STRUCTURAL GEOLOGY OF A GOLD-BEARING QUARTZ VEIN SYSTEM, WILDING LAKE REGION, CENTRAL NEWFOUNDLAND

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ABSTRACT

The structurally controlled gold belt of central Newfoundland is emerging as a significant exploration jurisdiction in Canada. The gold district occurs within a northeast-trending structural corridor defined by crustal-scale faults extending from southwestern to north-central Newfoundland. Silurian syn-orogenic polymict conglomerate (Rogerson Lake Conglomerate) characterizes the structural corridor. The presence of conglomerate reflects preservation of syn-orogenic upper crustal clastic sequences commonly associated with orogenic gold vein systems. The largest known gold resource along this corridor occurs at Marathon Gold Corporation's Valentine Lake property. Marathon's most recent public news release on Valentine Lake reports a measured and indicated gold resource of 2.69 Moz grading at 1.85 g/t and an inferred resource of 1.53 Moz grading at 1.77 g/t. Recent exploration by Antler Gold Inc. on previously unexplored property in the Wilding Lake area, adjacent to the northeast corner of the Valentine Lake property, exposed a system of gold-bearing quartz veins hosted by syn-orogenic sedimentary rocks, felsic volcanic rocks and volcaniclastic rocks.

Detailed structural study of these gold-bearing zones on the Antler Gold Inc. property demonstrates that the main ~2-m-wide gold-bearing quartz vein, which extends for ~230 m along strike, cuts the conglomerate host and occurs within an oblique sinistral reverse shear zone that involved a component of north-northeast-directed thrusting. An early set of stacked, moderately dipping extensional quartz veins, consistent with sinistral reverse shear, emanate outward into the country rock from the main vein. Younger, more steeply dipping sets of extensional quartz veins cut the main vein and the earlier shallow-dipping vein set, and are consistent with at least transient phases of horizontal extension and dextral transpression. Chalcopyrite and secondary malachite occur locally in the early vein sets, but are more abundant overall within the later, steeper, extensional vein sets. A nearly conjugate set of steeply dipping extension fractures cut the main vein and the extensional vein sets. These fractures are typically filled with an assemblage of vuggy quartz–chalcopyrite–malachite ± tourmaline ± pyrite ± hematite ± goethite ± bismuth–tellurium sulphide(s). Regional correlations suggest that the quartz vein system experienced a progressive structural history during the Late Silurian and Early Devonian.

INTRODUCTION

Structurally controlled gold systems comprise the most economically significant gold deposit type in Canada (Hodgson, 1993). The largest gold district, the late Archean Abitibi greenstone belt of the Canadian Shield (*e.g.*, Poulson *et al.*, 2000; Robert, 2001; Bleeker, 2015) consists of mineralized vein systems disposed along polydeformed, crustal-scale fault zones (Figure 1, inset; Hodgson, 1993; Kerrich and Cassidy, 1994; Groves *et al.*, 1998; Kerrich *et al.*, 2000; Goldfarb *et al.*, 2001). In central Newfoundland, numerous examples of epigenetic gold mineralization appear to be associated spatially with crustal-scale fault zones that preserve syn-orogenic clastic sedimentary rocks (Figure 1). This first-order relationship suggests that gold-bearing quartz veins throughout central Newfoundland are structurally controlled (*e.g.*, Evans, 1996), with broad similarities to mineralization of the Abitibi greenstone belt (Figure 1; Honsberger and Bleeker, 2018). However, the polymetallic nature of many examples of gold mineralization in central Newfoundland (*e.g.*, Tallman, 1991; Tallman and Evans, 1994; Evans and Wilson, 1994; Dalton and Scott, 1995; Evans, 1996; O'Driscoll and Wilton, 2005; Lake and Wilton, 2006; Sandeman *et al.*, 2013, 2017), may suggest local intrusion-related hydrothermal fluid inputs (*e.g.*, Sillitoe and Thompson, 1998; Hart, 2007).

The slowly growing, largest proven gold resource in Newfoundland (and among the top in Canada) is Marathon Gold Corporation's Valentine Lake gold property disposed
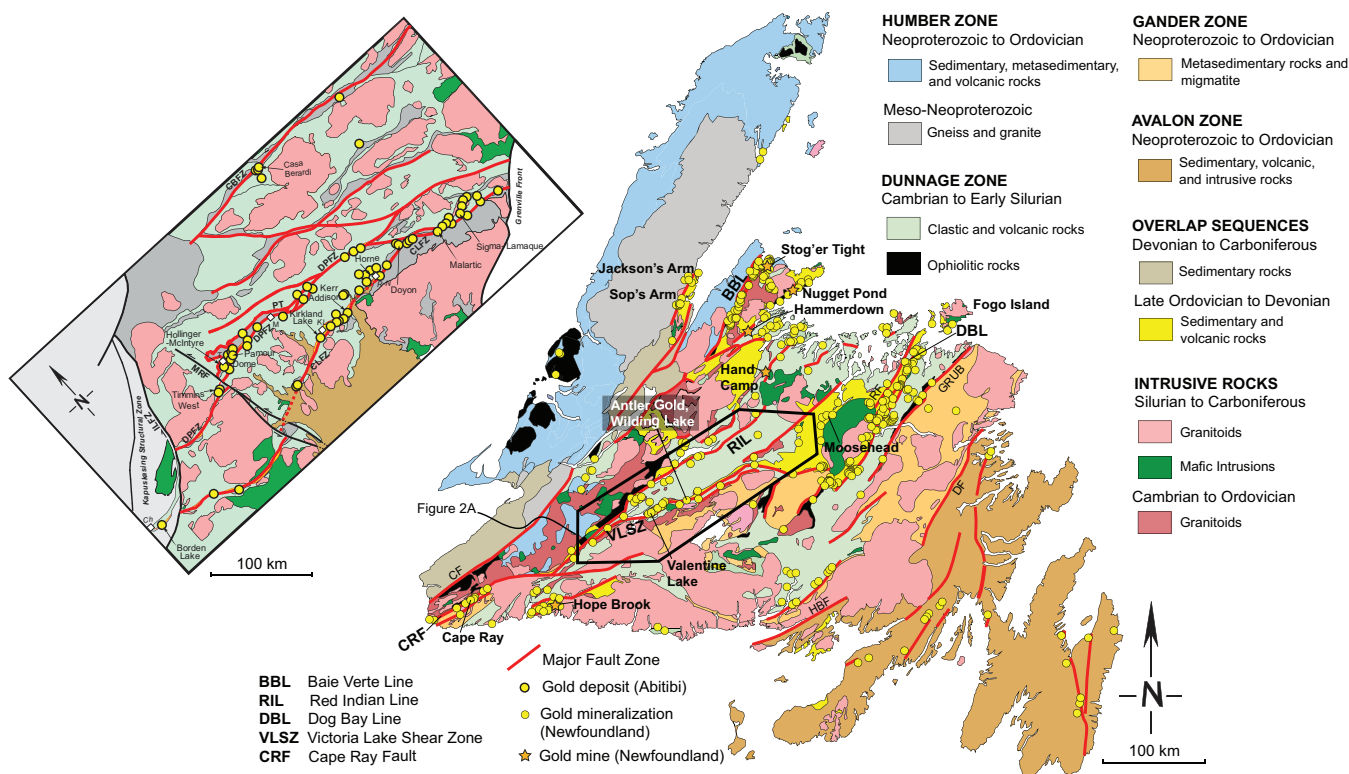
Figure 1. *Comparison of Abitibi (left) and Newfoundland (right) geology and gold systems at the same regional scale. The same rock types are the same colours on both the Abitibi and Newfoundland maps; however, detailed explanation of geological zones and rock units is for Newfoundland. The area outlined in black is enlarged in Figure 2A. Abitibi map modified after Poulsen et al. (2000), Dubé and Gosselin (2007), and Bleeker (2015). Newfoundland map adapted after Colman-Sadd et al. (1990), with gold occurrences from Evans (1996), O'Driscoll and Wilton (2005), and Sandeman et al. (2017). Abbreviations: CBFZ, Casa Berardi Fault Zone; CF, Cabot Fault; Ch, Chapleau; CLFZ, Cadillac-Larder Lake Fault Zone; DF, Dover Fault; DPFZ, Destor-Porcupine Fault Zone; GRUB, Gander River Ultrabasic Belt; HBF, Hermitage Bay Fault; KL, Kirkland Lake; M, Matheson; MRF, the Paleoproterozoic Matagami River Fault; PT, the Pipestone Thrust; R-N, Rouyn-Noranda; T, Timmins.*

