Rock Magnetism and Magnetic Fabric Analysis of Fault Produced Pseudotachylytes and Adjacent Host-rocks from the Mesoproterozoic Albany-Fraser Orogenic Belt, Cape Arid Region, Southwest Australia

By

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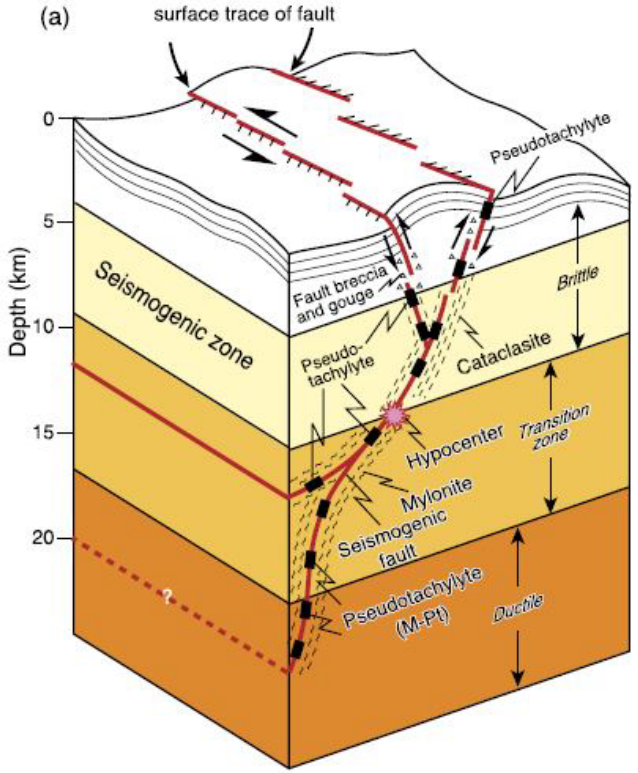
Southern coast of Cape Arid National Park. Photo taken by: Dr. John W. Geissman

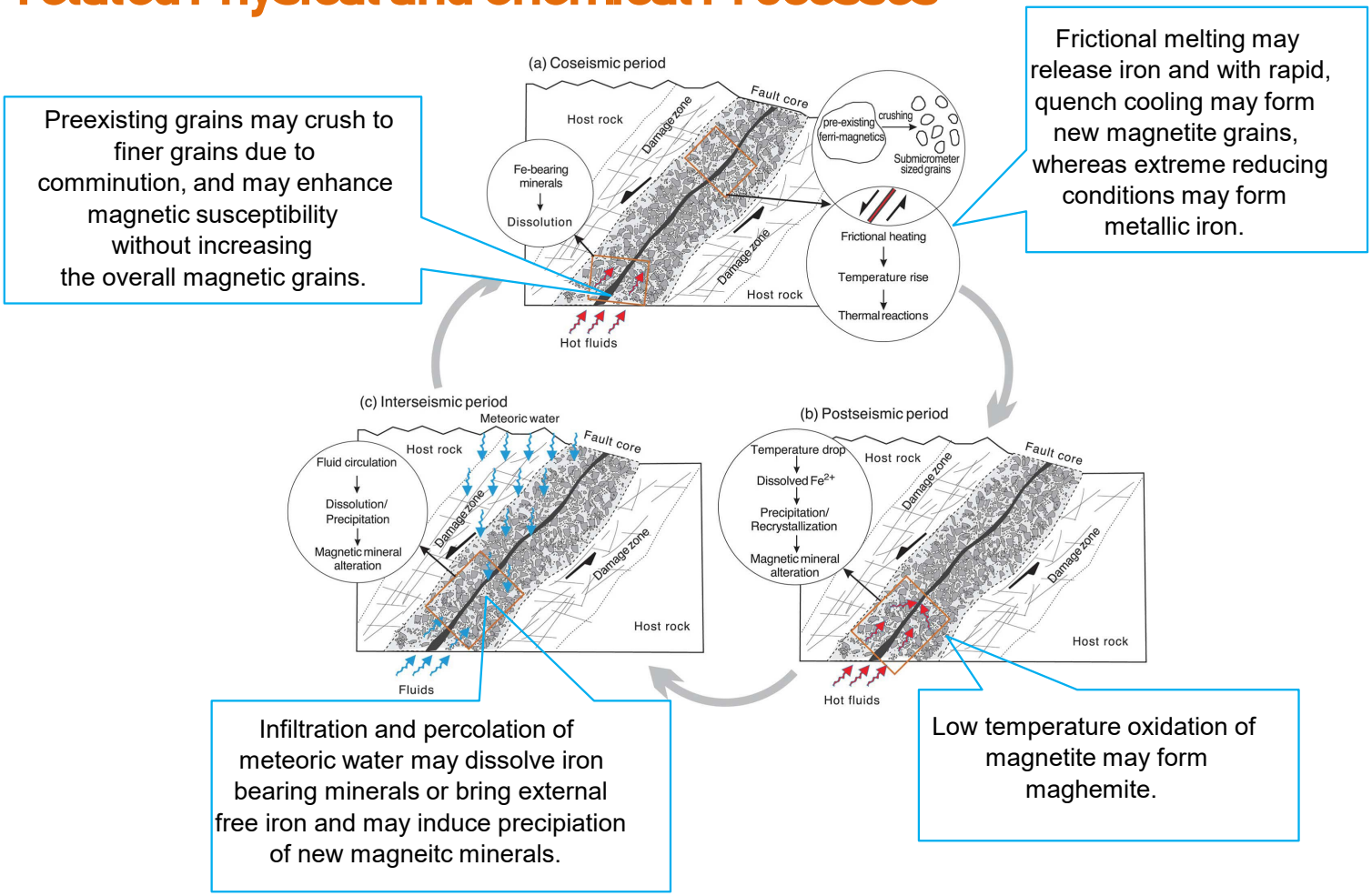
Fault rocks: Pseudotachylytes (fossil earthquakes)

