Structural controls on gold mineralization, Magino gold mine, Wawa Subprovince, Northern Ontario

I.C. Campos[1], B. Lafrance[1], R. Sherlock[1], and S. Kruse[2]

[1]Mineral Exploration Research Centre (MERC), Harquail School of Earth Sciences, Goodman School of Mines, Laurentian University, 935 Ramsey Lake Rd., Sudbury, ON, P3E 2C6, Canada;
[2]Terrane Geoscience Inc., 100 - 5435 Portland Place, Halifax, NS, B3K 2Y7, Canada;

Laurentian University Université Laurentienne

HARQUAIL SCHOOL OF EARTH SCIENCES ÉCOLE DES SCIENCES DE LA TERRE

ABSTRACT

The Magino gold mine is located approximately 40km northeast of the town of Wawa, within the Michipicoten greenstone belt of the Archean Wawa subprovince. It is a past-producing underground mine being redeveloped as a large tonnage open pit gold deposit with proven and probable reserves of 2.4 Moz of gold at a grade of 1.15 g/t Au. Gold mineralization at Magino is primarily hosted in the Webb Lake stock, a steeply-dipping ca. 2724 Ma[1] tabular trondhjemitic body which intrudes steeply-dipping ca. 2729 Ma[2] felsic metavolcanic rocks of the Wawa assemblage. The Webb Lake stock and Magino deposit underwent three episodes of ductile deformation and two pre- to syn-tectonic auriferous alteration events (Au_1 and Au_2; respectively). Gold mineralization occurs in two settings: 1) early, massive sheeted to stockwork style, steeply dipping quartz veins with primary auriferous quartz-white mica-pyrite selvages (Au_1, pre-D_1); and 2) late, steep to flat-lying fibrous quartz-carbonate/tourmaline veins with secondary auriferous iron carbonate-fuchsite/paragonite/albite-pyrite selvages (Au_2, syn-D_1). The pre-tectonic quartz veins are transposed and boudinaged along the steeply-dipping WSW-ENE striking regional cleavage (S_1). The fibrous quartz-tourmaline veins were emplaced syn- to late-D_1 and are deformed within D_2 shear zones. Flanking structures and asymmetric Z-shaped drag folds are indicative of dextral shear along the shear zones. A later flat-lying differentiated crenulation cleavage (S_3) and associated shallow crenulation lineation (L_3) overprints earlier structures and is overgrown by metamorphic chloritoid porphyroblasts within the older surrounding felsic metavolcanic rocks, suggesting that alteration of these rocks occurred prior to peak metamorphism. Mineralization is offset by Matachewan(?) diabase dykes with an apparent sinistral, E-side up sense of motion.