along the Victoria Lake shear zone in central Newfoundland (Figures 1 and 2A; Marathon Gold Corporation, press release, October 30, 2018). Presently, this emerging gold property is reporting a measured and indicated gold resource of 2.69 Moz grading at 1.85 g/t and an inferred resource of 1.53 Moz grading at 1.77 g/t (Marathon Gold Corporation, press release, October 30, 2018). These resources are based on ore extracted from four open-pit resource shells, as well as underground operations at the Leprechaun, Victory, Sprite and Marathon deposits (Lycopodium Minerals Canada Ltd., 2018). Structural examination of the Leprechaun gold deposit of the Valentine Lake gold property suggests that it is similar to the quartz–tourmaline vein systems at Val-d'Or in the Abitibi (Marathon Gold Corporation, Mountain Lake Resources Inc., press release, November, 2012). The recent expansion of the Valentine Lake gold property has stimulated renewed prospecting, staking, exploration and study elsewhere along the major encompassing structural corridor. The research reported herein documents the lithological and structural setting of

recently discovered gold mineralization on a mineral exploration industry property adjacent to the northeast corner of the Valentine Lake property (Figure 2A, B). Antler Gold Inc. has 100% interest in the claims on the property of the present study. This is the first detailed non-industry geological study of this prospective gold property.

GEOLOGICAL AND STRUCTURAL SETTING OF EPIGENETIC GOLD MINERALIZATION, CENTRAL NEWFOUNDLAND

Numerous epigenetic gold deposits and showings occur along crustal-scale faults within the Dunnage Zone of central Newfoundland (Figure 1; Tuach *et al.*, 1988; Evans, 1996, 1999). The eastern Dunnage Zone, (the Exploits Subzone), is particularly well-endowed in gold deposits and showings (Evans, 1996). The main gold-bearing structural belt in central Newfoundland extends northeast from Cape Ray for
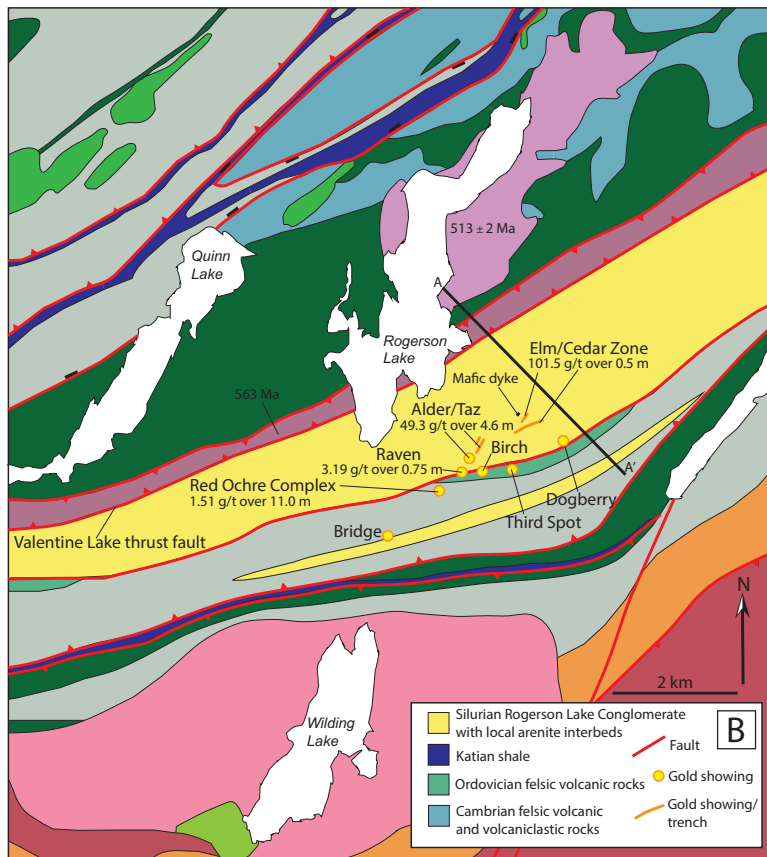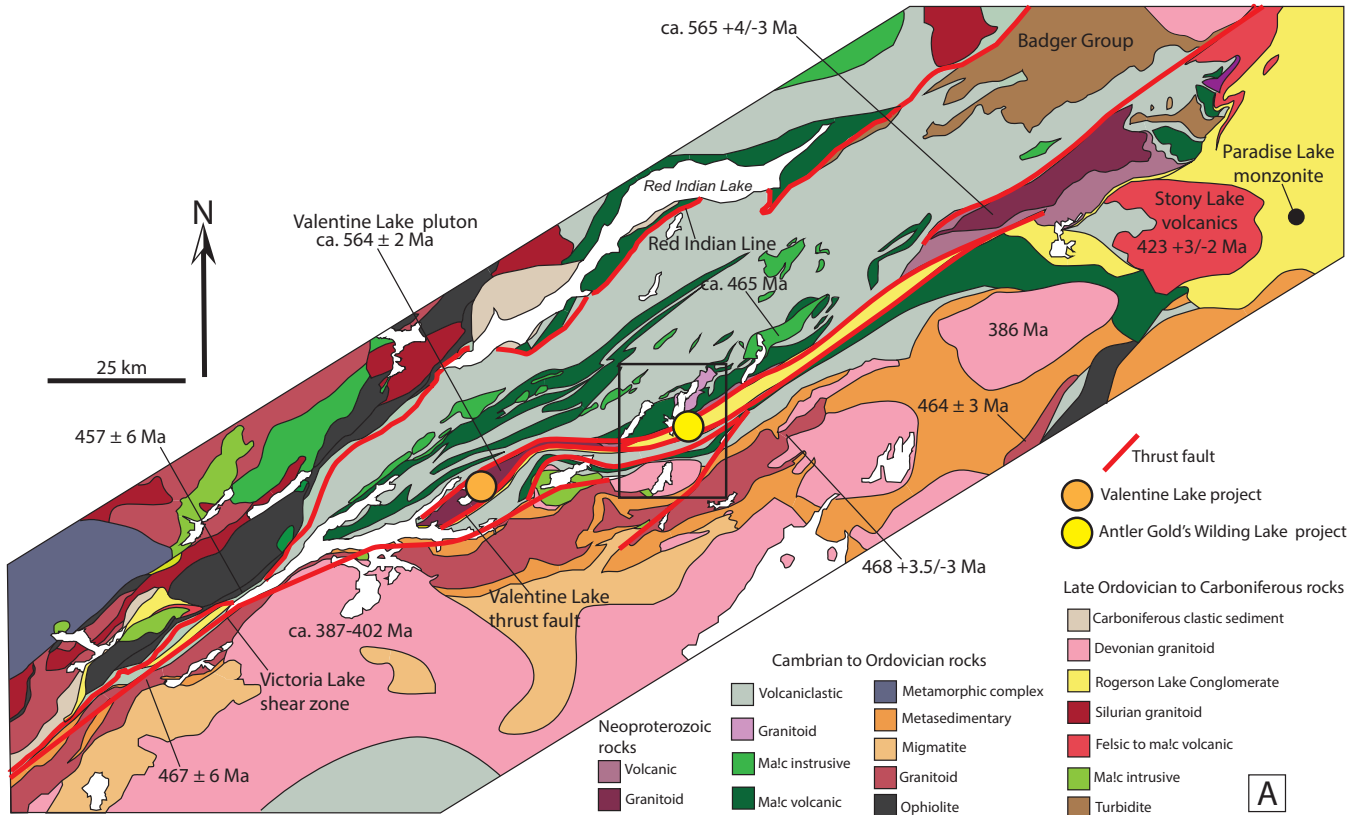
Figure 2. *A) Generalized geological map of the gold-bearing structural corridor, central Newfoundland. Thrust faults are traced in red. The large orange circle marks the Valentine Lake gold project and the large yellow circle marks Antler Gold's Wilding Lake project. Map adapted from van Staal et al. (2005), Rogers et al. (2005) and Valverde-Vaquero et al. (2005). Ages from Dunning et al. (1990), Evans et al. (1990), Rogers et al. (2005) and Valverde-Vaquero et al. (2006). Map legend is applicable to Figure 2B; B) Generalized geological map of the Wilding Lake region. A-A' represents the trace of the cross-section illustrated in Figure 3. Map adapted from Valverde-Vaquero et al. (2005). Ages from Evans et al. (1990).*

