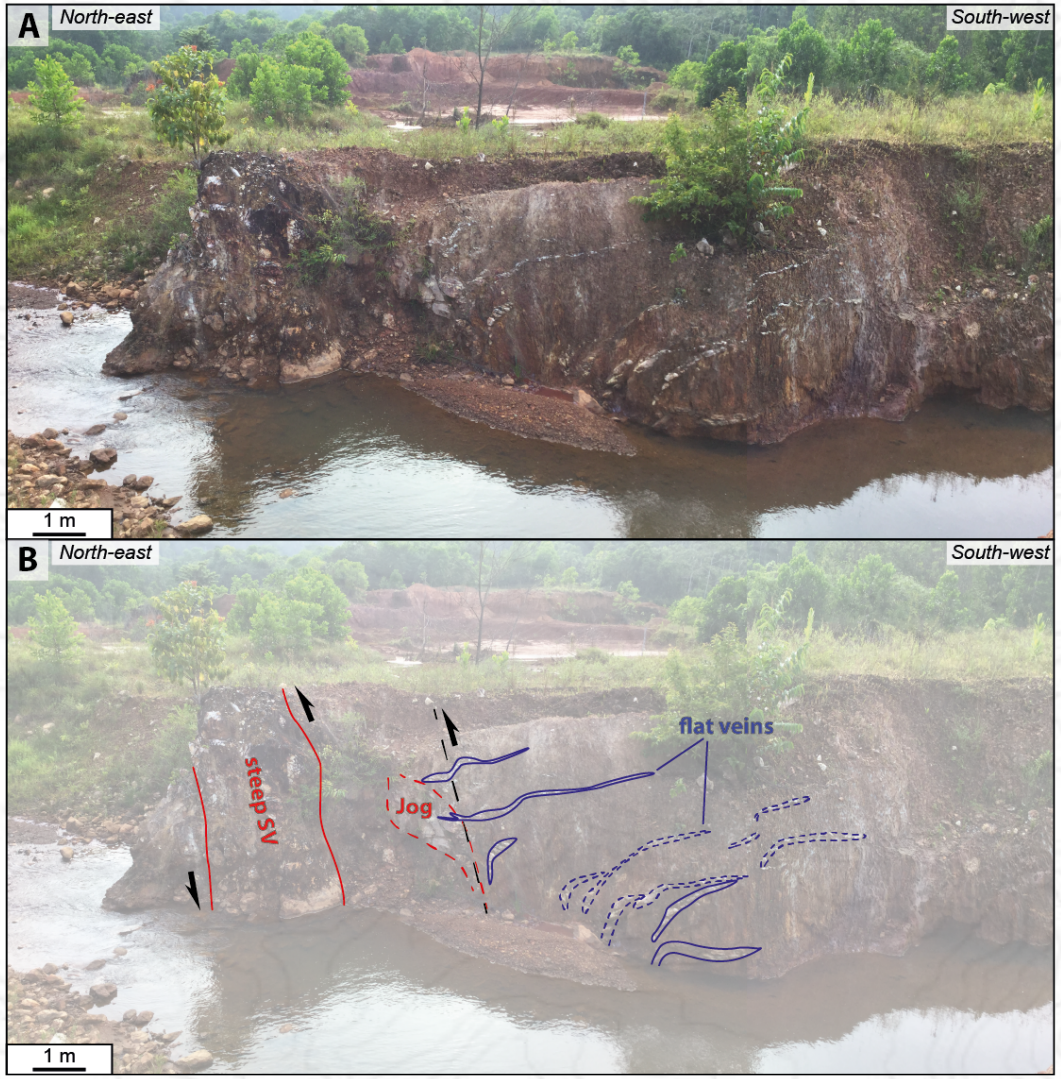
Map view

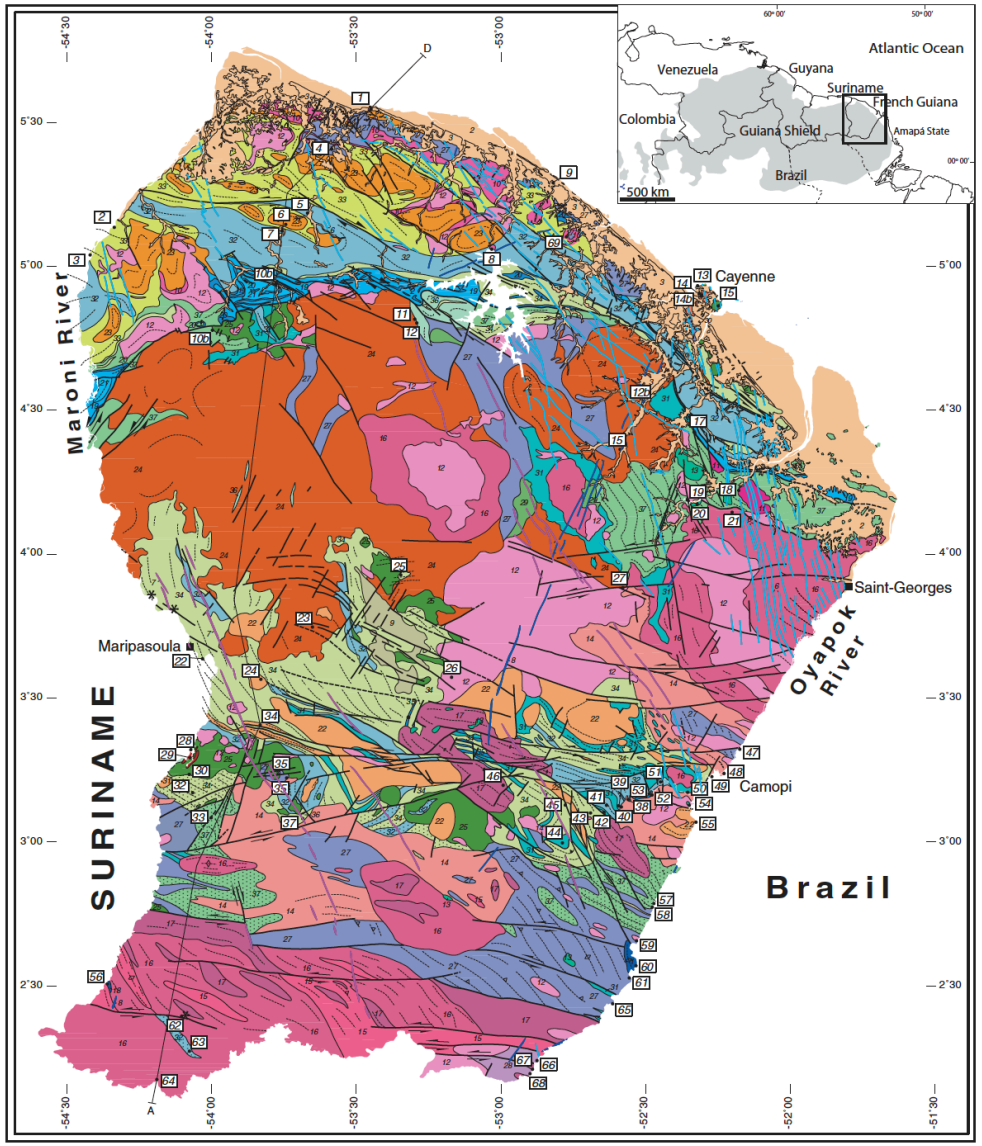
Tilted view looking west



BOULANGER – FRENCH GUIANA

The studied deposits consist to typical orogenic gold systems – Vein related





Delor et al. (2003)