REGIONAL AND DEPOSIT-SCALE GEOLOGY

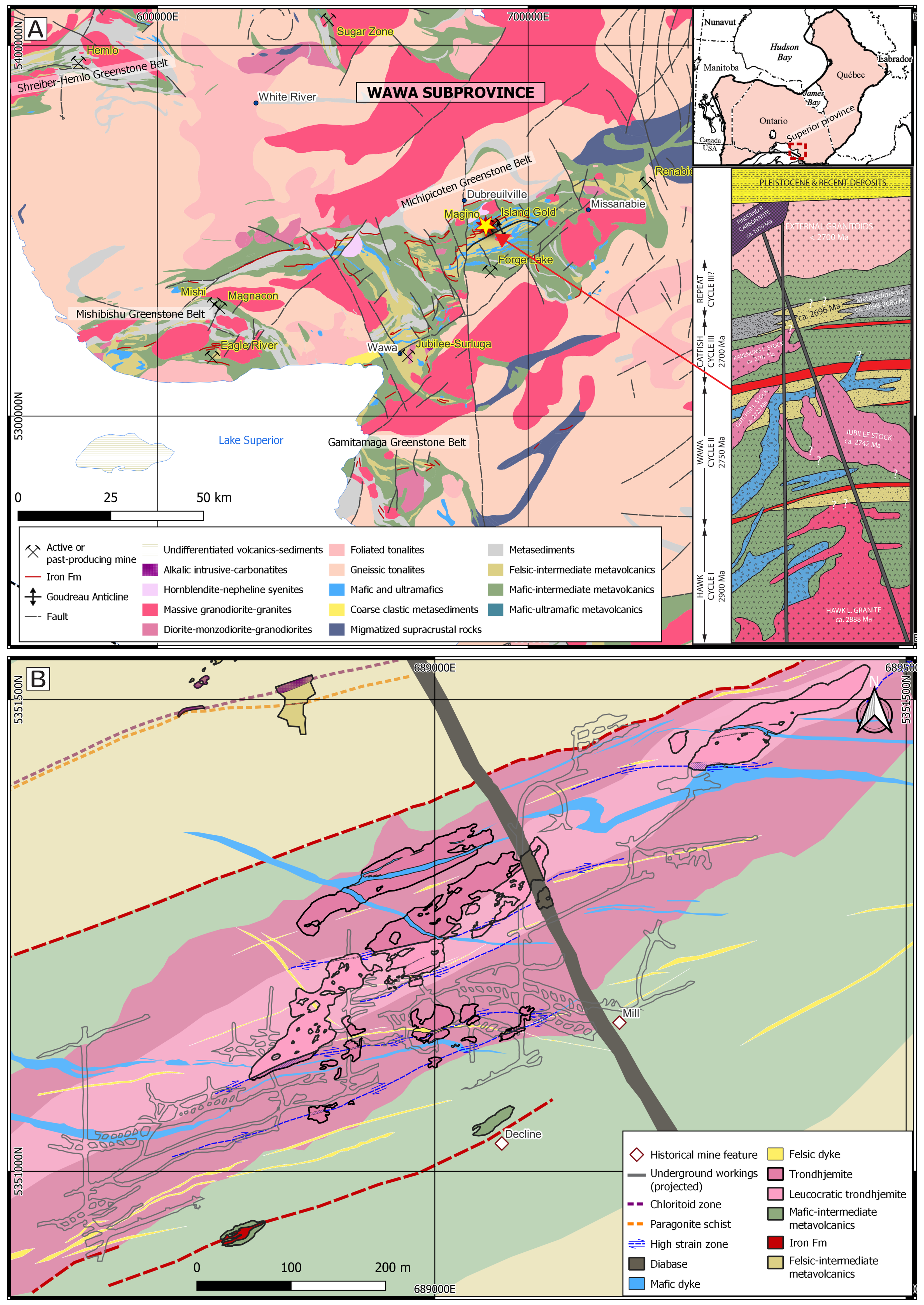

Figure 1. A) Simplified regional geological map and stratigraphy of the Wawa subprovince, compiled after Ontario Geological Survey (2011), Sage (1994), and Stott et al. (2010). B) Deposit-scale geological map showing mapped outcrops (solid outlines), historical underground workings and interpreted units (no outlines) compiled after Deevy (1993) and Argonaut Gold (unpublished).