~400 km to Fogo Island (Figure 1), and is characterized by crustal-scale fault zones that locally preserve polymict conglomerate. The gold-bearing fault zones, from southwest to northeast, are the Cape Ray fault, Red Indian Line and Victoria Lake shear zone, and Dog Bay Line (Figure 1). Marathon Gold Corporation's Valentine Lake gold property occurs along the Victoria Lake shear zone (Valverde-Vaquero and van Staal, 2001) just northeast of Victoria Lake, whereas the Antler Gold Inc. property in the Wilding Lake region occurs farther northeast along the same structure (Figures 1 and 2A). Silurian Rogerson Lake Conglomerate occurs along the major fault zone in both locations.

The geology of the gold-bearing corridor is characterized by accreted Neoproterozoic to Ordovician magmatic–sedimentary arc terranes of peri-Gondwanan affinity with overlying Early Ordovician to Silurian sequences composed of volcanic and sedimentary rocks (Williams, 1978; Williams *et al.*, 1988, 1993; Colman-Sadd *et al.*, 1990; Evans and Kean, 2002; O'Brien, 2003; Rogers *et al.*, 2005, 2006; Valverde-Vaquero *et al.*, 2005; van Staal *et al.*, 2005). The Valentine Lake pluton, a Neoproterozoic granitoid of the Crippleback Intrusive Suite (Colman-Sadd *et al.*, 1990; Evans *et al.*, 1990; van Staal *et al.*, 2005) hosts gold mineralization at the Valentine Lake gold property (Figure 2A). The gold resource at Valentine Lake occurs in the hanging wall of the steeply northwest-dipping Valentine Lake thrust, which places the Valentine Lake pluton over Rogerson Lake Conglomerate (Marathon Gold Corporation, corporate presentation, October 30, 2018). Rogerson Lake Conglomerate is interpreted to represent the southwestern continuation of the Silurian Botwood Group (Williams, 1972), which is dominated farther northeast by red, green and grey-green sandstones of the Wigwam Formation and magmatic rocks of the Mount Peyton intrusive suite and Fogo Island batholith (Colman-Sadd *et al.*, 1990; O'Brien, 2003). An Upper Ordovician to Devonian volcano-sedimentary sequence containing polymict conglomerate occurs along the gold-bearing Cape Ray fault (Dubé *et al.*, 1996; van Staal *et al.*, 1996) in a structural position comparable to Rogerson Lake Conglomerate.

Gold mineralization on Antler Gold's property at Wilding Lake occurs along the northeastern extension of the Valentine Lake thrust, and is hosted within footwall rocks composed of Rogerson Lake Conglomerate and inferred Ordovician volcanic and volcaniclastic rocks (Figures 2B and 3). Grey, muscovitic, medium-grained quartz arenite beds interlayered with Rogerson Lake Conglomerate (Plate 1A) in the Wilding Lake region preserve local younging-direction reversals (Plate 1B) consistent with tight upright folding and a synclinal structure for the Silurian rocks and underlying Ordovician rocks (Figure 3). The syncline is truncated on the northwest by the northeastern extension of the

Valentine Lake thrust, which places Neoproterozoic volcanic rocks and Cambrian to Ordovician arc rocks toward the southeast over the Silurian–Ordovician sequence (Figure 3). The contact between Silurian Rogerson Lake Conglomerate and the Ordovician volcanic and volcaniclastic rocks is not exposed in this area; however, the absence of Late Ordovician to Early Silurian Badger Group implies that the contact is a deformed unconformity (Figure 3). The overall structure suggests preservation of Silurian conglomerates in a broad, partially truncated "footwall syncline" identical to panels of syn-orogenic conglomerates in the Abitibi greenstone belt (Bleeker, 2015). The overall synclinal structure may also help explain local outcrops of conglomerate preserved above Ordovician volcanic and volcaniclastic rocks south of the gold showings (Figures 2B and 3).

In the Wilding Lake area, gold mineralization is hosted by Silurian Rogerson Lake Conglomerate as well as Ordovician volcanic and volcaniclastic rocks. The Red Ochre Complex, a gold-bearing feldspar porphyry unit, occurs within the inferred Ordovician volcanic-volcaniclastic sequence (Figure 3 and Plate 1C), whereas smaller gold showings (*e.g.*, Birch Zone) occur near the Rogerson Lake Conglomerate–Ordovician felsic volcanic contact (Figure 3 and Plate 1D). In Rogerson Lake Conglomerate, gold mineralization is associated with laterally extensive quartz veins (*e.g.*, Elm Zone and Alder Zone) that dip moderately to the southeast and preserve structural evidence for oblique sinistral shear. Gold is associated with quartz, chalcopyrite, Bi–Te sulphides, tourmaline, and secondary malachite.

EXPLORATION HISTORY OF THE VALENTINE LAKE AND WILDING LAKE AREAS

From the early 1960s to 1998, base-metal exploration in the Valentine Lake region by Asarco, Hudson Bay Oil and Gas, Abitibi-Price, BP Canada, and Noranda led to the discovery of quartz veins containing gold (Marathon Gold Corporation, Mountain Lake Resources Inc., press release, November, 2012). In 2006, InnovExplo studied the structure of the Valentine Lake gold system and compared it to quartz–tourmaline gold deposits at Val-d'Or in the Abitibi (Marathon Gold Corporation, Mountain Lake Resources Inc., press release, November, 2012). The main deposit, Marathon, presently defines a resource pit shell down to a depth of ~1 km, with 1.9 Moz of measured and indicated gold at 1.765 g/t (Marathon Gold Corporation, corporate presentation, October 30, 2018).