BOULANGER – FRENCH GUIANA

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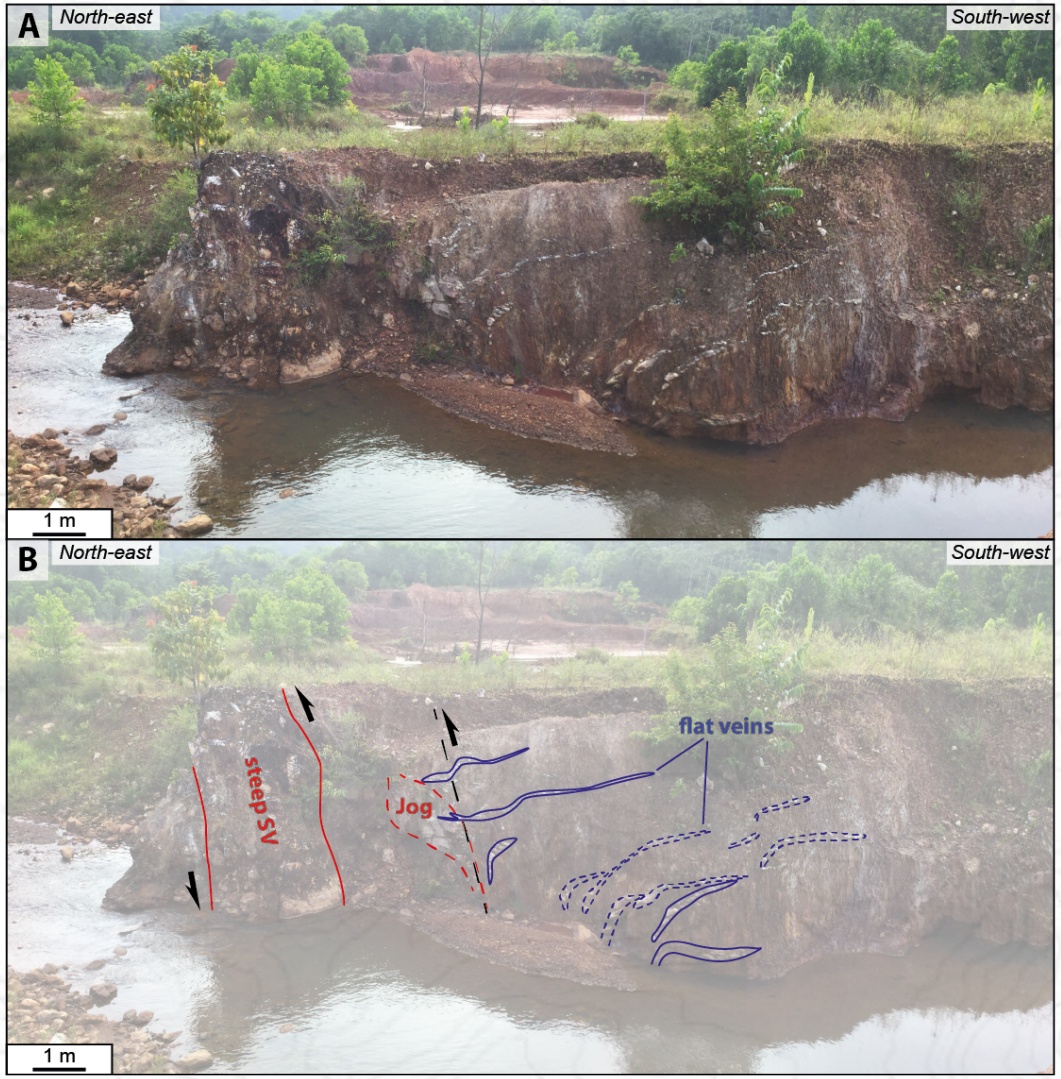
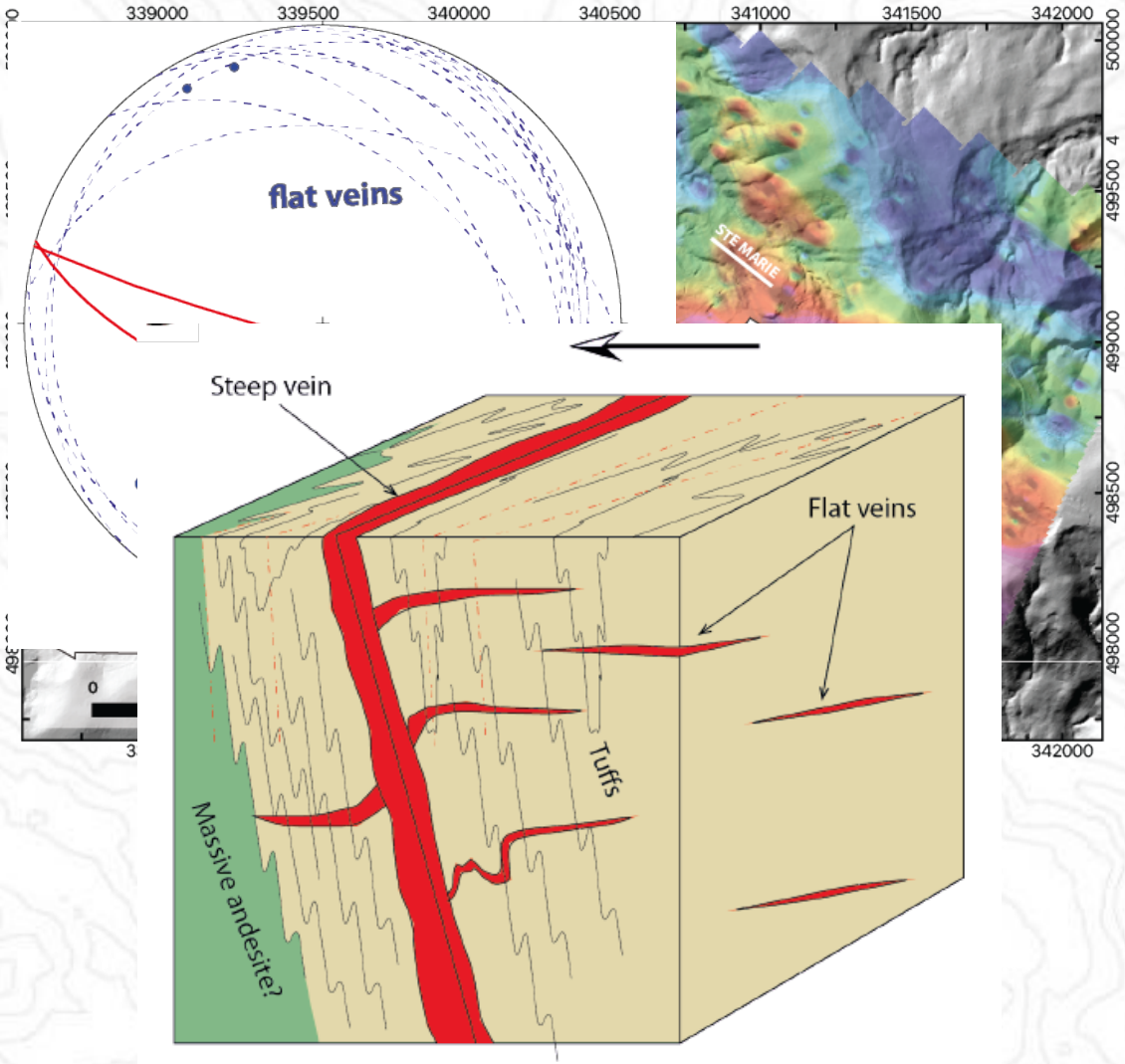
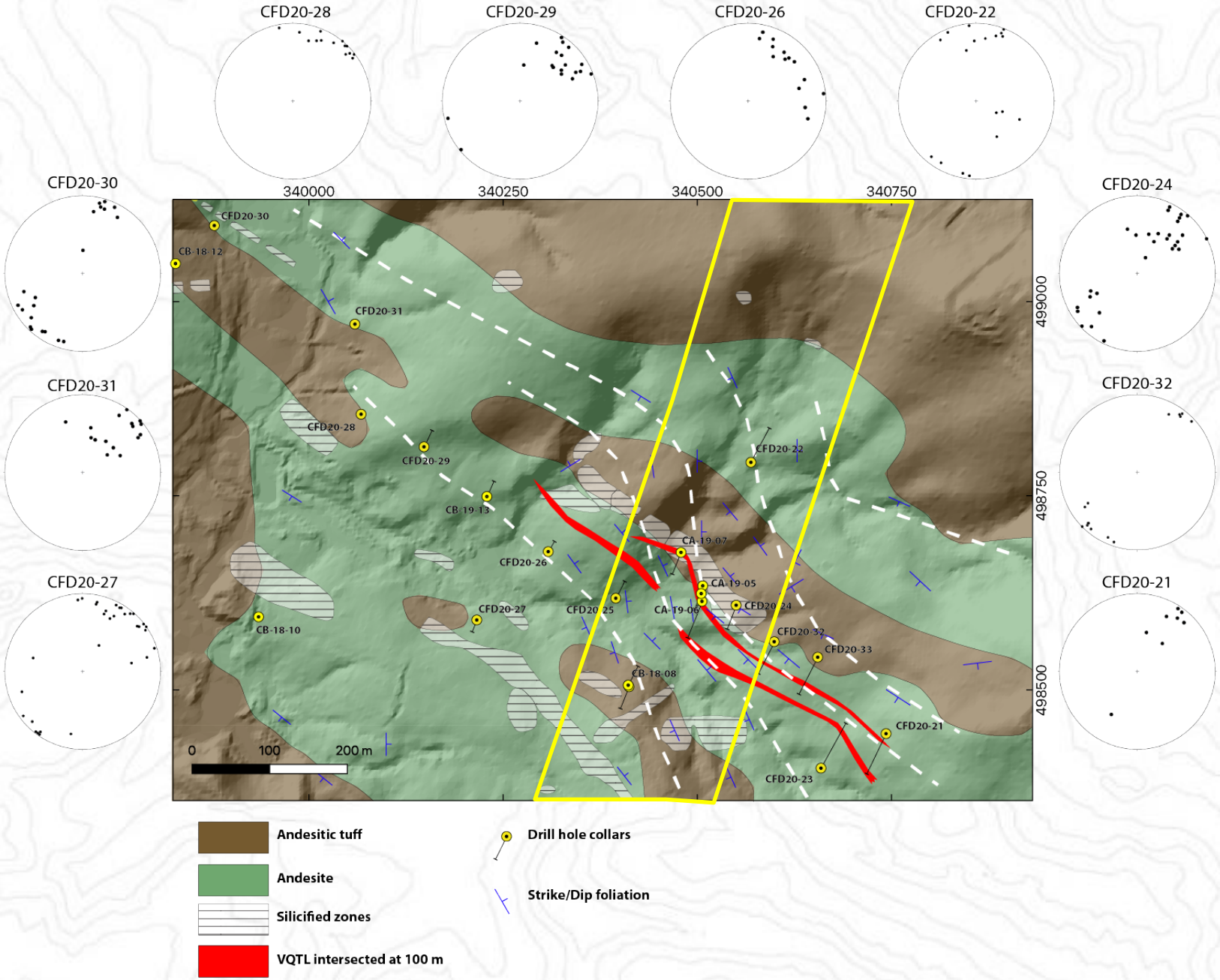
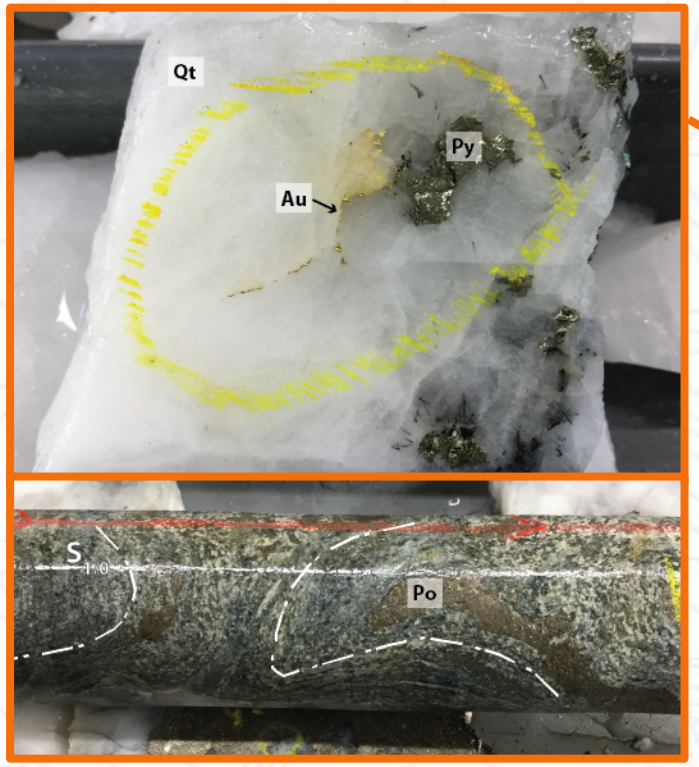