MINERALIZATION

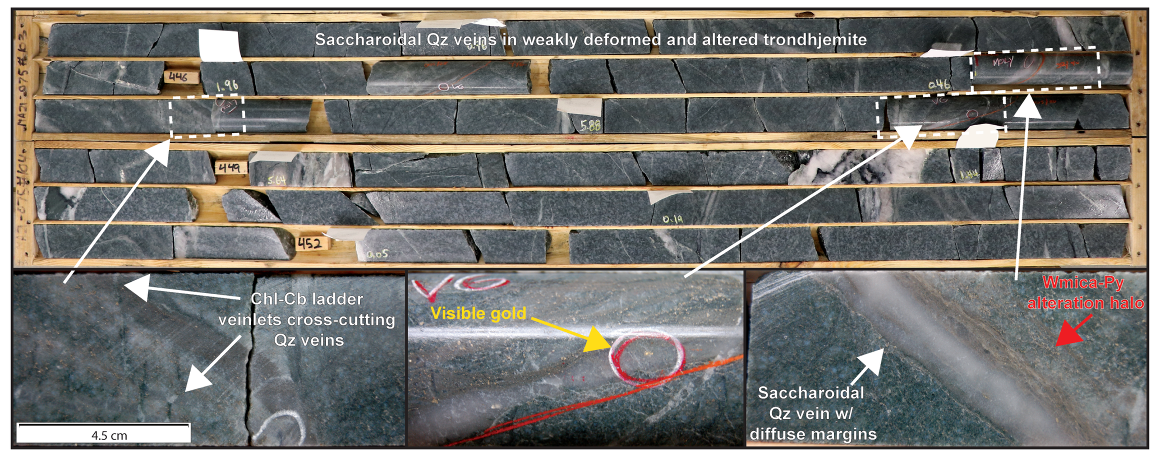

Figure 2. Au_1 mineralization. Saccharoidal quartz (Qz) veins hosting visible gold with narrow auriferous White mica-Pyrite (Wmica-Py) bleached halos in weakly altered and deformed trondhjemite. Note diffuse margins and cross-cutting chlorite-carbonate (Chl-Cb) ladder veinlets.

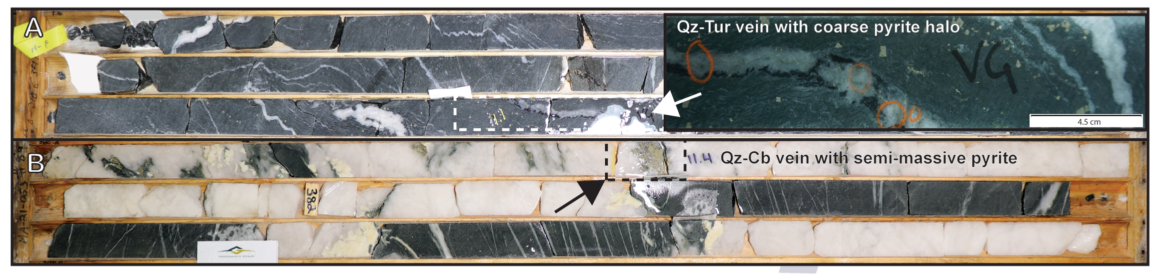

Figure 3. Au_2 mineralization. A) Folded quartz-tourmaline (Qz-Tur) vein with coarse pyrite in crenulated, chlorite-altered felsic-intermediate metavolcanics. B) Coarse-grained quartz-carbonate (Qz-Cb) vein with semi-massive pyrite in mafic dyke.

Figure 4. Shear zone in altered and veined interval. Note strongly deformed saccharoidal quartz (Qz) vein.