Gold exploration in the Wilding Lake area began in 2015, when prospectors discovered visible gold in quartz boulders along new logging roads. Prospecting and soil sampling by Altius Resources in the summer of 2016 led to

Plate 1. *Field photographs. A) Interlayered polymict conglomerate and sandstone, Rogerson Lake Conglomerate; B) Basal scour in sandstone, Rogerson Lake Conglomerate; C) View toward the west of a gold-bearing quartz vein in feldspar porphyry, Red Ochre Complex; D) Altered conglomerate, Birch Zone.*

the discovery of additional quartz–tourmaline boulders with visible gold. In September 2016, Antler Gold Inc. (Antler) optioned the Wilding Lake property from Altius Resources. Subsequent trenching between September 2016 and November 2016 by Antler Gold Inc. exposed five new gold showings, including Alder, Taz, Elm, Cedar and Dogberry, all hosted in Rogerson Lake Conglomerate (Antler Gold Inc., press release, August 30, 2017). Prospecting also identified three additional showings near the boundary with inferred Ordovician felsic volcanic rocks (Birch, Third Spot and Bridge). In 2017, Antler discovered the Red Ochre Complex within the volcaniclastic rock-dominated terrane south of the contact with Rogerson Lake Conglomerate, and they exposed and defined more completely the other recently discovered gold-bearing zones. A first phase of channel sampling and drilling was completed by Antler in 2017, including three drillholes in the Alder Zone and 13 drillholes

in the Elm Zone (Antler Gold Inc., press release, December 13, 2017). Gold values of 19.2 g/t over 0.9 m and 49.92 g/t over 0.98 m were reported for the Alder and Elm zones, respectively, with local gold values of 101.5 g/t at Elm (Antler Gold Inc., press release, January 24, 2017).

STRUCTURAL GEOLOGY, ELM ZONE, WILDING LAKE PROPERTY

The gold-bearing quartz vein system of the Elm Zone (Figures 4 and 5 and Plate 2) is the focus of this report because it is the most extensive vein system known on the property[1], and has yielded the highest gold assays. Gold values within the main quartz vein are higher in the southwestern trench (Figure 4B) than in the northeastern trench (Figure 4A). The main quartz vein cuts Rogerson Lake Conglomerate (Plate 2A), dips moderately (35–65°) to the

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[1]Trenches were studied in the field prior to being backfilled in Fall 2018.
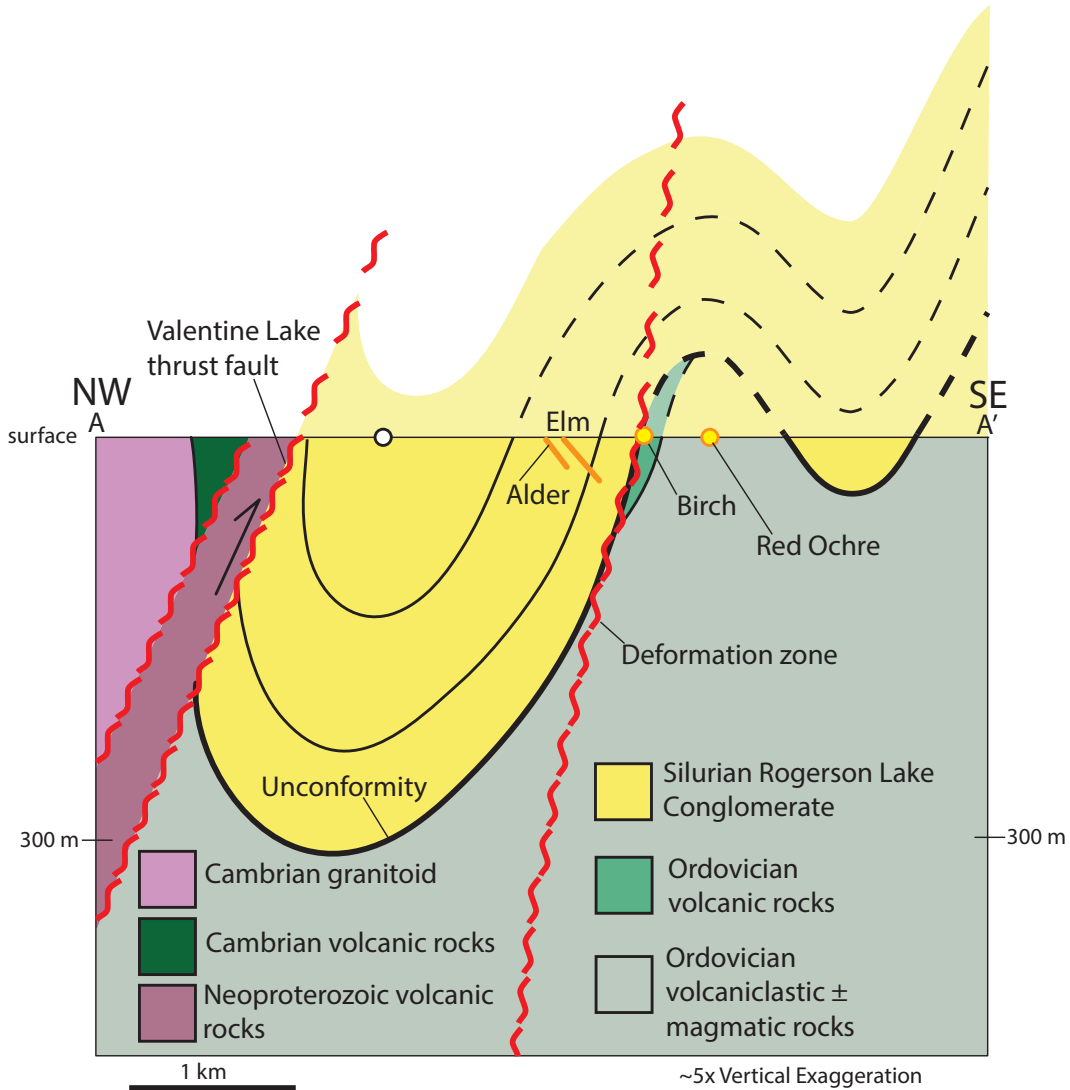
Figure 3. *Interpreted cross-sectional view along A-A'. Locations of mineralized zones are indicated with yellow circles (Red Ochre Complex and Birch Zone) and short orange lines (Elm Zone and Alder Zone). White circle marks the location of field photographs of Rogerson Lake Conglomerate shown in Figures 4A and 4B.*

