

Kinematic analysis of the Manitou-Dinorwic deformation zone and its implications for mineral exploration in the western Wabigoon subprovince

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INTRODUCTION

Located within the Archean western Wabigoon subprovince (WWS) in north-western Ontario (Fig. 1), the NE-trending Manitou-Dinorwic Deformation Zone (MDdz) hosts 95% of the historical gold production in the Dryden area (Manitou Gold Inc., 2010). **The goal of this study is to document the structural development, alteration and kinematic history of the MDdz with the potential to help guide future exploration along similar deformation zones within the WWS.**

Despite sharing a similar magmatic, sedimentary and tectonic evolution with the well-endowed Abitibi subprovince (Veillette et al., 2005), the Wabigoon subprovince is largely underexplored, structurally uncharacterized and assumed poorly endowed (Blackburn et al., 1991). Relative timing of orogenic gold mineralization compared to the structural evolution of both the Wabigoon and the Abitibi subprovinces may explain the disparity in gold endowment between the two regions.

In order to better understand the relative timing of mineralization and deformation in the WWS, we investigated the MDdz at the Kenwest property (Manitou Gold Inc., 2010) where gold mineralization has been documented (see inset in Fig. 1A). To differentiate between regional scale deformation and MDdz-specific deformation, all localized structures will be denoted with a subscript M to indicate that the observation was made along the MDdz (e.g. D_{1M} indicates the first deformation event observed along the MDdz).