FIELD & STRUCTURAL RELATIONSHIPS

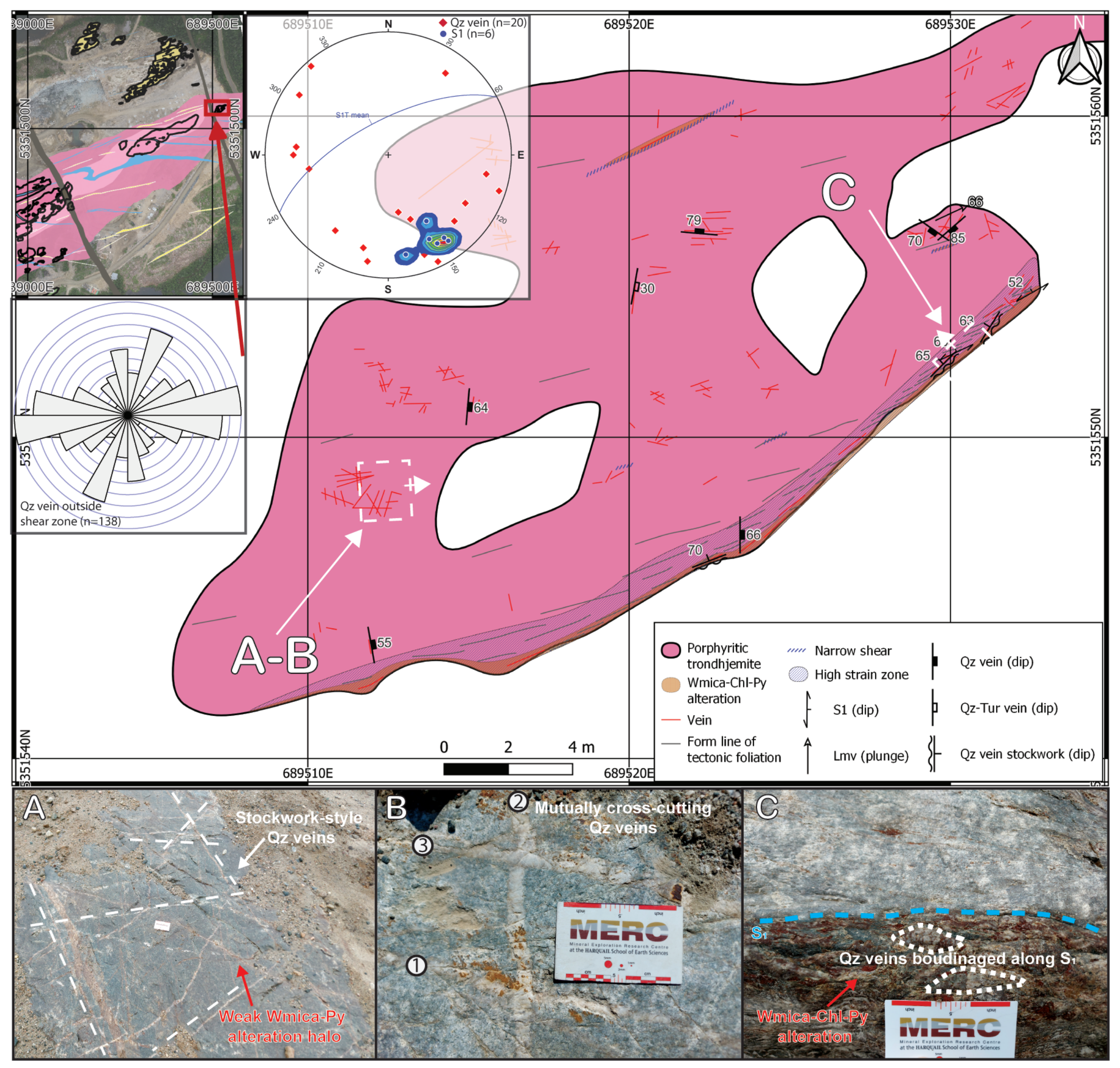

Figure 5. Far east pit outcrop and saccharoidal quartz (Qz) vein relationships to regional S_1 foliation, including stereonet plot (equal area; 1% area contours at 10% intervals) and rose diagram of measured orientations and form lines, respectively. A) Stockwork-style Qz veins with weak white mica-pyrite (Wmica-Py) alteration halos in undeformed trondhjemite. B) Mutually overprinting Qz veins. C) Boudinaged Qz veins parallel to S_1 along weakly altered white mica-chlorite-pyrite (Wmica-Chl-Py) shear zone.