- Narrow zones of crushed rocks along which two blocks moved
- Movement could be either as unstable, fast movement (***brittle fault)*** or stable, slow sliding ***(ductile fault)***
- Brittle-ductile transition zone often associated with frictional melt due to rapid rise in temperature (~ >1000°C) during seismic slip
- Fault-produced cryptocrystalline to glassy-textured rocks called pseudotachylytes and considered as ***"fossil earthquake"***
- May hold important information regarding the assembly of tectonic units and may provide improved insight into the generation of earthquakes and the process of seismic rupture



Sketch illustrating the occurrence of diverse fault rocks at different depths (from Yang et al., 2020).

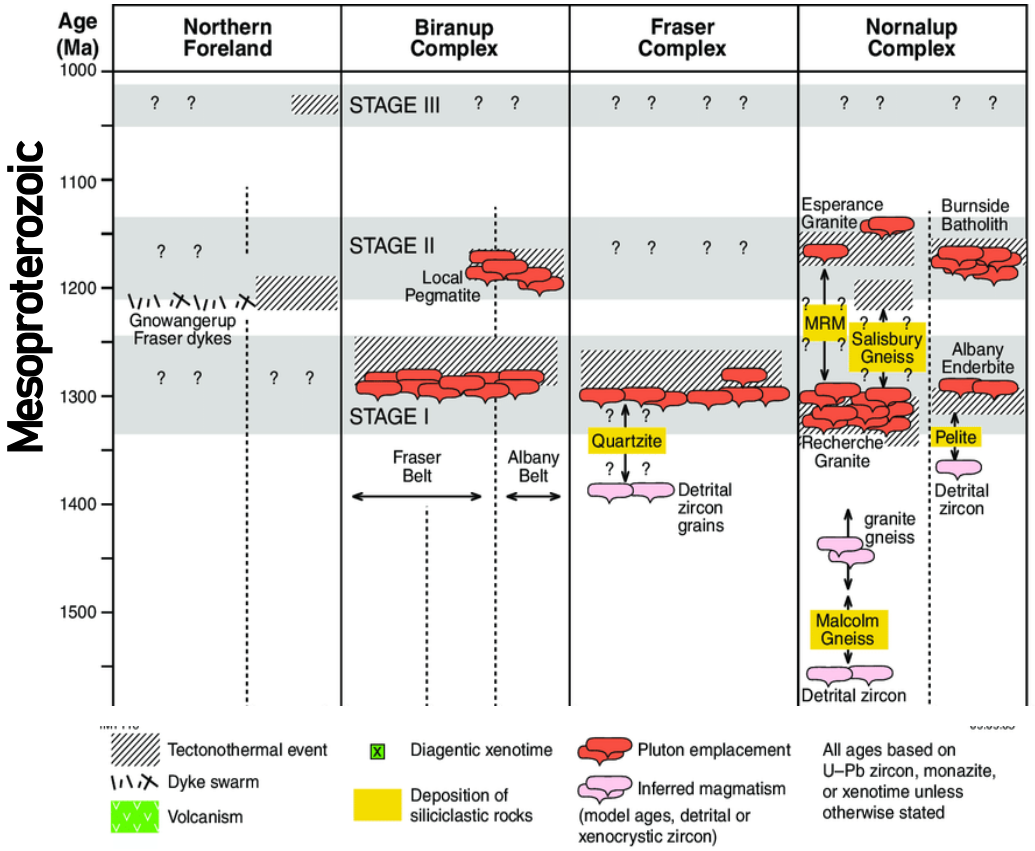
Faulting-related Physical and Chemical Processes



Conceptual model showing the faulting-related physical and chemical processes during the different stages of the seismic cycle (modified from Yang et al., 2020).