BOULANGER – FRENCH GUIANA



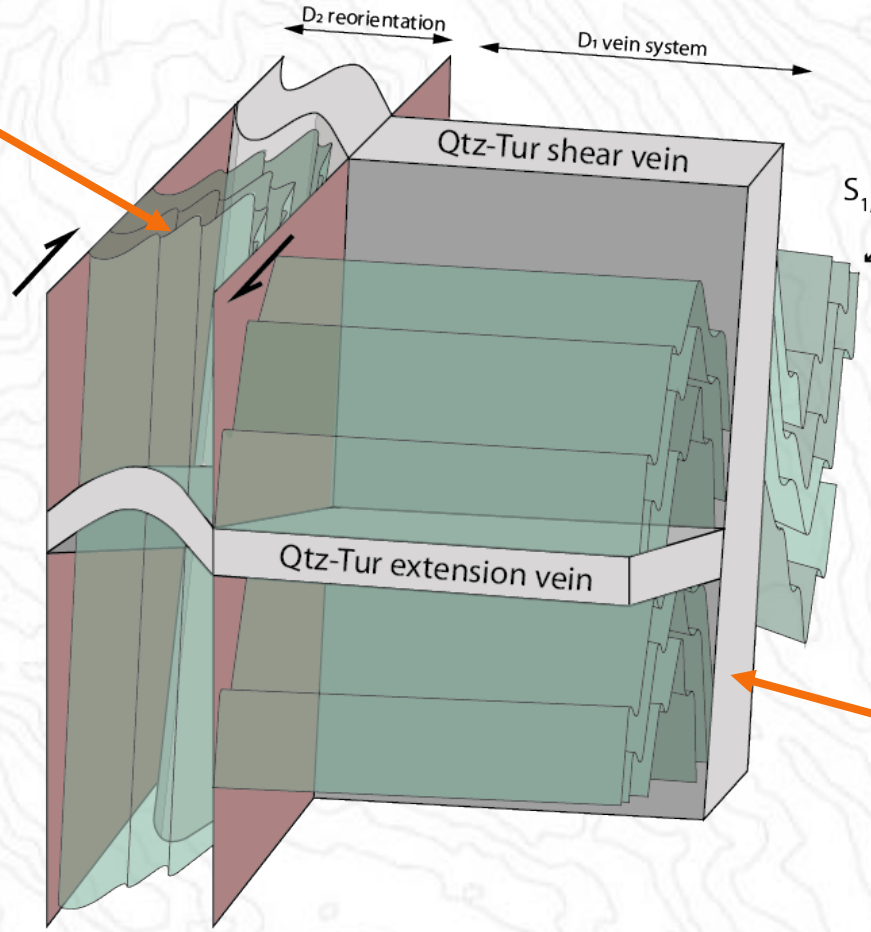
Model of mineralization – D_1 folding event