GEOLOGICAL SETTING & STUDY AREA

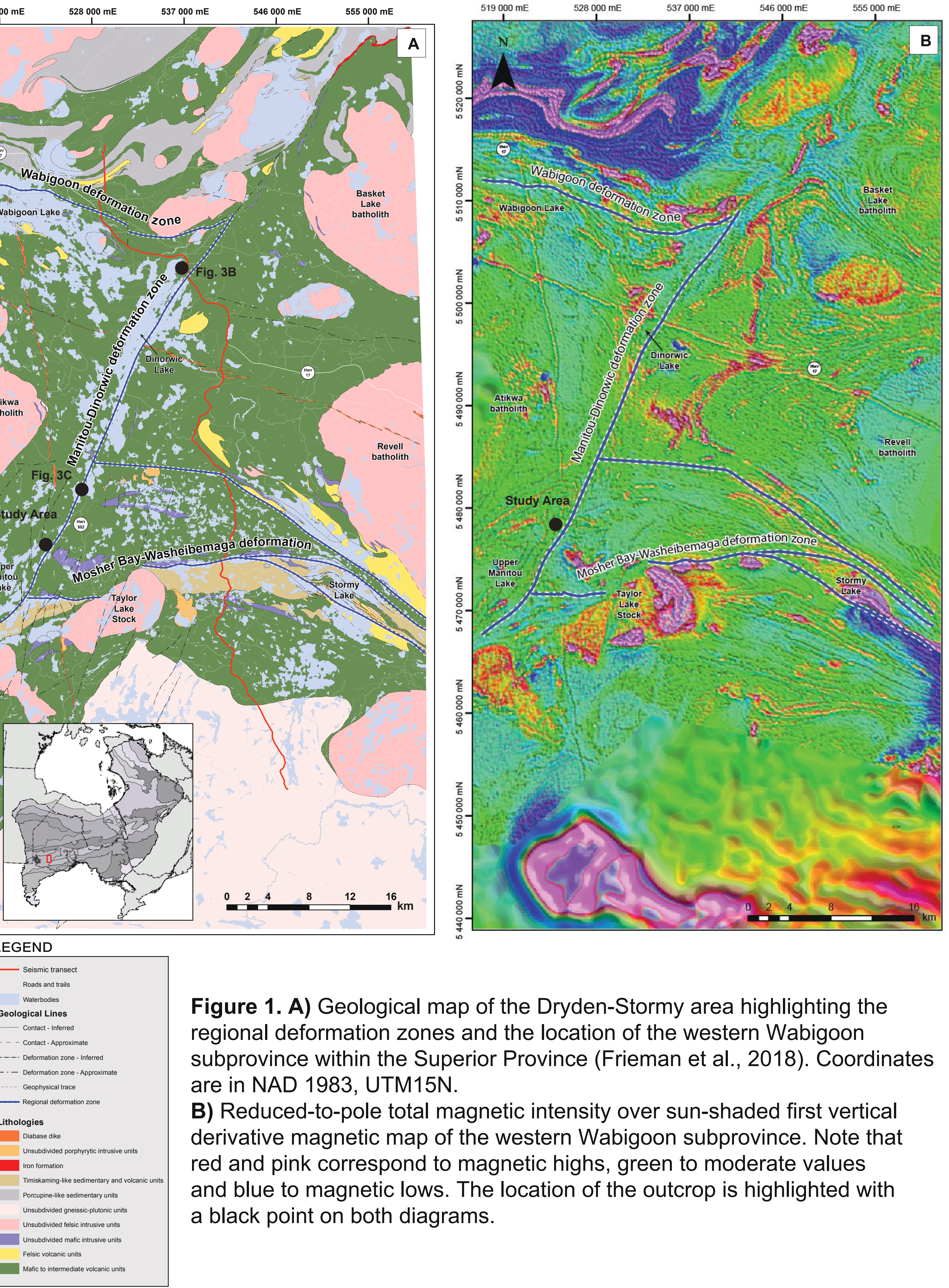


Figure 1. A) Geological map of the Dryden-Stormy area highlighting the regional deformation zones and the location of the western Wabigoon subprovince within the Superior Province (Frieman et al., 2018). Coordinates are in NAD 1983, UTM15N. **B)** Reduced-to-pole total magnetic intensity over sun-shaded first vertical derivative magnetic map of the western Wabigoon subprovince. Note that red and pink correspond to magnetic highs, green to moderate values and blue to magnetic lows. The location of the outcrop is highlighted with a black point on both diagrams.