Study area: Albany-Fraser Orogenic Belt (AFO):

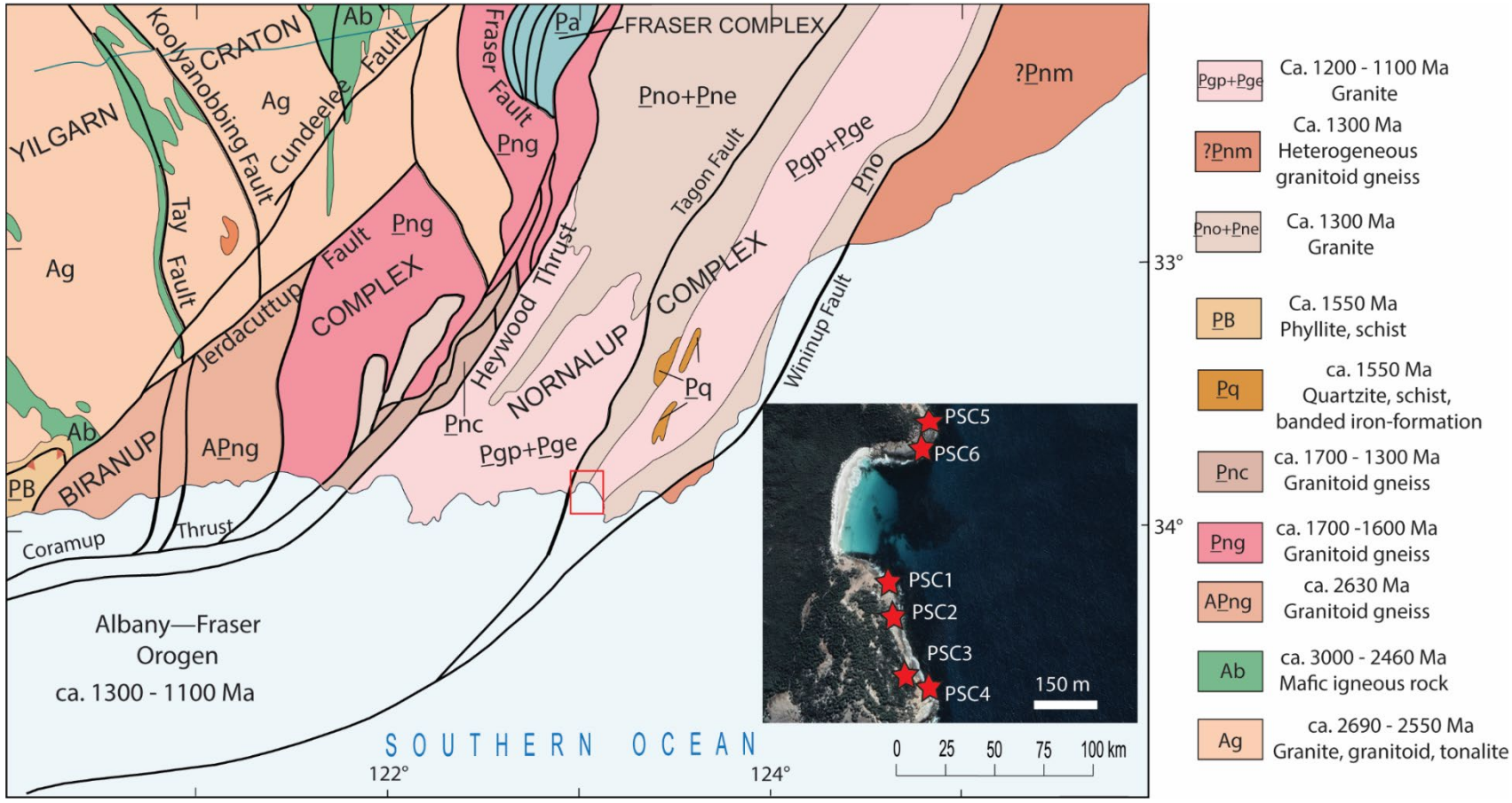
- Exposed along the southern coast of Western Australia
- Formed due to the continental collision and suturing of West Australian Craton and the Mawson Craton
- Records the tectonic evolution of Rodinia assembly (~1300 – 1100 Ma)
- Characterized by intense deformation, polyphase metamorphism, and emplacement of plutonic rocks