Figure 4A. *(Figure on page 29) (Top) Orthorectified drone image of the northeastern portion of the Elm trench. The main quartz vein (white lineament) cuts deformed and altered Rogerson Lake Conglomerate. Short black lines are the channel samples traced on accompanying geological maps. Outlined areas are enlarged as geological maps in the lower portion of figure. (Bottom) Geological maps of the northeastern portion of the Elm trench. The smaller map area covers the northeastern-most portion of the drone image, whereas the larger map area covers the southwestern portion. Foliations (grey lines), extension veins (green lines), and fractures (purple lines) are superimposed. Different line thicknesses represent schematically varying thicknesses of veins and fractures.*
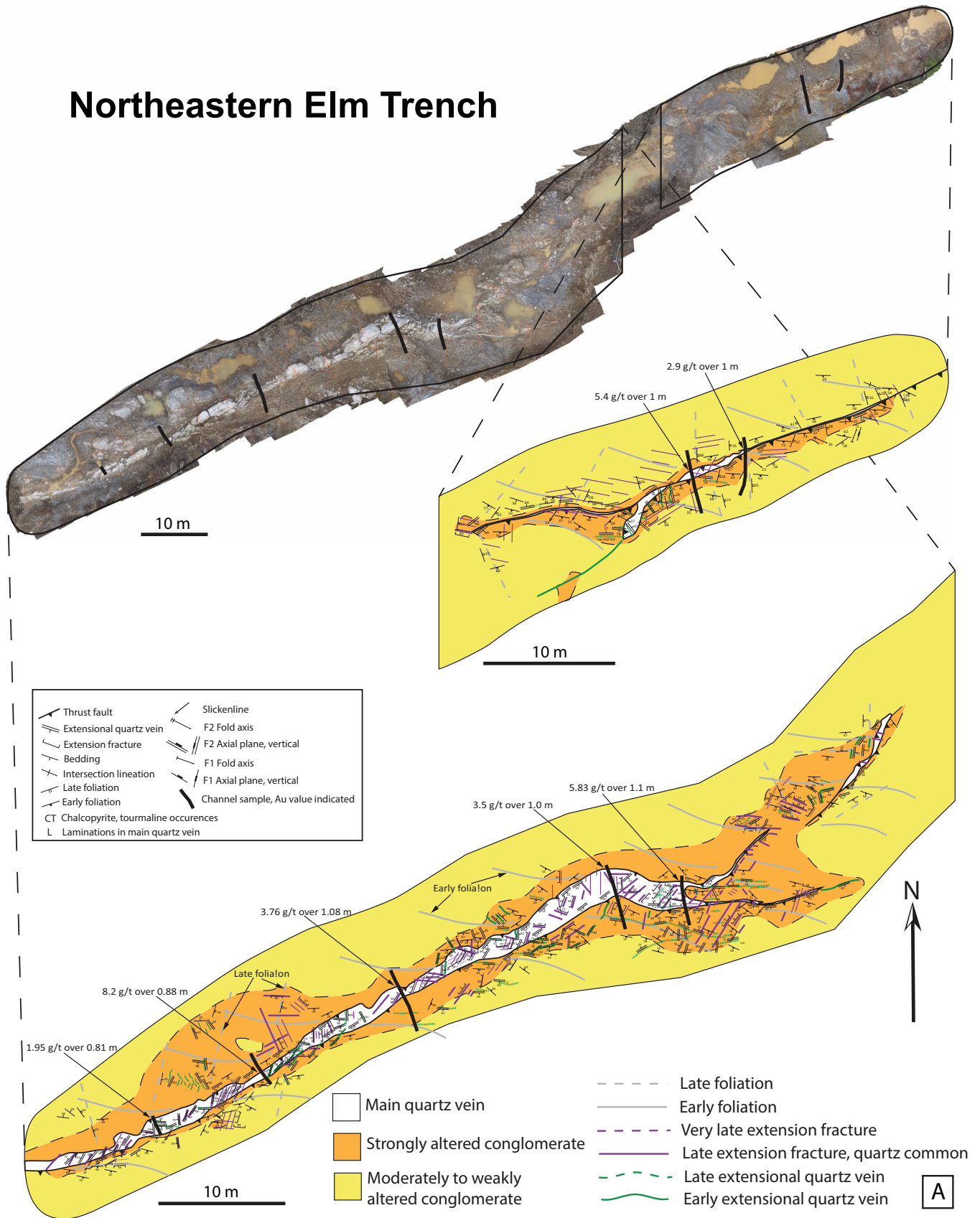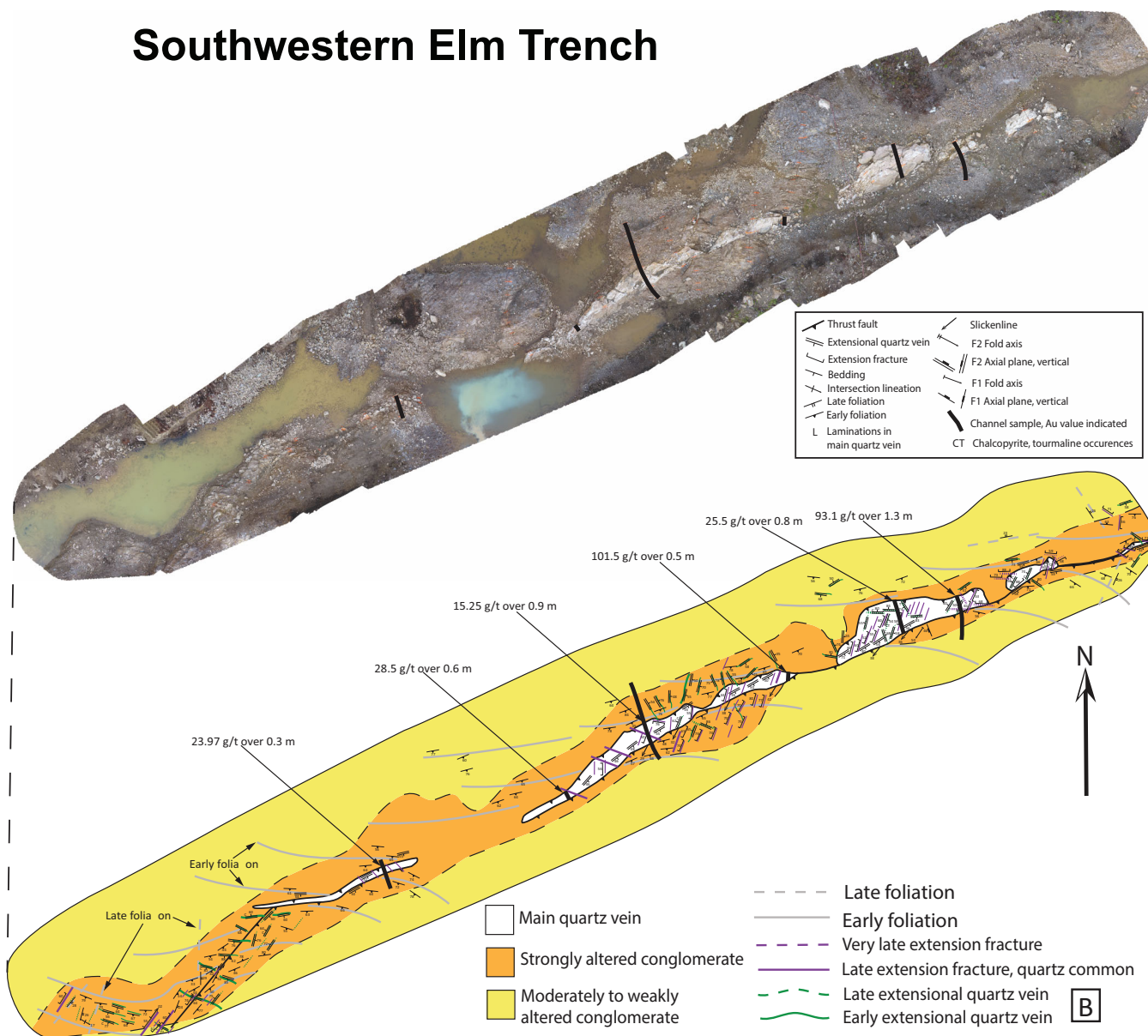
Figure 4A. *Caption on page 28.*

Figure 4B. *(Top) Drone image of the southwestern portion of the Elm trench showing the continuation of the main quartz vein (white lineament). (Bottom) Geological map of the southwestern portion of the Elm trench. Map legend and symbols the same as in (A).*

southeast (Figure 5A), is up to 2.5 m wide, and is exposed for about 230 m along strike to the northeast (Figure 4). It is composed of multiple generations of laminated and massive, medium- to coarse-grained milky white quartz in its interior and near the hanging-wall contact, but more laminated and carbonate-altered vein material proximal to the footwall contact. The latter is marked by a zone of strongly deformed conglomerate, locally transformed into a fault breccia. Disseminated chalcopyrite, secondary malachite, and dark fibrous tourmaline occur sporadically in the main vein. Preliminary X-ray diffraction and scanning electron micro-

scope (SEM) investigations also identified abundant Bi–Te sulphides.