SUMMARY OF STRUCTURAL & PETROGRAPHIC OBSERVATIONS

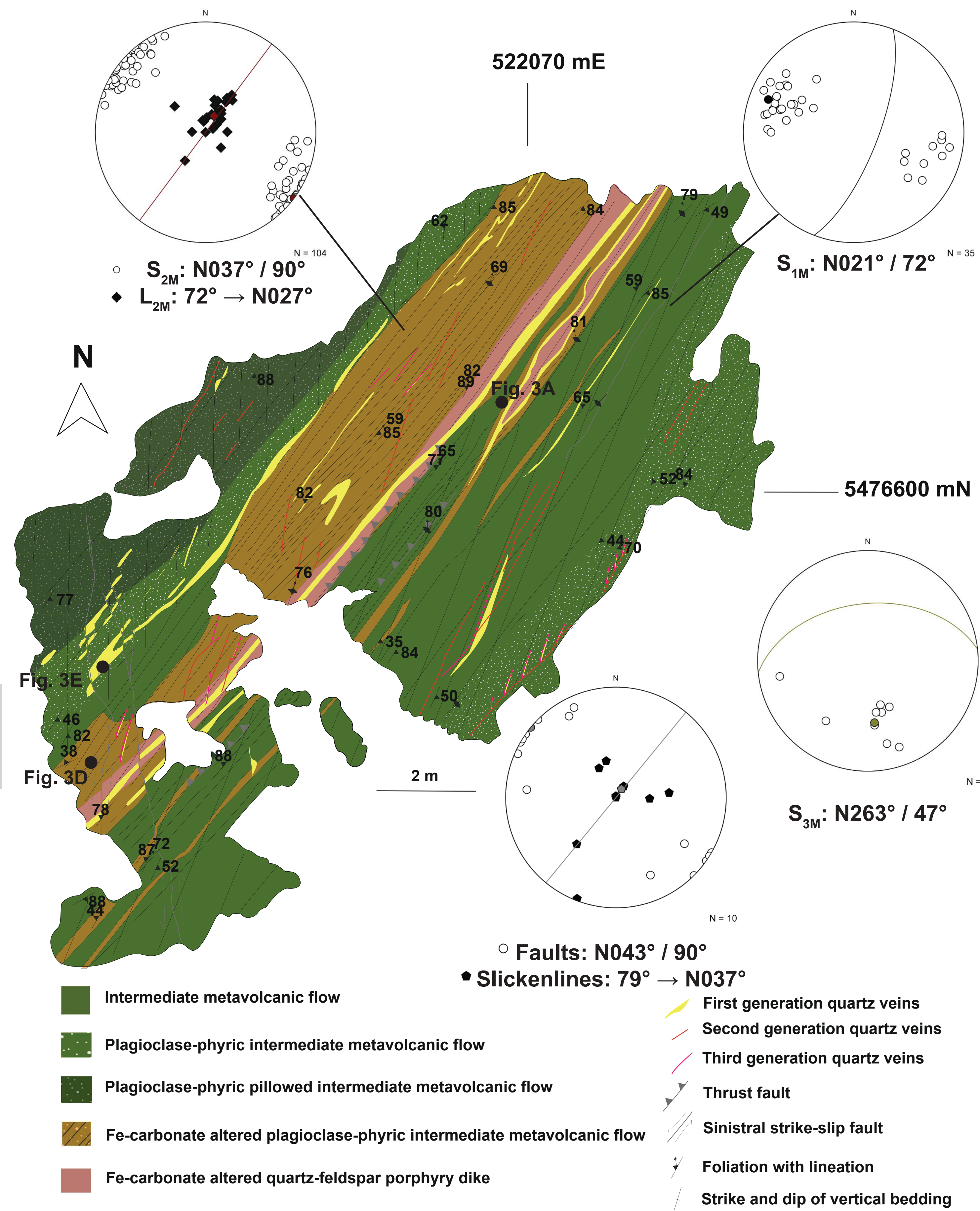


Figure 2. Map displaying lithological units, structural features and corresponding stereoplots with average orientations. Coordinates are in NAD 1983, UTM15N.