FIELD & STRUCTURAL RELATIONSHIPS

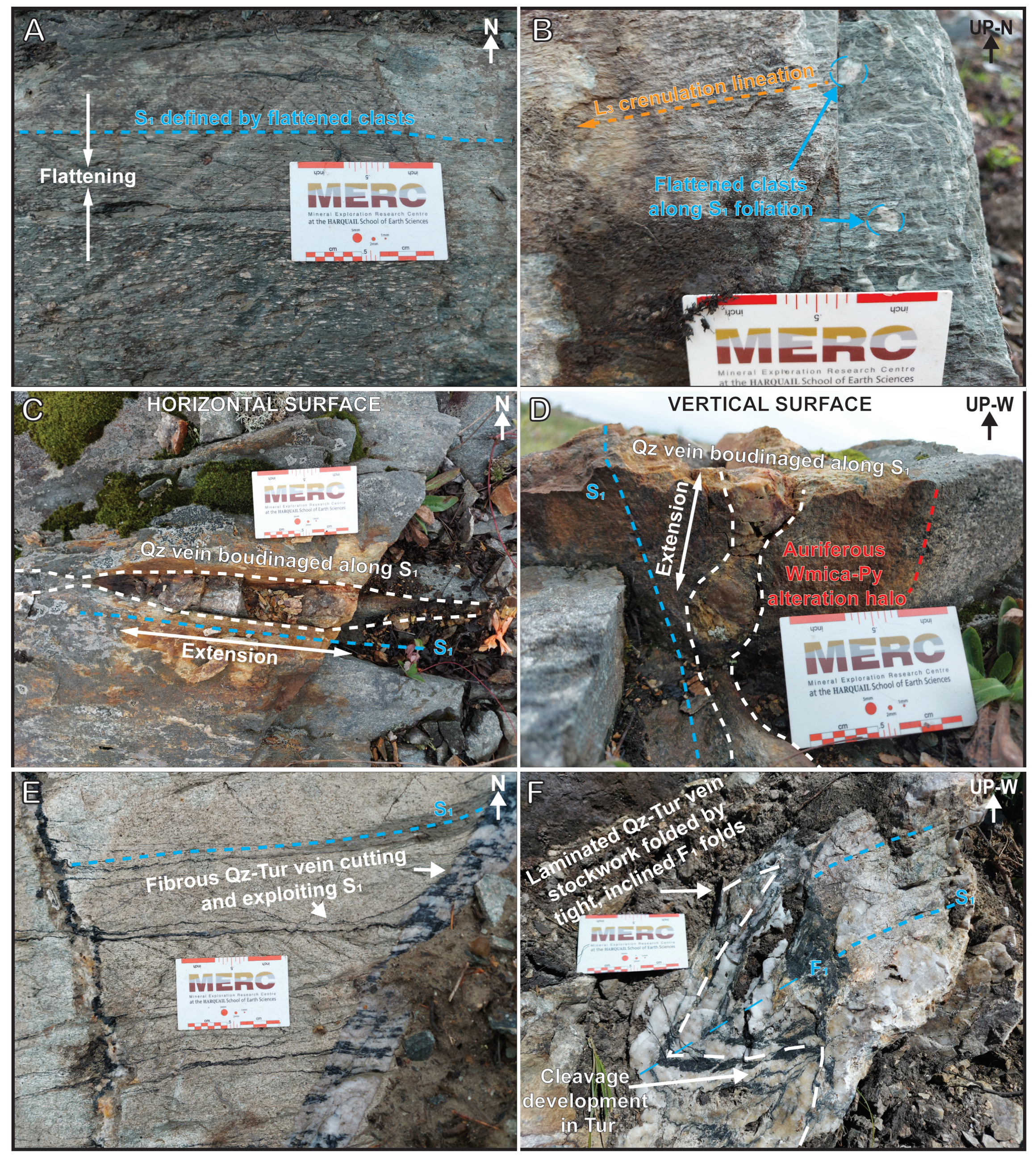

Figure 6. Field relationships of D_1 structures. A-B) S_1 transposition foliation defined by flattened S>>L feldspathic clasts in felsic-intermediate metavolcanics. Note L_3 crenulation lineation. C-D) Auriferous saccharoidal quartz (Qz) vein boudinaged along both horizontal (left) and vertical (right) surfaces (chocolate tablet boudinage). E) Steep, N-S fibrous quartz-tourmaline (Qz-Tur) vein exploiting S_1 in FIV. F) Laminated quartz-tourmaline stockwork folded axial planar to spaced S_1 cleavage in altered trondhjemite.