Po-Py + VG

Delamination of $S_{1/0}$

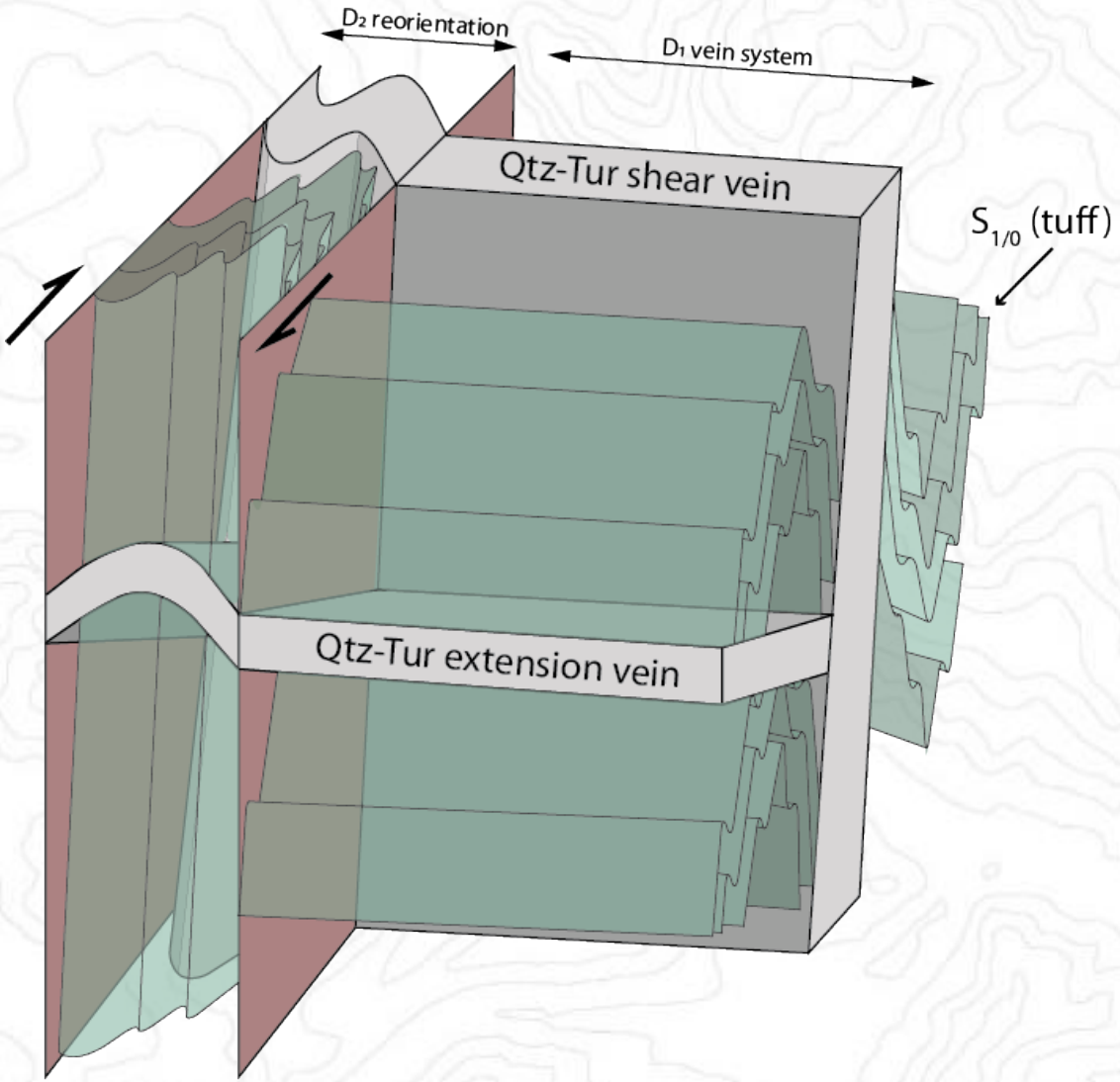
VG along late fractures

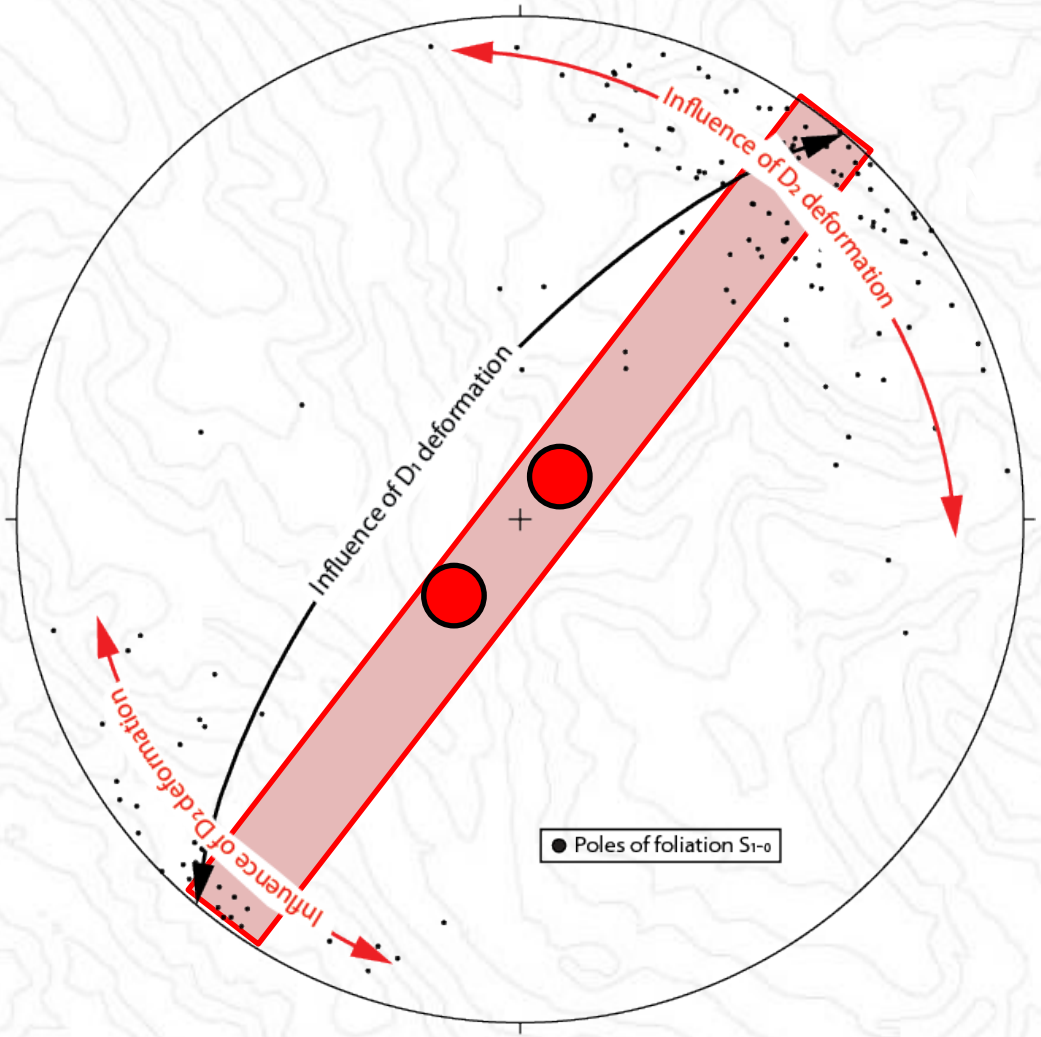


EV and SV vein system

Qtz-Tur-Py

BOULANGER – FRENCH GUIANA





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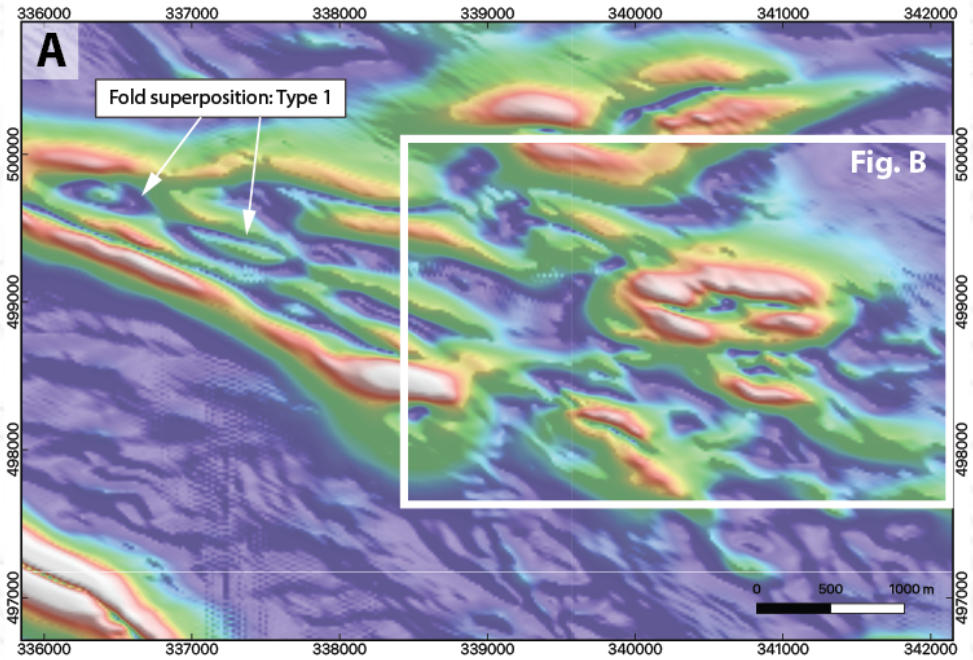
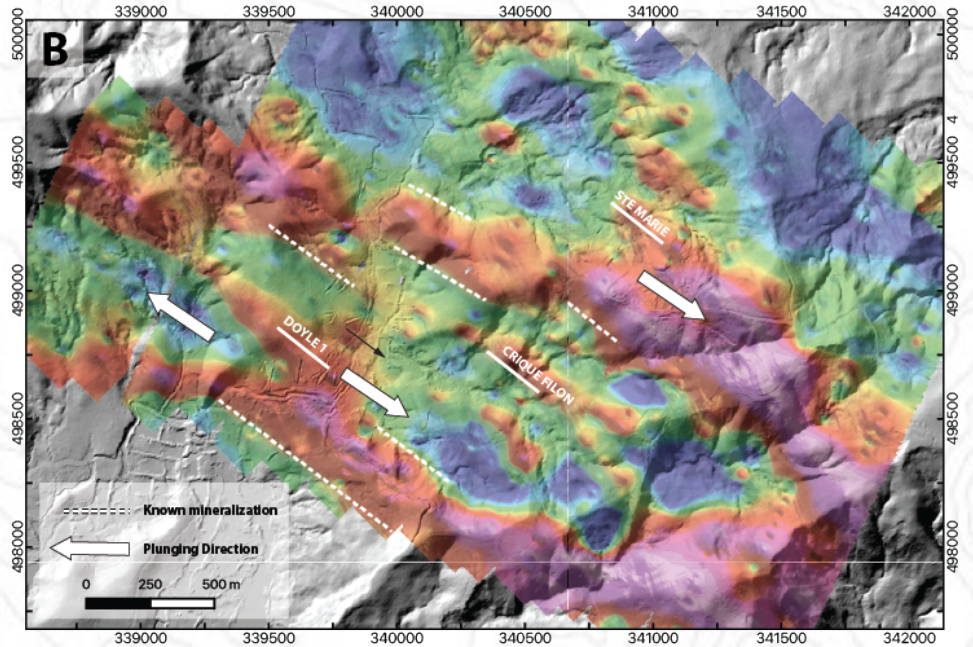
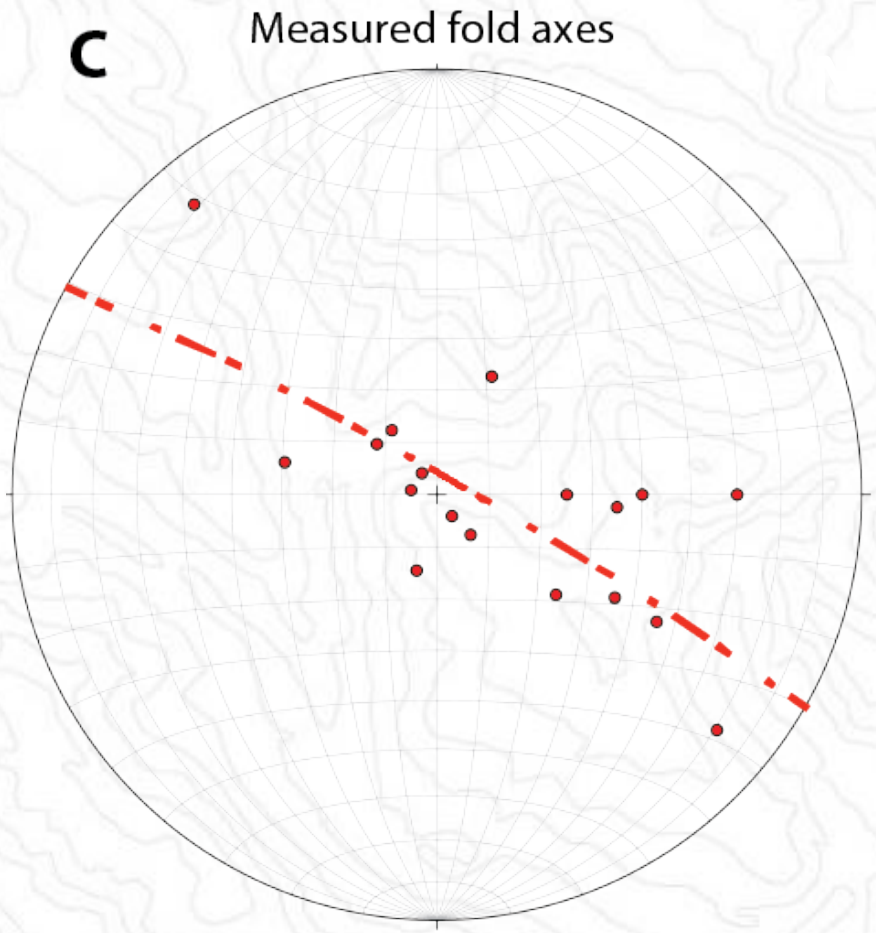
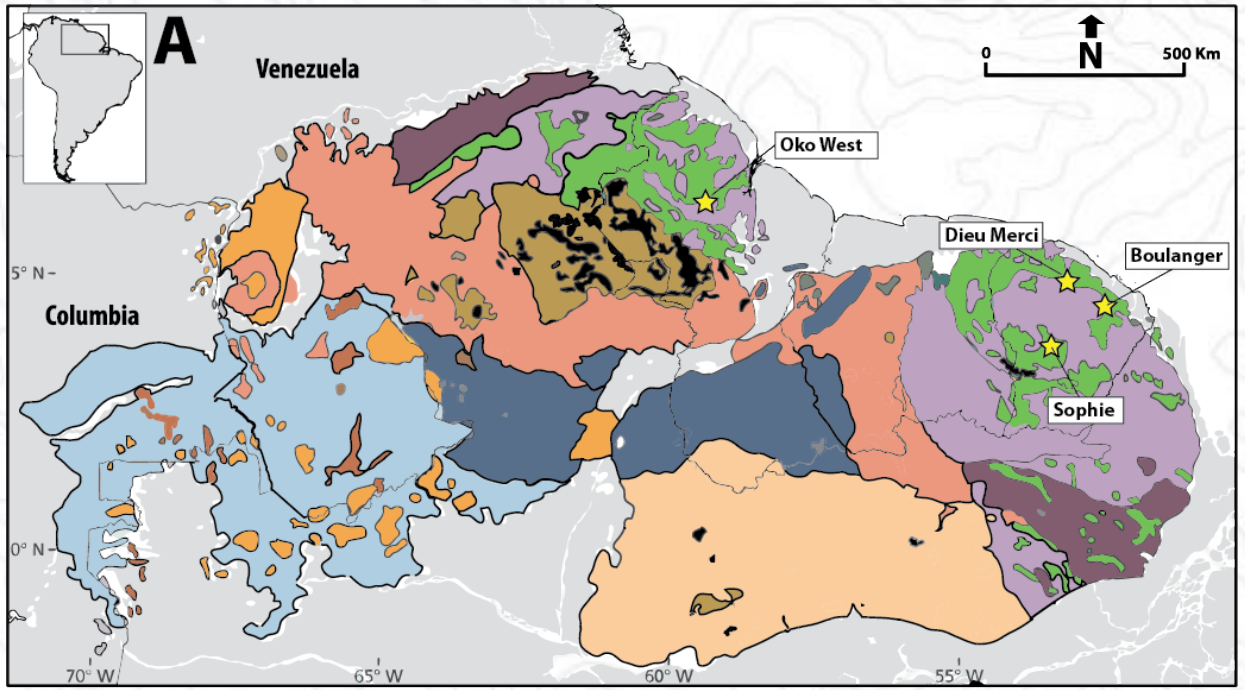






SYNTHESIS – ALL LOCATIONS

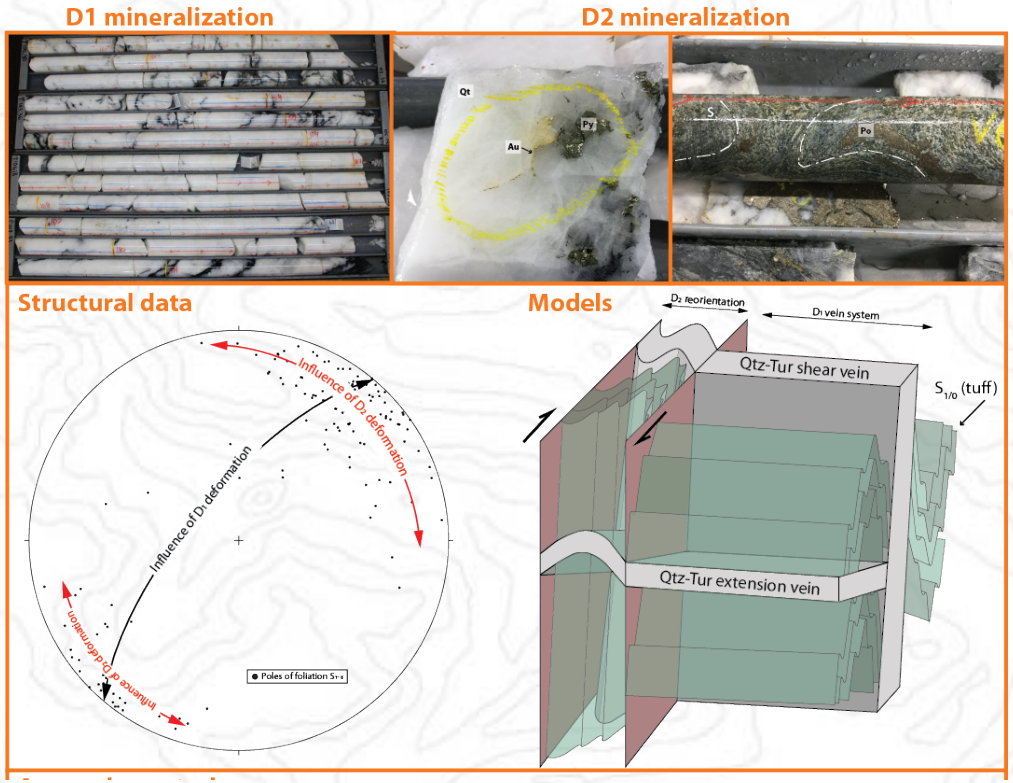
	TECTONIC EVENTS		
	D_1	D_2	Fold superposition pattern
OKO WEST	WNW-ESE tectonic stress Regional N020 folding Top-to-the west kinematic Development of S_1 Bedding-parallel veins (SV_1) + Extension veins (EV_1) N020 mineralization system	NE-SW tectonic stress EW fold overprint EW Foliation S_2 Remobilization of Au along D2 hinges	Type-2 interference pattern 2
DIEU MERCI	N-S tectonic stress Regional EW folding Development of S_1	E-W tectonic stress NS fold overprint NS foliation S_2	Type-2 interference pattern 2
BOULANGER	NNE-SSW tectonic stress Regional Folding (P_1) Emplacement of EV-SV Structures oriented N110 S_1 oriented N110	WNW-ESE tectonic stress Dextral mouvment	Type-1 interference pattern 1
CRIQUE SOPHIE	WSW-ENE tectonic stress Regional N350 folding Top-to-the east kinematic Development of S_1	NNW-SSE tectonic stress	Type-2 interference pattern 2