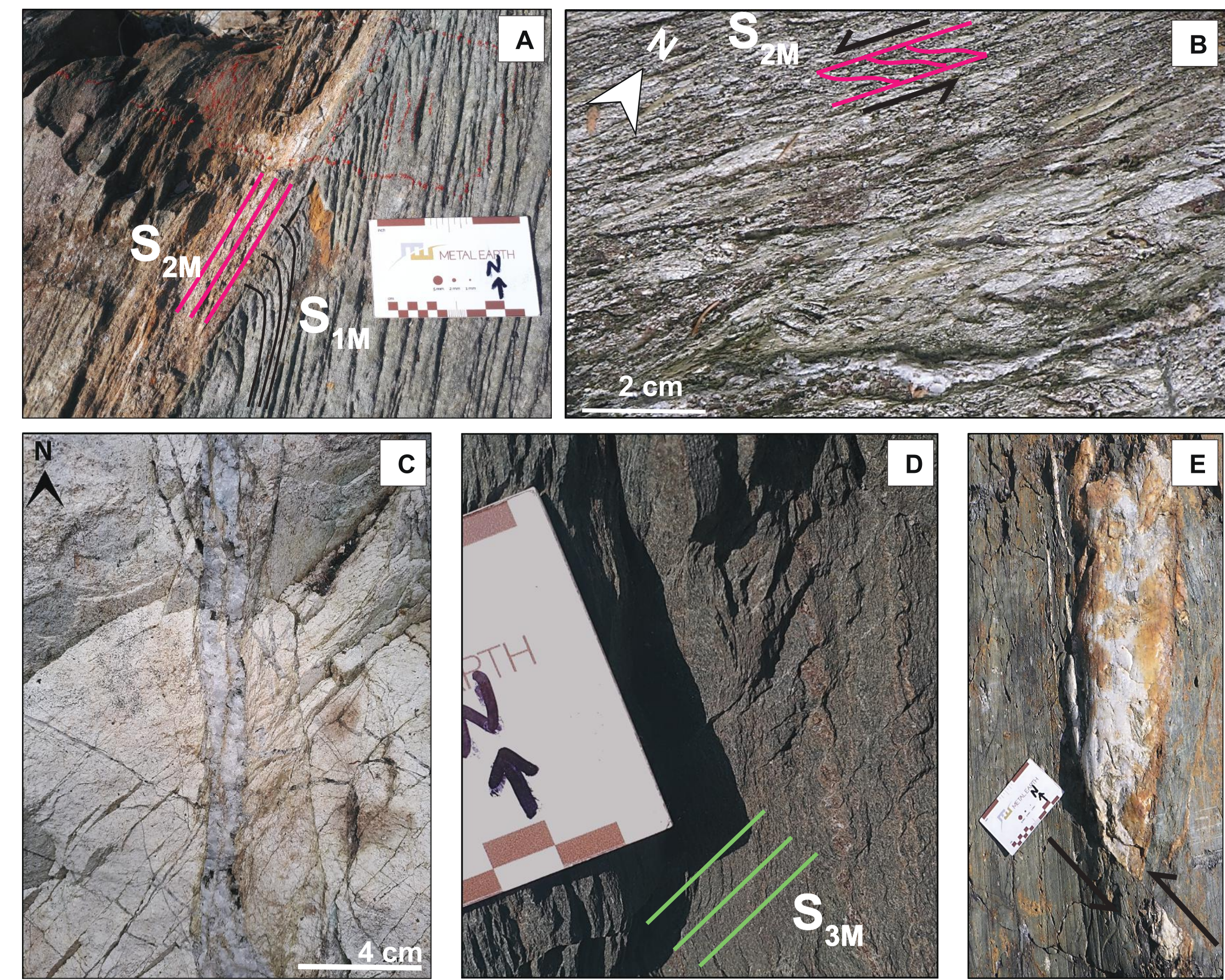


Figure 3. Macrostructures and kinematic indicators observed at the Kenwest outcrop unless otherwise stated. **A)** Overprinting of the S_{2M} fabric over the S_{1M} fabric. **B)** Sinistral C-S fabric in a volcanoclastic rock along Dinorwic Lake (Fig. 1A). **C)** S_{2M} fabric sinistrally bent around a fracture-filling quartz vein on Highway 502, along strike of the MDdz (Fig. 1A). **D)** D_{3M} crenulation cleavage. **E)** Late sinistral faulting of 2nd generation quartz veins.