The host conglomerate is typically purple-grey, clast-supported and polymict, containing angular and subangular to subrounded clasts up to ~15 cm in diameter consisting of felsic to intermediate plutonic and volcanic rocks, clastic sedimentary rocks, and jasper. The conglomerate is strongly altered proximal (≤4 m) to the main vein (Plate 2B) and relatively unaltered elsewhere (Plate 2C). Light to dark-brown colouration of conglomerate is likely a result of ankerite
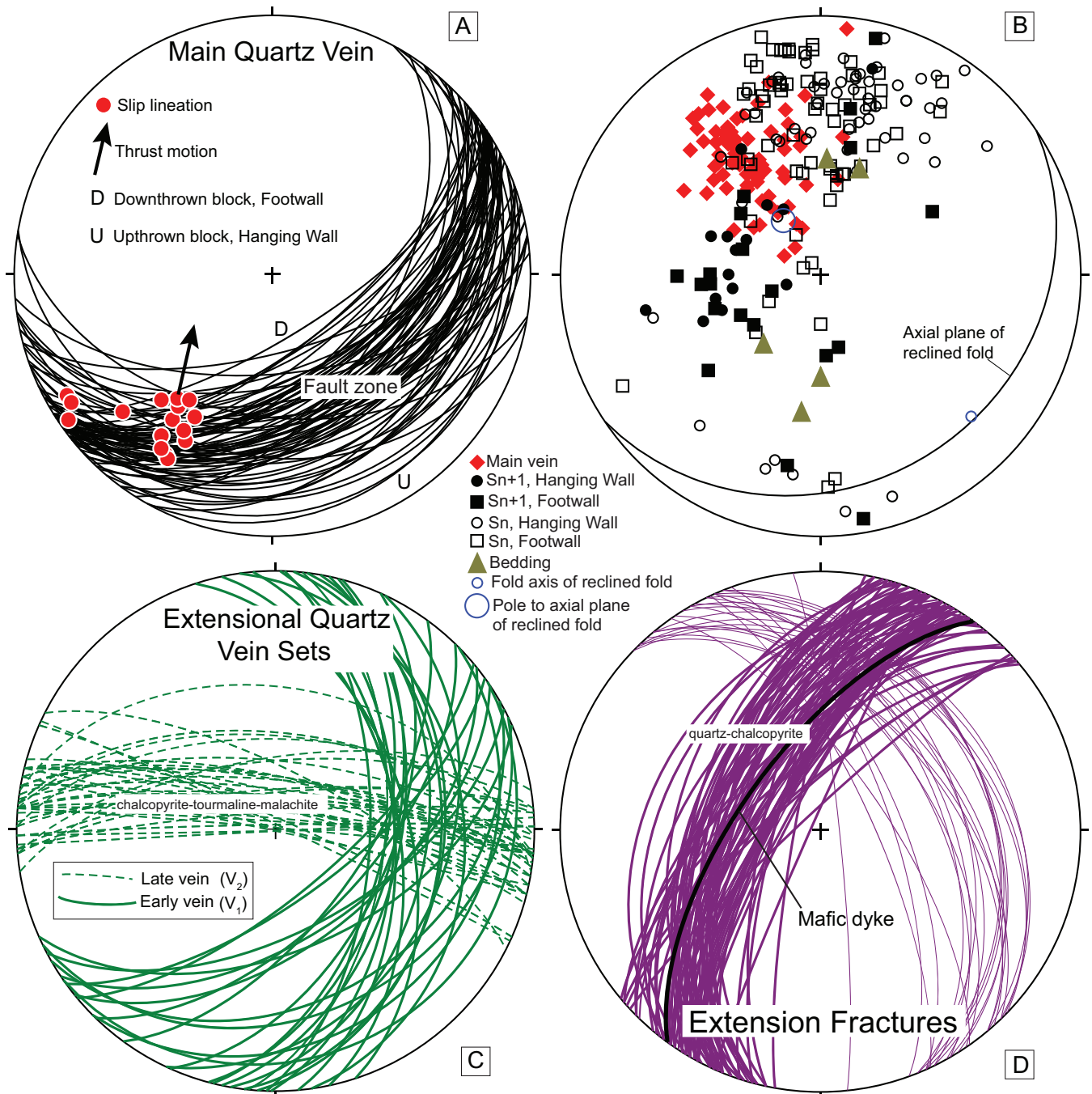
Figure 5. *Lower hemisphere equal-area projections of relevant structures throughout the Elm Zone. A) Great circles showing attitudes of main quartz vein. Red circles show attitudes of slip lineations on main quartz vein, which are consistent with oblique thrusting; B) Poles to early foliation (Sn) and late foliation (Sn+1) in the hanging wall and footwall of the main quartz vein. Poles to bedding and the main quartz vein are plotted for reference. Representative attitude of axial plane and fold axis for reclined folds are shown respectively as a great circle and pole; C) Great circles showing attitudes of early (V₁) and late (V₂) extensional quartz vein sets. The late vein set is richer in chalcopyrite, tourmaline, and secondary malachite; D) Great circles showing attitudes of conjugate extension fracture sets and, as well, a nearby mafic dyke. The attitude of the mafic dyke (black line) is subparallel to the northwest-dipping fracture set (bold purple lines), which is rich in vuggy quartz, chalcopyrite, and secondary malachite, goethite and bismuth–tellurium sulphide(s).*
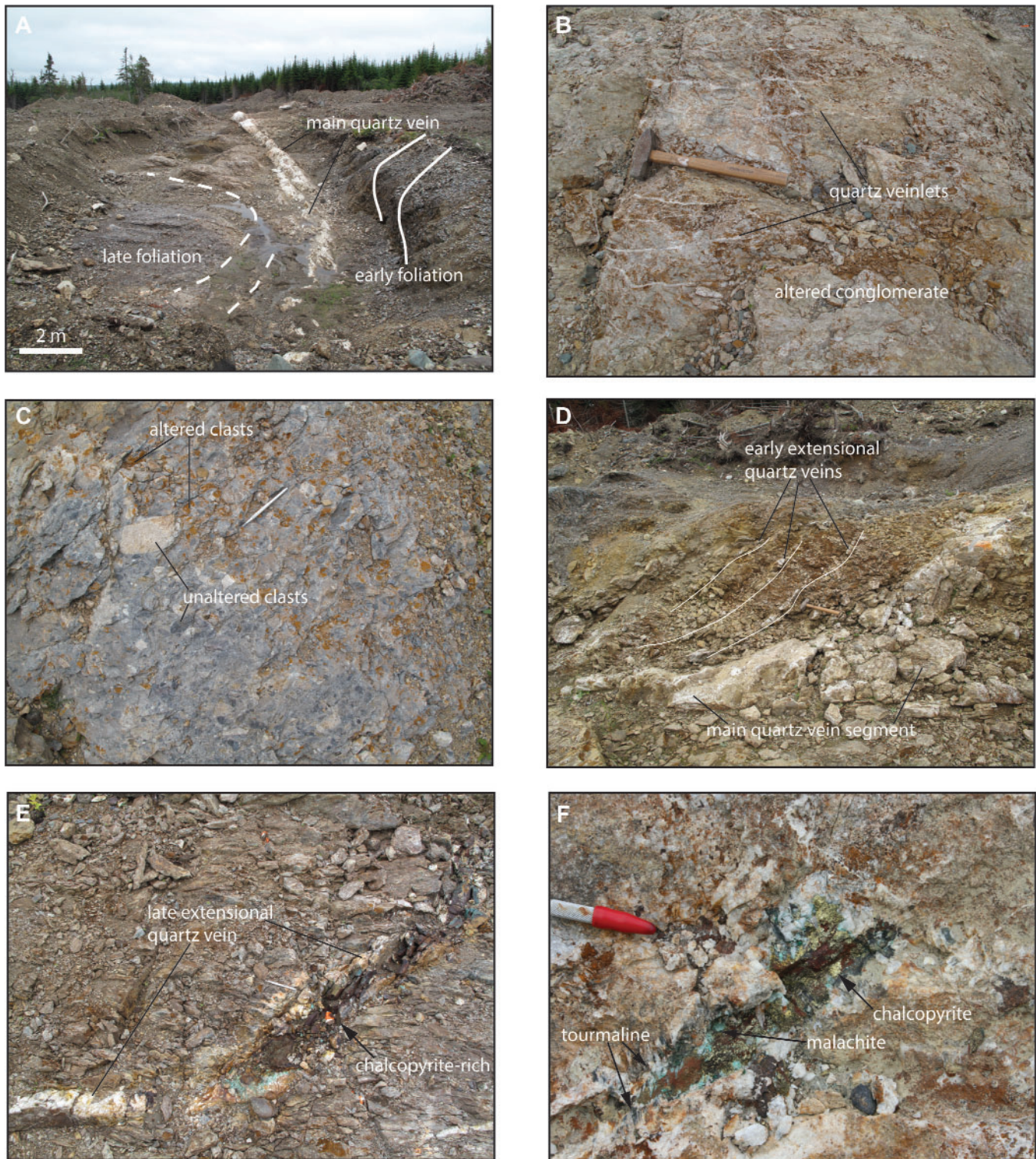
Plate 2. *Field photographs, Elm Zone. A) View toward the northeast of the main quartz vein cutting deformed Rogerson Lake Conglomerate; B) Strongly altered conglomerate with quartz veinlets; C) Moderately to weakly altered conglomerate displaying local carbonate alteration of clasts; D) View toward the east of early, moderately dipping extensional quartz veins; E) View toward the south of late, steeply dipping extensional quartz vein with chalcopyrite and secondary malachite. Vein cuts deformed conglomerate. Hand magnet above vein for scale; F) Vuggy quartz, tourmaline, chalcopyrite, and secondary malachite in late extension fracture. Red pen is pointing north.*