From Fitzsimons and Buchan, 2005

Time-space plot of the Albany-Fraser Orogen

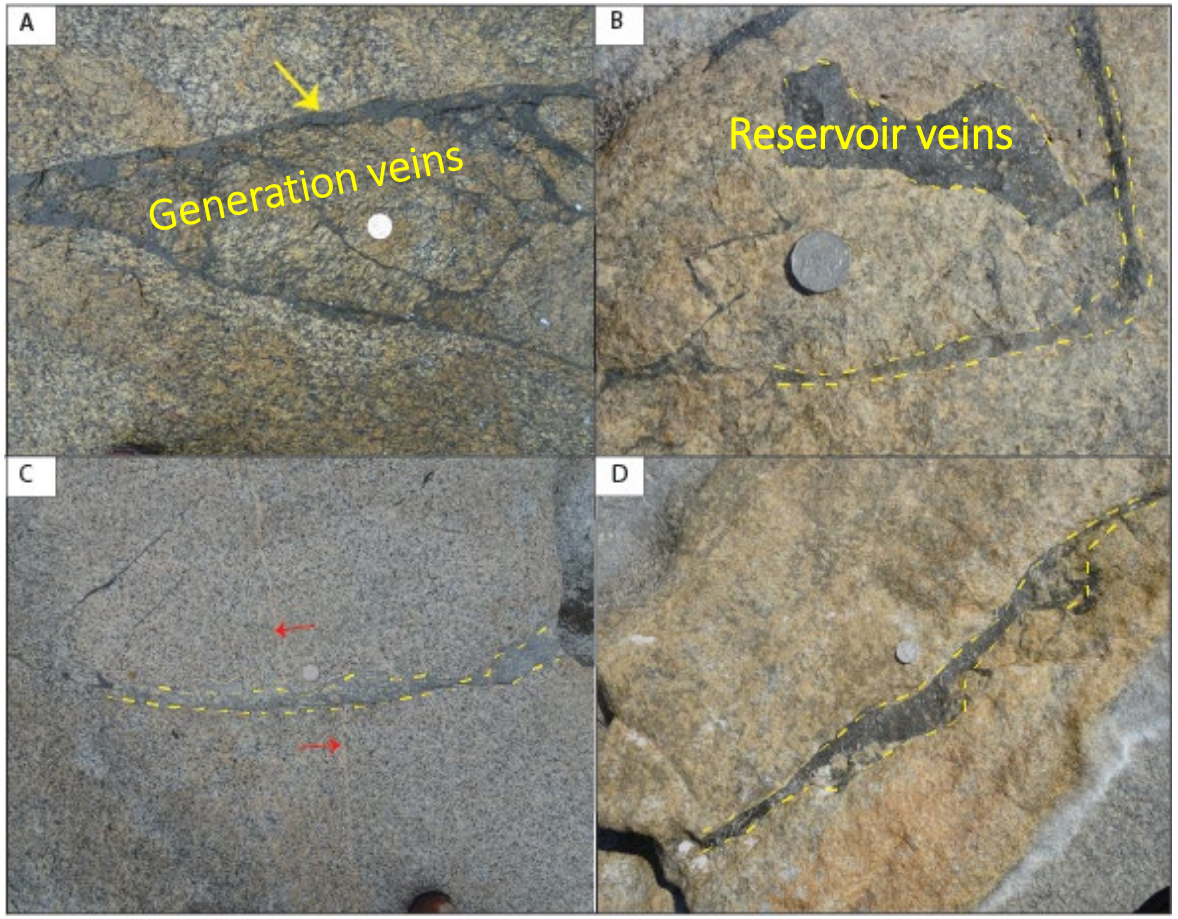
Generalized Geologic Map of AFO belt and field location:

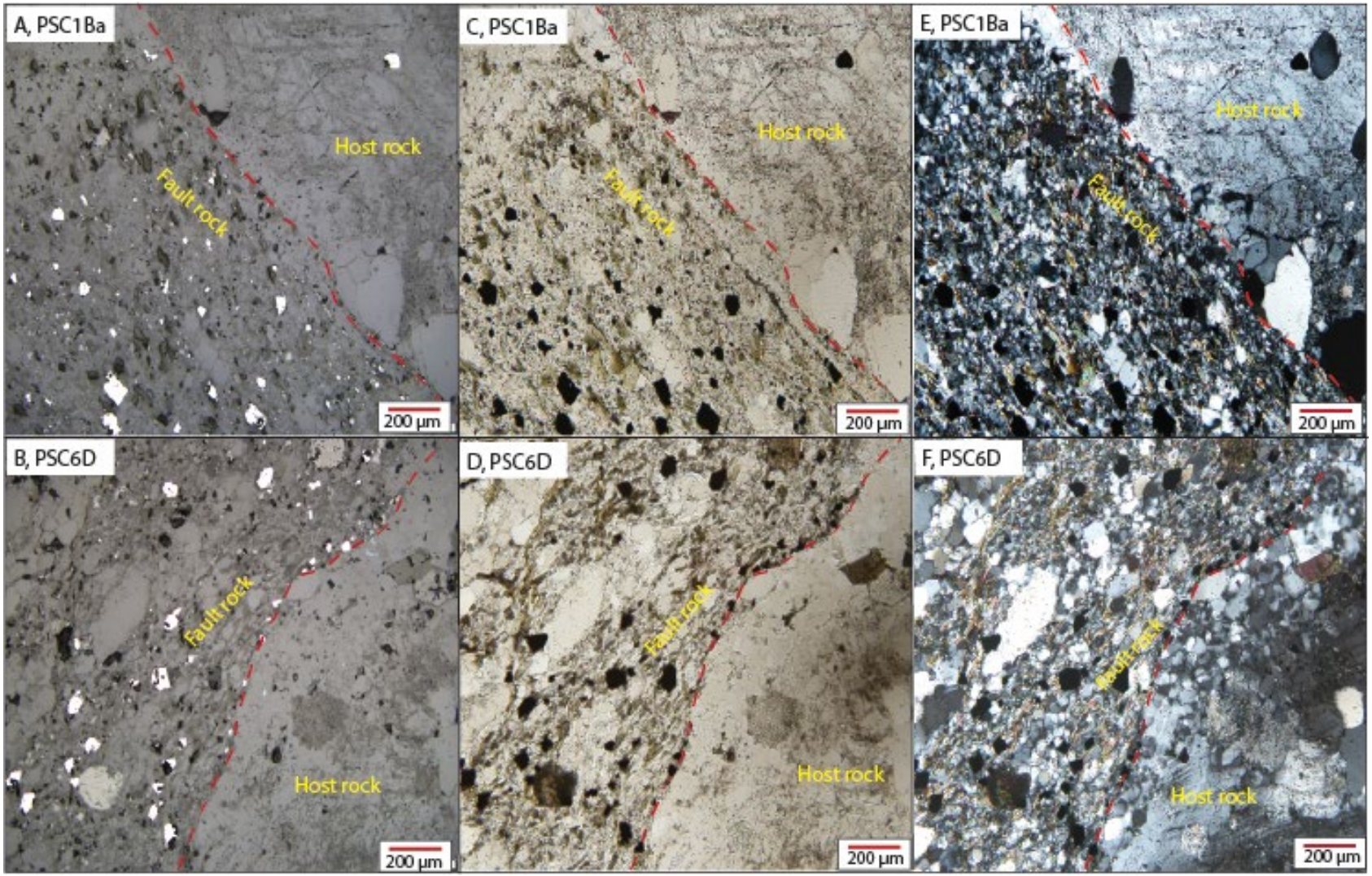


Pseudotachylyte Veins in the AFO

Field Recognition:

- Cross-cut relationships
- Sharp layer boundaries
- Presence of injection veins
- Host-rock derived survivor clasts
- Ultra-fine grain polymineralic assemblage




A, PSC1Ba
Host rock
Fault rock
200 µm
C, PSC1Ba
Host rock
Fault rock
200 µm
E, PSC1Ba
Host rock
Fault rock
200 µm
B, PSC6D
Fault rock
Host rock
200 µm
D, PSC6D
Fault rock
Host rock
200 µm
F, PSC6D
Fault rock
Host rock
200 µm

Research Objectives:

Physiochemical conditions and fault-kinematics to contribute information regarding the complex tectonic evolution of the Mid-Proterozoic Albany- Fraser Orogenic Belt by documenting the-

- Mineralogical and microstructural properties; and the rock magnetic/paleomagnetic characteristics of fault rocks and surrounding host rocks
- Magnetofabric analysis to evaluate the flow-direction of the frictional melt and to infer the regional maximum stress direction
- Determining the slip-sense which has been difficult from the outcrop relations
- Paleomagnetic data to constraint the age of formation of the pseudotachylytes vein rocks