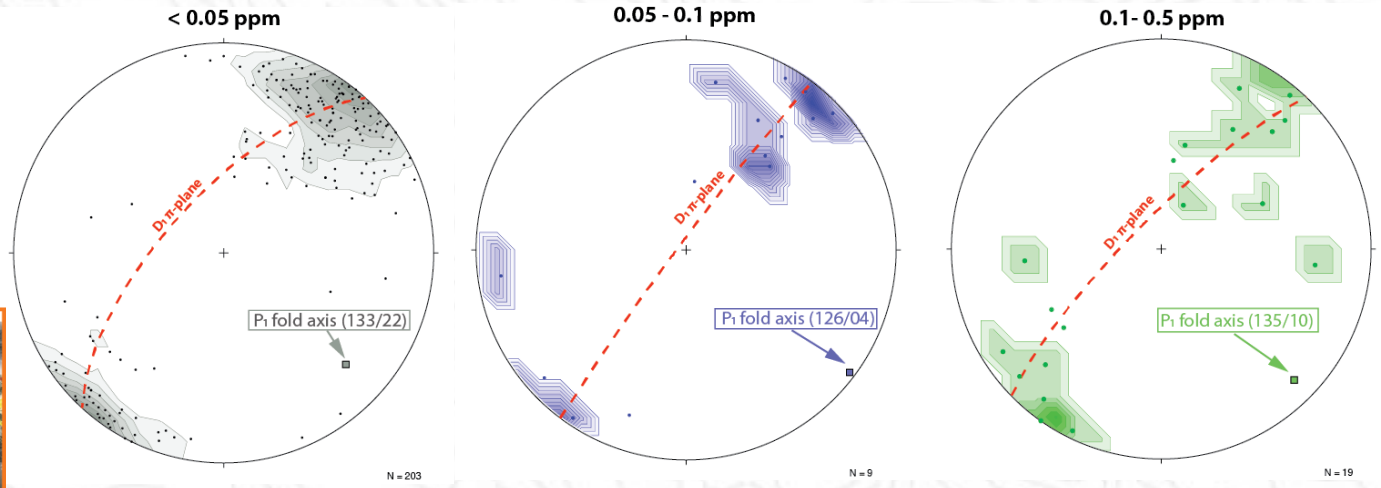


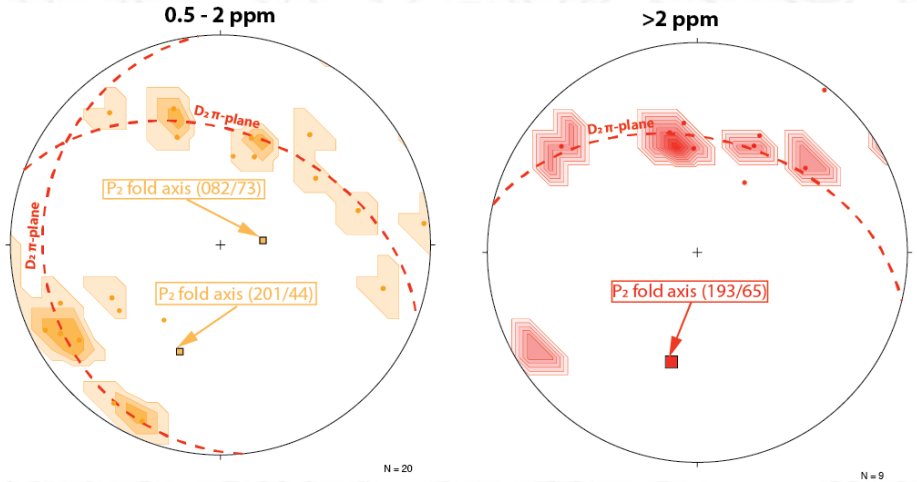
Tedeschi et al. (2020)
Kroonenberg et a. (2016)

SO WHAT?

What about D_2?