and/or siderite alteration, whereas fine-grained muscovite (sericite) is likely responsible for the waxy luster in altered conglomerate.

Primary bedding is locally preserved as sub-metre-scale sandy layers in the conglomerate that typically strike subparallel to foliation (Figure 5B). At least two generations of foliations are preserved in the conglomerate. The older generation is well-preserved in the hanging wall of the main vein, and typically strikes to the east-southeast and dips steeply toward the south-southwest (Figure 5B). Deflection and shallowing of this foliation into the main vein is consistent with oblique sinistral shear and a component of thrusting toward the north-northeast. The younger, crosscutting foliation defines a spaced cleavage in the conglomerate that typically dips shallowly to the northeast and southeast, and is locally well-developed in the altered footwall of the main vein. Where both foliations are present, the two form an intersection lineation that plunges shallowly to the southeast.

The deformed conglomerate is cut by the main vein, which defines the main shear plane. Along the sheared contact with hanging-wall conglomerate, the main vein displays slickenlines plunging moderately toward the south-southwest (Figure 5A). These linear features are also compatible with oblique thrust motion toward the north-northeast (Figure 5A). Stacked, deformed extensional quartz veins (V_1) consistent with sinistral shearing occur within strongly altered conglomerate surrounding the main vein (Figure 4). These extension veins dip moderately to shallowly to the southeast and east-northeast (Plate 2D and Figure 5C), and are locally folded into open to tight reclined folds that plunge moderately to the southeast (Figure 5B). The axial planes of such folds are subparallel to the main quartz vein (Figure 5B), and the fold geometries are consistent with drag folding during progressive oblique reverse shearing. A late, steeply dipping set of extensional quartz veins (V_2) cuts the moderately dipping extensional vein set and also the main quartz vein (Figures 4 and 5C and Plate 2E). This younger vein set is richer in chalcopyrite, tourmaline, and secondary malachite than the older vein set, with chalcopyrite filling vuggy spaces in the centre of the veins (Plate 2E). Locally, another late set of steep extensional quartz veins (V_3) displaying asymmetry consistent with dextral motion cuts the main quartz vein and early foliation. Steeply dipping sets of nearly conjugate extension fractures cut the main vein and both generations of extension veins (Figures 4 and 5D). The fracture set that dips moderately toward the northwest (Plate 2F) is very tightly spaced in portions of the main vein and usually contains vuggy quartz, chalcopyrite, malachite ± tourmaline ± pyrite ± hematite ± goethite ± bismuth–tellurium sulphide(s), based on reconnaissance X-ray diffraction and SEM studies. These particular fracture planes form local intersection lineations on the main quartz

vein that are subparallel to slightly oblique to the displacement vectors (slickenlines). A ~1.8-m-wide, carbonate-altered mafic dyke that occurs ~200 m northwest of the Elm Zone (Figure 2B) also displays a moderately northwest-dipping orientation (Figure 5D). The youngest planar structures observed in the Elm Zone are very late, weakly developed fracture sets that parallel both the early foliation and laminations in the main quartz vein.

KINEMATICS−ELM ZONE

The overall coherent geometry of the quartz vein system and relatively consistent mineralogy of the different vein sets is compatible with one progressive deformation cycle. The conglomerate-hosted quartz vein system of the Elm Zone defines an oblique sinistral contractional shear zone that accommodated north to north-northeast-directed shearing of the hanging wall relative to the footwall (Figure 6). Brittle overprint of earlier ductile shear structures suggests that progressive deformation may have occurred in the upper crust during exhumation of the conglomerate across the brittle–ductile transition, a depth of ~10 km based on experimentally derived flow laws (*e.g.*, Gleason and Tullis, 1995).

The main gold-bearing quartz vein and associated extensional structures cut sheared conglomerate, implying that shearing was initiated prior to emplacement of the main vein. Thickness variations in the main vein are compatible with deposition of silica-rich fluids in semi-brittle dilatational jogs that formed during sinistral, reverse shearing. Folding of stacked extension veins (V_1) where the main vein is thinnest in the northeast of the trench supports progressive compressional semi-ductile deformation. The late, brittle, steep crosscutting vein set (V_2) and late, shallow foliation suggest rotation of the maximum principal stress (σ_1) to subvertical, potentially reflecting vertical shortening related to structural collapse or a transient phase of syn-orogenic extension. The local occurrences of late, steep veins with dextral asymmetry (V_3) may reflect a late episode of localized transpression. Although the late sets of extension fractures crosscut most veins, their geometries suggest that they may have formed under a similar state of stress as the late vein sets. The abundance of chalcopyrite, malachite, and ankerite–siderite in the extensional veins and fractures suggests that Cu^{2+} and CO_2, and likely Au, were mobilized multiple times during deformation of the main vein system.