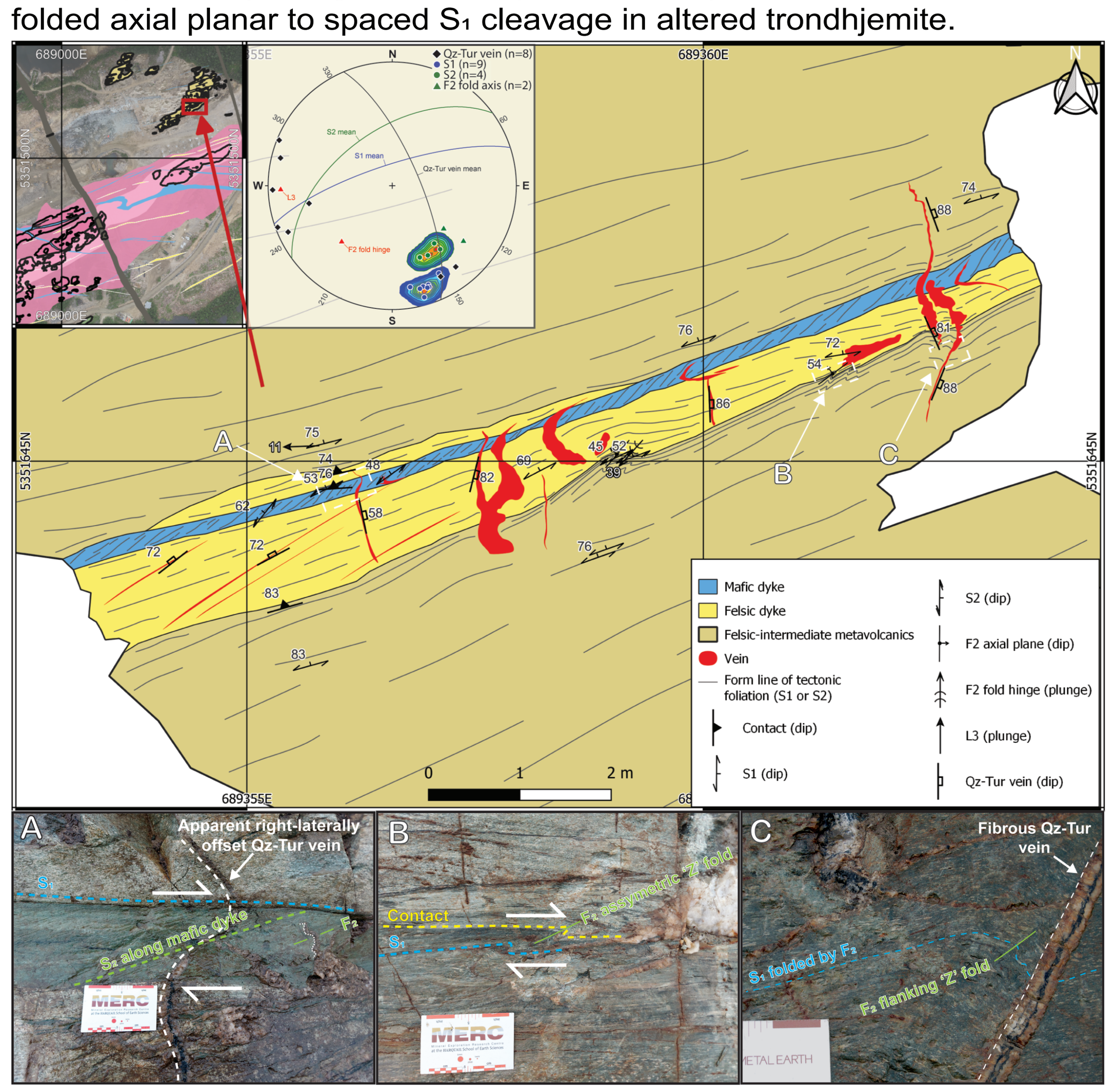

Figure 7. North east pit outcrop and D_2 shear zone relationships, including stereonet plot (equal area, area contours at 10% intervals) of dominant structures. A) Mylonitic S_2 foliation preferentially developed in mafic dyke overprinted by right laterally-offset quartz-tourmaline (Qz-Tur) veins. B) Z-shaped assymetric F_2 folds defined by flattened clasts