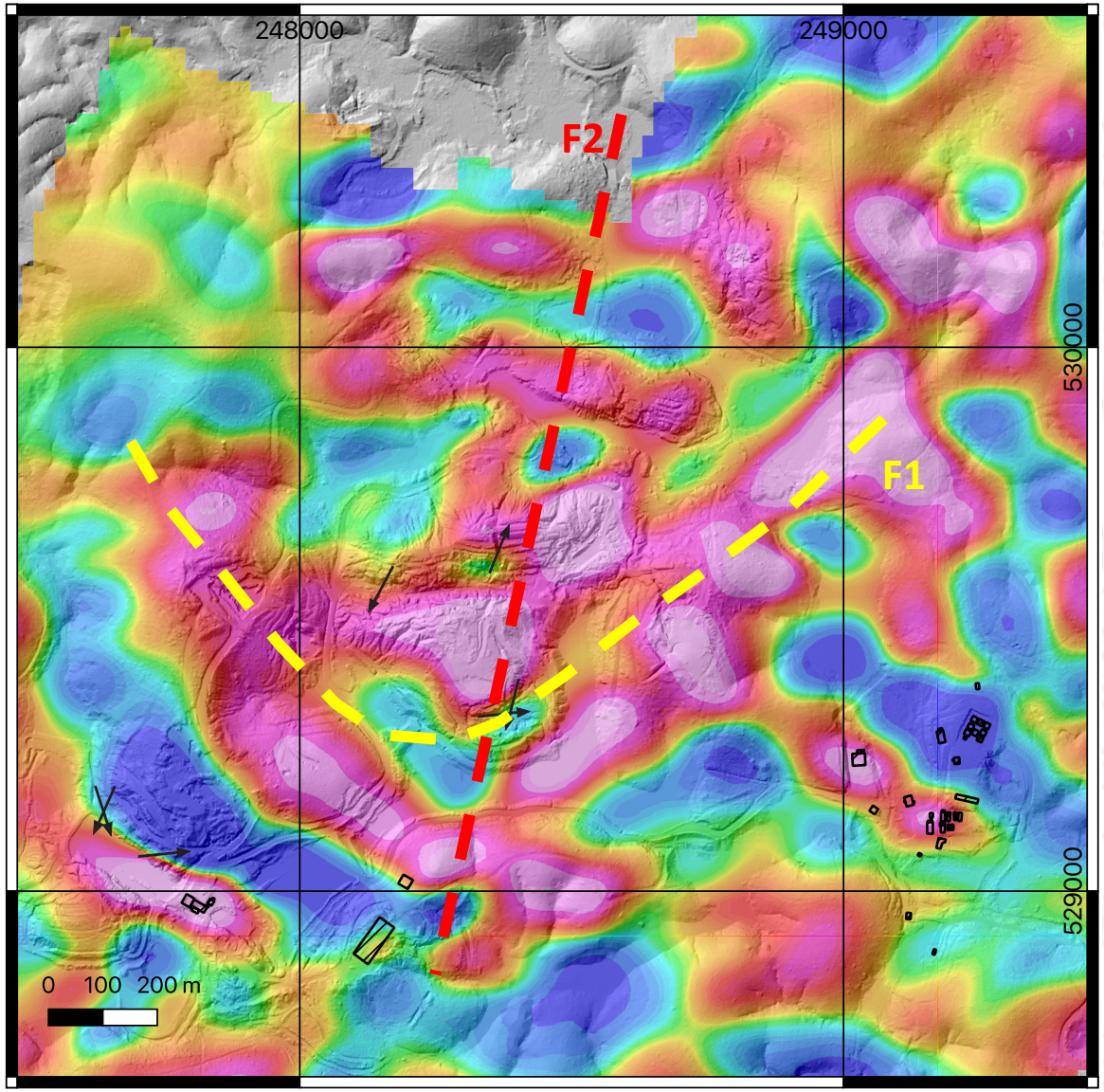


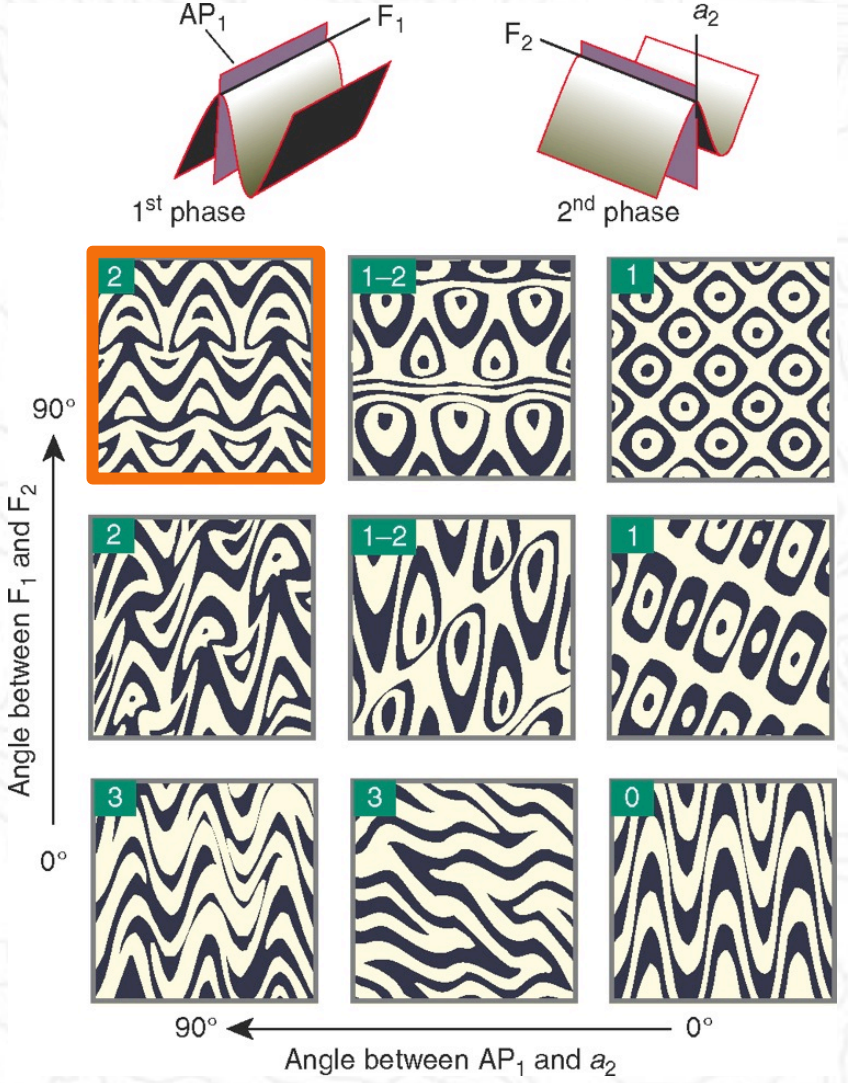


Au enrichment along F2 axial surface - Type 1

SO WHAT?

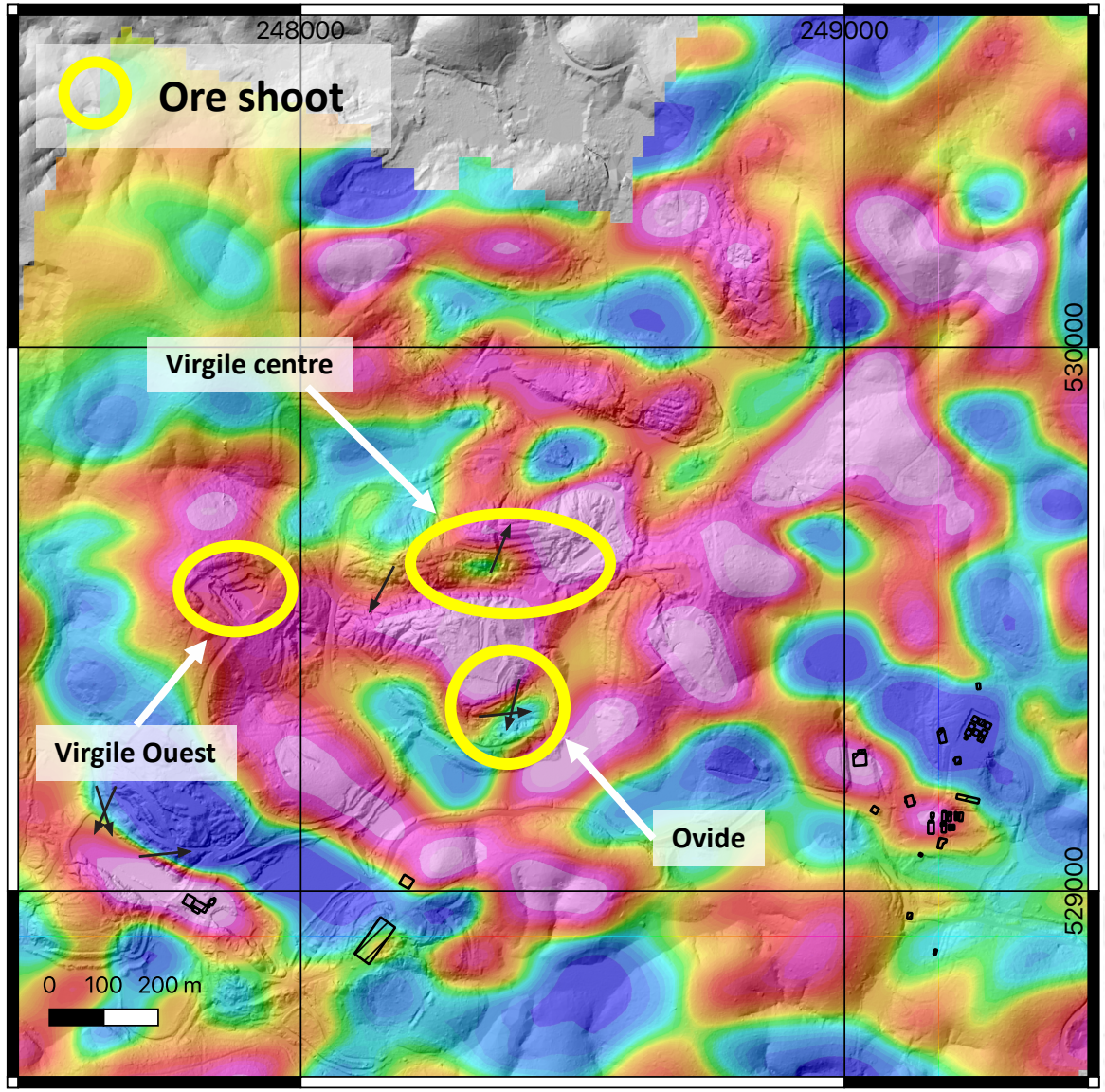
Magnetic Susceptibility – DIEU MERCI



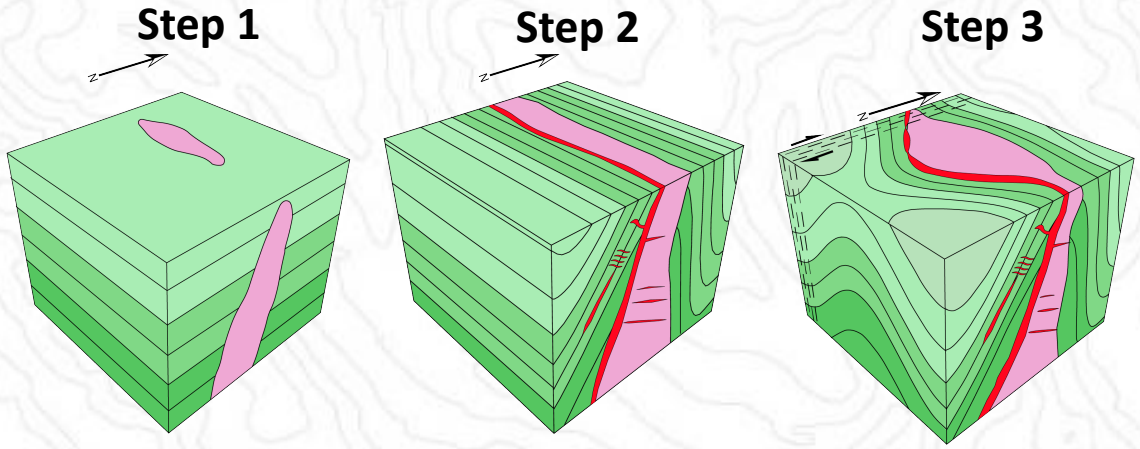


SO WHAT?