GEOCHRONOLOGICAL IMPLICATIONS

Considering the Silurian tectonic evolution of the Exploits Subzone (Dunning *et al.*, 1990; Williams *et al.*, 1993; O'Brien, 2003; van Staal *et al.*, 2014), deformation in the Elm Zone may have spanned Late Silurian to Early
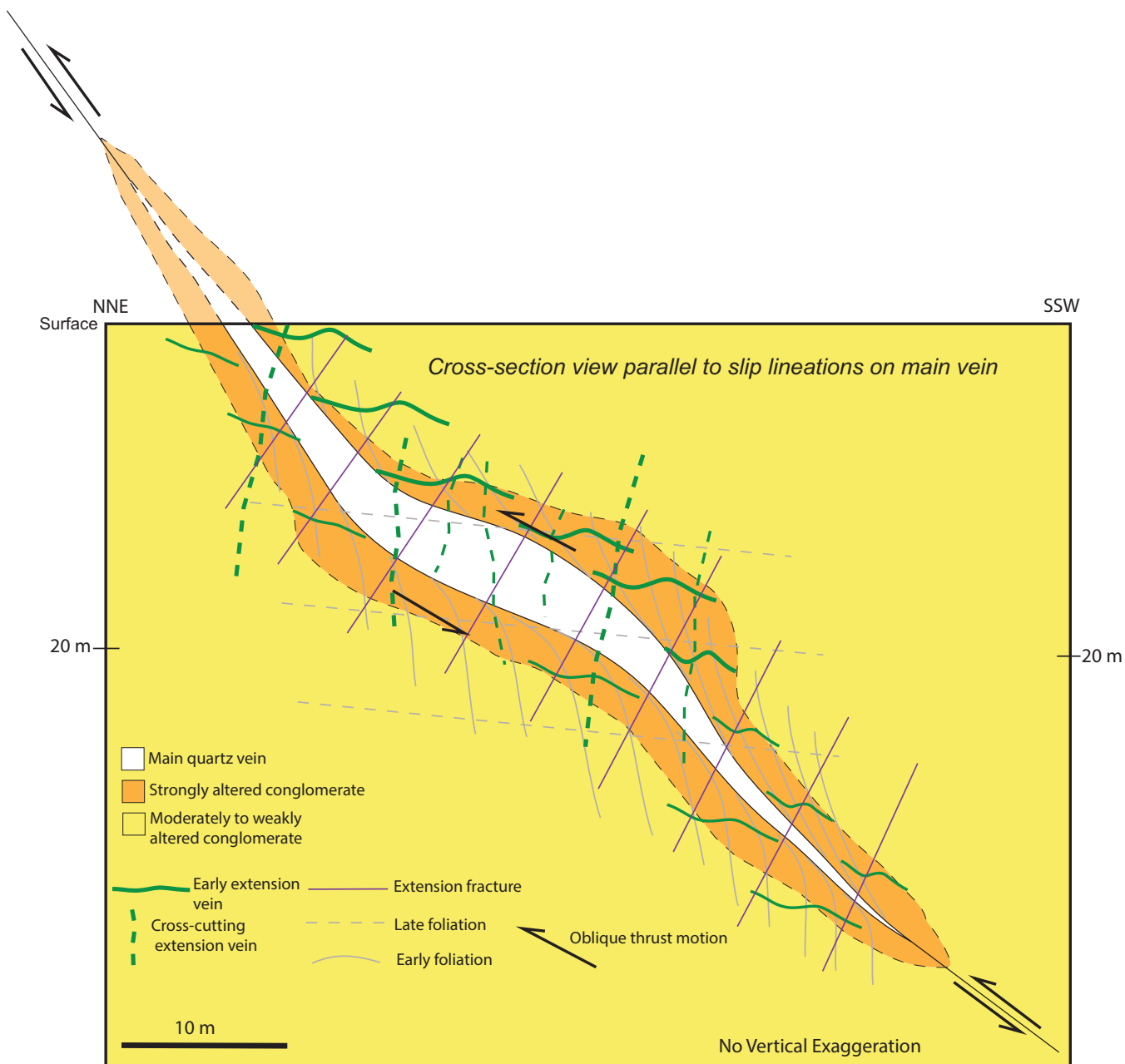
Figure 6. *Structural cross-section interpretation of the main quartz vein of the Elm Zone, with structural data superimposed. Black arrow describes sense of oblique sinistral thrust motion. The vuggy quartz–chalcopyrite-rich extension fracture set (bold purple lines in Figure 5D) is not shown because these fracture planes are subparallel to the cross-sectional slice.*

Devonian times. Regionally, deformed sedimentary rocks and locally deformed magmatic rocks of the Botwood Group disconformably overlie *ca.* 433 Ma and older sedimentary rocks of the Badger Group, which were first deformed during the earliest phase of Salinic deformation (van der Pluijm *et al.*, 1993; O'Brien, 2003). The Badger–Botwood Group unconformity is interpreted to represent a time gap of at least 7 m. y (433–426), and is inferred to correspond to the main phase of Salinic deformation (van

Staal *et al.*, 2014). On this basis, folding of Rogerson Lake Conglomerate, the apparent stratigraphic base unit of the Botwood Group at Wilding Lake soon after deposition may have been initiated in the Ludlovian (late Salinic) by *ca.* 425 Ma, and progressed during emplacement of the Stony Lake volcanic rocks (Figure 2A) at *ca.* 423 Ma (Dunning *et al.*, 1990; McNicoll *et al.*, 2008) and the granitoid rocks of the Mount Peyton intrusive suite between 425 and 418 Ma (Sandeman *et al.*, 2017). Constraining the crystallization age

of a presently undated, largely undeformed, locally brecciated monzonite body at Paradise Lake (Figure 2A) may help to define a minimum age of Late Silurian–Early Devonian deformation in central Newfoundland.

The oblique sinistral north-northeast-directed contractional shear component of deformation in the Elm Zone is compatible with Late Silurian–Early Devonian oblique sinistral transpression documented elsewhere along northeast-trending shear zones within the central Newfoundland gold district (*e.g.*, O'Brien, 1993, 2003; Dubé *et al.*, 1996). Such movement along the Cape Ray fault zone (Figure 1) occurred at *ca.* 415 Ma based on a metamorphic monazite age (Dubé *et al.*, 1996), whereas intrusive relationships along the Bay d'Est and Cinq Cerf fault zones (Hope Brook gold deposit, Figure 1) constrain such motion to *ca.* 420 Ma (O'Brien *et al.*, 1991). Northeast-trending shear zones in central Newfoundland similar to the Elm Zone are interpreted to have accommodated sinistral transpression during early Acadian north–south shortening (Currie and Piasecki, 1989; Hibbard, 1994). The onset of subsequent brittle overprint, including late-stage subhorizontal extension, and coeval vein formation in the Elm Zone may have roughly coincided with deformation in Late Silurian–Early Devonian sedimentary rocks near the Dog Bay Line (415–410 Ma, McNicoll *et al.*, 2006), with minor components of dextral transpression potentially late Early Devonian or younger in age (*e.g.*, Currie and Piasecki, 1989; Dubé *et al.*, 1996). Considering the abundance of unaltered and altered sulphide minerals in the late brittle vein and fracture sets of the Elm Zone, the age of gold mineralization may be Early Devonian or younger. This is compatible with a preliminary 411 Ma age of hydrothermal rutile from a gold-bearing extensional quartz vein at Valentine Lake (Dunsworth and Walford, 2018).

CONCLUSIONS

The field data documented herein confirm that Antler Gold Inc.'s Elm Zone mineralization and related veins represents a structurally controlled gold-bearing quartz vein system that is likely an extension of the well-endowed Valentine Lake structure to the southwest. However, whereas mineralization at Valentine Lake occurs in the structural hanging wall of the Valentine Lake thrust zone, mineralization at Wilding Lake occurs in the structural footwall of the thrust zone. Footwall gold mineralization in association with syn-orogenic clastic sedimentary rocks bears close resemblance to the major gold-bearing structures of the Abitibi greenstone belt (*see* Bleeker, 2015). Deeper drillholes into Rogerson Lake Conglomerate on the Antler property will be important for determining its full economic potential, as rigid plutonic rocks, which are rheologically favourable for gold-bearing fluid entrapment, have been observed in drill-core to structurally underlie the conglomerate at Wilding Lake (Antler Gold Inc., press release, December 13, 2017). Future exploration and drilling in the Wilding Lake region might target both hanging wall and footwall rocks, particularly in rheologically competent, chemically reactive host rocks, both at depth on site and farther northeast along the extension of the Valentine Lake thrust.

ACKNOWLEDGMENTS

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