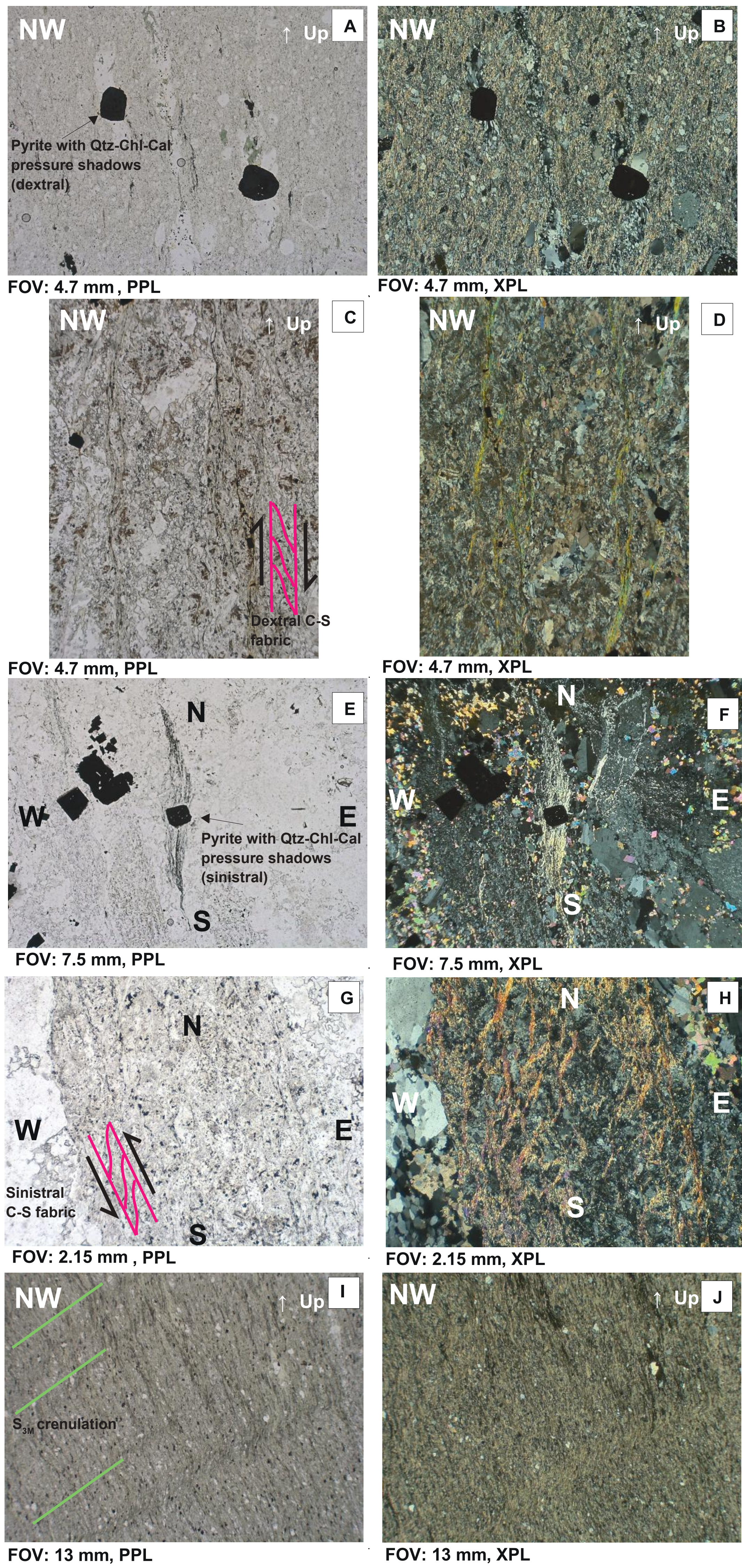


Figure 4. Microstructures along the MDdz. **A), B)** Dextrally rotated pyrite (parallel to stretching lineation) in vertical plane. **C), D)** Dextral C-S fabric in quartz-feldspar-porphyritic dike (parallel to stretching lineation) in vertical plane. **E), F)** Sinistrally rotated pyrite in horizontal plane. **G), H)** Sinistral C-S fabric in horizontal plane. **I), J)** Crenulation of S_{2M} fabric by S_{3M} fabric (parallel to stretching lineation).

Table 1. Summary of the structural development of the Manitou-Dinorwic deformation zone.

Event	Shortening Direction	Structure	Veins	Alteration
Series of intermediate metavolcanic flows	N/A	Primary: pillows, vesicles, amygdulodes	None observed	N/A
D _{1M}	NWW-SEE	1. Regional isoclinal folding, axial planar foliation	None observed	None observed
Intrusion of quartz-feldspar-porphyritic dike	N/A	N/A	1 st generation quartz rich (post QFP intrusion)	N/A
D _{2M}	NW-SE	Transpressional shear zone 1. NW over SE thrusting 2. Late sinistral offset 3. QFP dike boudinaged along strike	2 nd generation quartz rich, fracture filling, host gold mineralization	Sericitic Iron-carbonate Pyrite dissemination
D _{3M}	NE-SW	1. Crenulation of main D ₂ fabric 2. Late faulting	3 rd generation calcite rich pre to early D ₃	None observed

OBSERVATIONS & INTERPRETATIONS

1) Four main rock units are observed at the Kenwest property: massive intermediate metavolcanic flows, pillowed to massive intermediate plagioclase-phyric metavolcanic flows, a quartz-feldspar porphyritic dike and quartz veins (Fig. 2).

2) Three generations of veins have been identified: quartz-rich between D_{1M} and D_{2M}, gold-hosting fracture-filling quartz-rich late to post-D_{2M} and calcite-rich pre to early-D_{3M}.

3) Three phases of deformation have been recognized on the outcrop: D_{1M} - NEE striking isoclinal folding, D_{2M} - NE striking transpressional sinistral shearing, D_{3M} - late crenulation and faulting (Table 1).

4) Dominant chlorite-epidote metamorphic assemblages indicate that D_{1M}, D_{2M} and D_{3M} deformation occurred at **greenschist facies metamorphic conditions**.

5) Hydrothermal alteration is syn-D_{2M} and is characterized by extensive quartz veining associated with a sericite-calcite-ankerite-quartz-sulfide mineral assemblage (Fig. 4).

6) Gold mineralization along the Manitou-Dinorwic deformation zone is located within **quartz veins and disseminated sulfide minerals that are spatially associated with felsic dikes** within metavolcanic flows.

IMPLICATIONS FOR GOLD EXPLORATION IN THE WESTERN WABIGOON SUBPROVINCE

1) Gold mineralization on the Kenwest property occurred during the local D_{2M} event, which corresponds to the regional D₃ event.

2) Gold mineralization within the WWS is associated with **felsic dikes along NE-trending transpressional shear zones that have crosscut earlier E-W trending deformation zones and major isoclinal folds**. During deformation, brittle fractures within these dikes likely acted as conduits for gold-bearing mesothermal fluids that have the potential to deposit mineralization in economic quantities within quartz-carbonate veins (e.g. 53 700 g/t on Kenwest property; Manitou Gold Inc, 2010).

3) This study proposes a new structural setting and timing for **orogenic gold mineralization** in the WWS, which is late relative to terrane accretion during regional amalgamation and **localized along NE-trending high-strain corridors**. Future exploration in the Superior Province could therefore consider similar NE-SW deformation zones to be potentially prospective for high-grade gold mineralization.

Acknowledgments & References

Financial support was provided by Canada First Research Excellence Fund, Queen’s Tectonics Research Laboratory (QTRL), and the Mineral Exploration Research Center (MERC) at Laurentian University. I am particularly grateful to Dr.S Perrouty, Dr. B. Frieman and Dr. L. Godin for your expertise and guidance. Data contributions from Kendra Zammit, David Downie and Rebecca Montsion are very much appreciated.
Harquail School of Earth Sciences, Mineral Exploration Research Centre contribution MERC-ME-2019-110

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