along Felsic-intermediate metavolcanics-felsic dyke contact. C) Flanking F_2 fold along Qz-Tur vein.

PEAK METAMORPHISM & LATE FOLDING

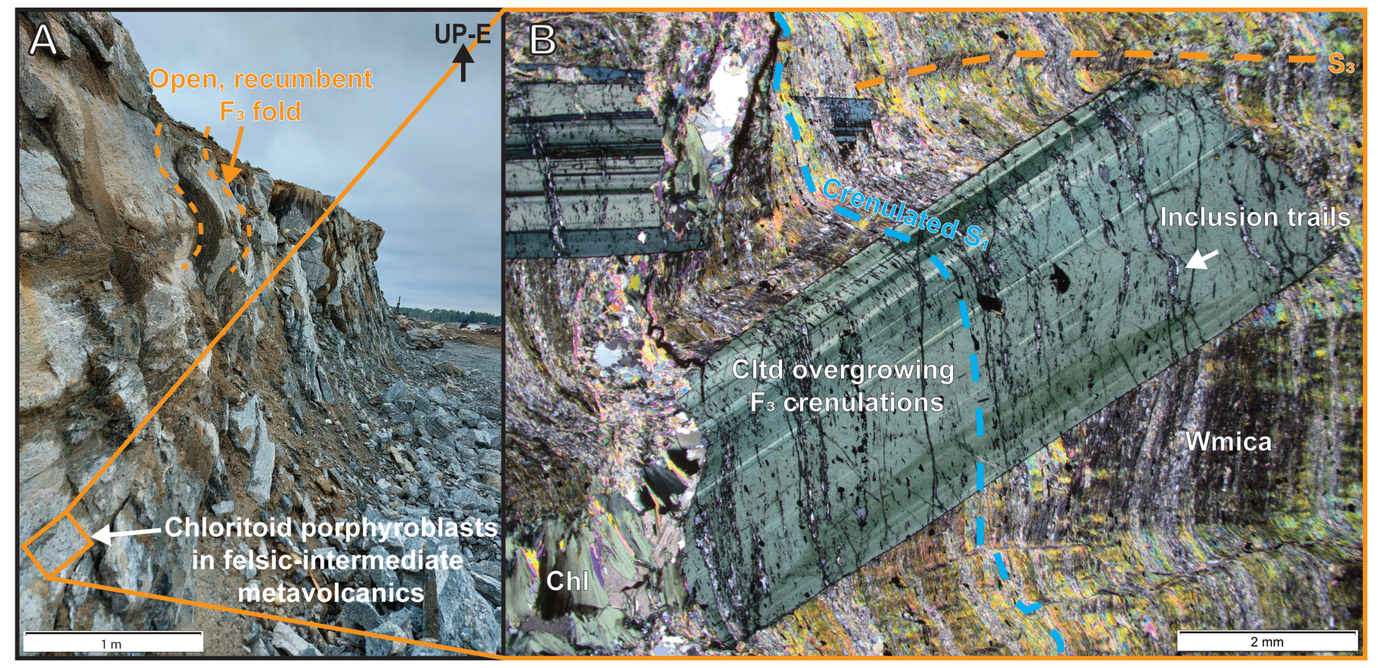

Figure 8. A-B) Chloritoid (Cltd) porphyroblasts overprinting D_3 recumbent folds and flat-lying S_3 crenulation cleavage in felsic-intermediate metavolcanics. Chl = chlorite; Qz-Cb = quartz-carbonate; Wmica = white mica.