Magnetic Susceptibility – DIEU MERCI



- Magnetic susceptibility confirms the presence of polyphase folding → type 2
- Also supported by measured fold axis (black arrows)
- Former extraction zones (Virgile ouest and centre, Ovide) spatially correlated to fold hinges → possible endowment during D_2



CONCLUSIONS

- Clear evidences that Rhyacian greenstone belts are affected by polyphase folding → **So do the mineralization**
- Typical orogenic gold system formed during D1 (shortening) followed by D2 (transcurrent?)
- Gold enrichment during second folding stage (remobilization?, new mineralizing fluid?)
- Quantitative structural geology approach can be used to constrain the interference patterns and ore shoot
- Also allows to better interpret drill sections, resource models, geophysical data

	TECTONIC EVENTS		
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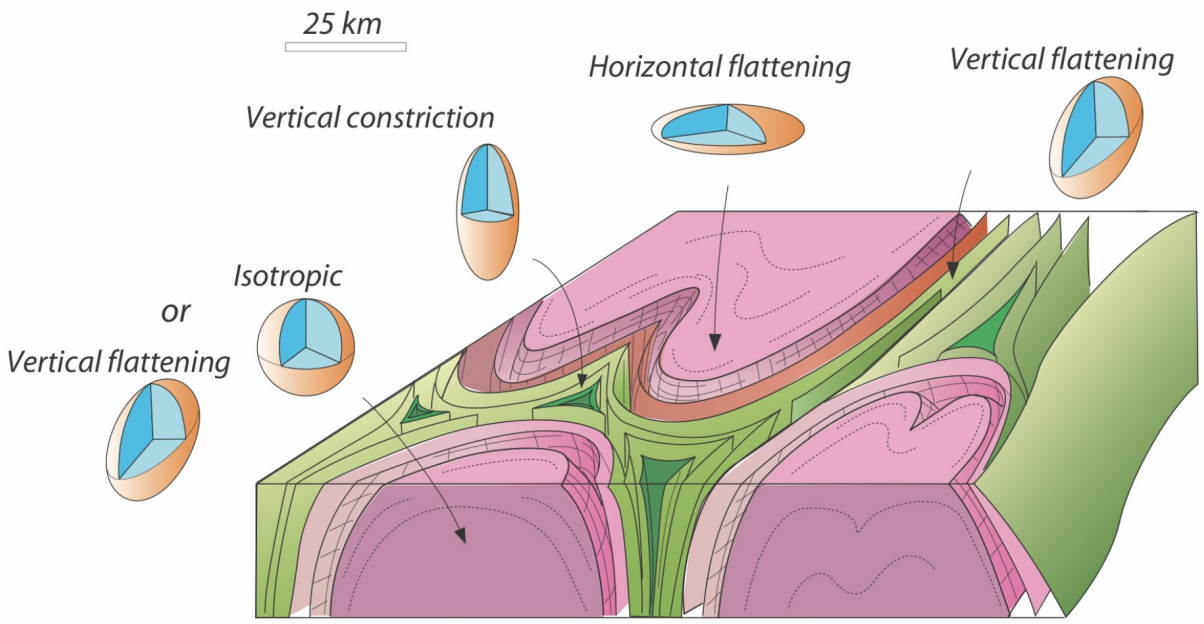
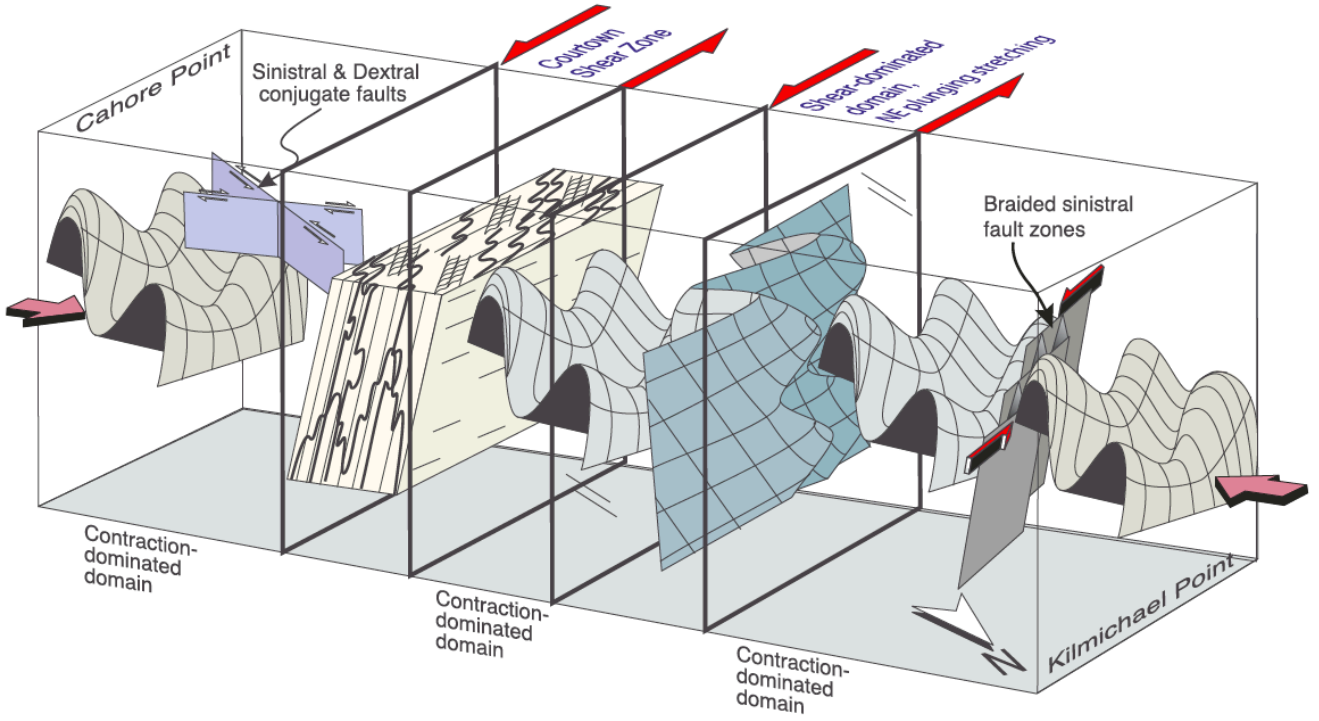


Source: Patrice Rey

CONCLUSIONS

- Clear evidences that Rhyacian greenstone belts are affected by polyphase folding → **So do the mineralization**
- Typical orogenic gold system formed during D1 (shortening) followed by D2 (transcurrent?)
- Gold enrichment during second folding stage (remobilization?, new mineralizing fluid?)
- Quantitative structural geology approach can be used to constrain the interference patterns and ore shoot
- Also allows to better interpret drill sections, resource models, geophysical data

	TECTONIC EVENTS		
	D_1	D_2	Fold superposition pattern
OKO WEST	WNW-ESE tectonic stress Regional N020 folding Top-to-the west kinematic Development of S_1 Bedding-parallel veins (SV_1) + Extension veins (EV_1) N020 mineralization system	NE-SW tectonic stress EW fold overprint EW Foliation S_2 Remobilization of Au along D2 hinges	Type-2 interference pattern 2
DIEU MERCI	N-S tectonic stress Regional EW folding Development of S_1	E-W tectonic stress NS fold overprint NS foliation S_2	Type-2 interference pattern 2
BOULANGER	NNE-SSW tectonic stress Regional Folding (P_1) Emplacement of EV-SV Structures oriented N110 S_1 oriented N110	WNW-ESE tectonic stress Dextral mouvment	Type-1 interference pattern 1
CRIQUE SOPHIE	WSW-ENE tectonic stress Regional N350 folding Top-to-the east kinematic Development of S_1	NNW-SSE tectonic stress	Type-2 interference pattern 2



Fossen et al. (2019)

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THANKS FOR YOUR ATTENTION

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