PRELIMINARY INTERPRETATION & FUTURE WORK

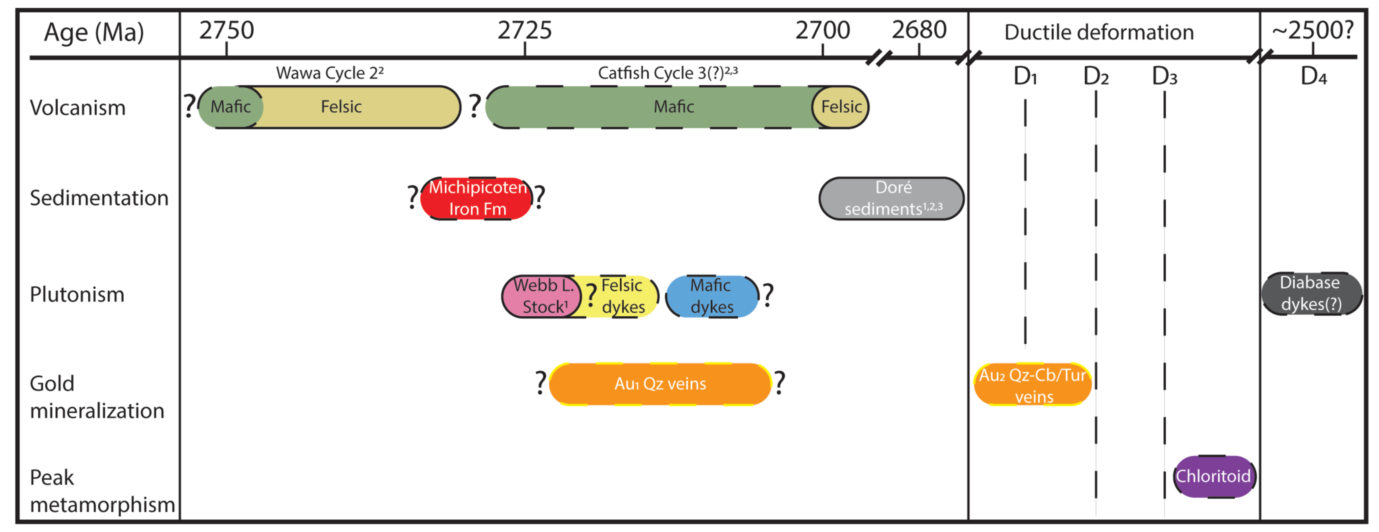

Figure 9. Geochronological diagram summarizing deposit-scale age constraints (dashed outlines = no absolute age constraint).

1) Primary gold mineralization (Au_1) at Magino is associated with steep, sheeted to stockwork-style saccharoidal quartz veins, which pre-date D_1 N-S shortening and associated regional S_1 foliation.

2) Secondary gold mineralization (Au_2) is associated with steep to flat-lying, fibrous quartz-carbonate/tourmaline veins, which were emplaced syn- to late- D_1.

3) Later, dextral N-side-down D_2 shearing, D_3 loading/recumbent folding (overgrown by chloritoid), and D_4 sinistral E-side-up faulting modify earlier structures and mineralization.

Further work is being undertaken to provide absolute timing constraints on mineralization through Re-Os and U-Pb geochronology of post-Au_1 molybdenite veins and syn- to post-Au_2 alteration-related xenotime, respectively.

Acknowledgments & References

Acknowledgments

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Contact

icampos@laurentian.ca; blafrance@laurentian.ca; rsherlock@laurentian.ca

MERC Mineral Exploration Research Centre

Laurentian University Université Laurentienne

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