Vein-hosted gold mineralization in the Wilding Lake area, central Newfoundland: Structural geology and vein evolution

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ABSTRACT

Crustal-scale fault zones in central Newfoundland are being recognized as significant gold-mineralized structures. In particular, a northeast-trending structural corridor in the eastern Dunnage Zone (Exploits subzone), delineated by the Rogerson Lake Conglomerate, contains highly prospective vein-hosted gold deposits. Such mineralized vein systems, exposed near Valentine Lake (Marathon Gold Corp.) and Wilding Lake (Antler Gold Inc.), are products of progressive Paleozoic deformation and fluid-pressure cycling along crustal-scale faults that cut the Late Silurian to Early Devonian Rogerson Lake Conglomerate and underlying Neoproterozoic basement rocks. Well exposed, gold-bearing quartz-vein systems in the Wilding Lake area reveal a kinematic history that involved a main phase of reverse sinistral shearing and subsequent transient phases of horizontal extension, oblique compression, and, at least locally, components of late dextral strike-slip. High-grade gold mineralization is associated with siderite-ankerite-sericite alteration of the host rocks, structurally controlled quartz-vein emplacement, and supergene alteration of pyrite and chalcopyrite. Gold-bearing vein sets contain quartz, pyrite, chalcopyrite, tourmaline, native gold, Ag-poor electrum, bismuth-silver-gold tellurides, rutile, and secondary goethite, malachite, and acanthite. Prospective gold exploration targets in the Wilding Lake area are Late Silurian feldspar porphyry and felsic volcanic rocks overlying the Rogerson Lake Conglomerate, as well as, rheologically favourable Neoproterozoic basement granitoids that may provide a setting similar to that at Valentine Lake.

INTRODUCTION

The eastern Dunnage Zone of central Newfoundland is an area of active gold exploration because structurally controlled gold mineralization occurs predictably for more than 200 km along major northeast-trending fault structures (Fig. 1). The gold-bearing structural corridor includes the Cape Ray gold deposit in southwestern Newfoundland (Dubé and Lauzière, 1997), as well as the developing gold deposit at Valentine Lake in central Newfoundland (Lincoln et al., 2018). Numerous epigenetic gold showings and prospects along strike from Valentine Lake (*see* Evans, 1996), including the Wilding Lake gold prospect (this study), demonstrate the potential for additional structurally controlled gold deposits along trend of the Victoria Lake shear zone and in the vicinity of the Dunnage Zone – Gander Zone boundary in central Newfoundland (Fig. 1).

Structurally controlled gold mineralization in the Wilding Lake area is concentrated within quartz shear vein systems that cut Late Silurian to Early Devonian polymict conglomerate (Rogerson Lake Conglomerate) and associated Late Silurian felsic and mafic igneous rocks. Two exploration trenches that partially represent the Wilding Lake gold prospect (e.g. Honsberger et al., 2019a), the Alder and Elm zones, were mapped in detail during the summer of 2018 as part of Natural Resources Canada's Targeted Geoscience Initiative. This contribution and a supplementary Open File report (Honsberger et al., 2020a) present lithological and structural data from the Wilding Lake gold prospect to constrain the local structural geology and quartz vein evolution and provide a basis for future targeted exploration in the region. The results of this ongoing research demonstrate that the Paleozoic structural architecture of the emerging gold district in central Newfoundland bears strong similarity to world-class, orogenic Archean gold systems, such as in the Abitibi greenstone belt (e.g. Bleeker, 2015; Honsberger and Bleeker, 2018).

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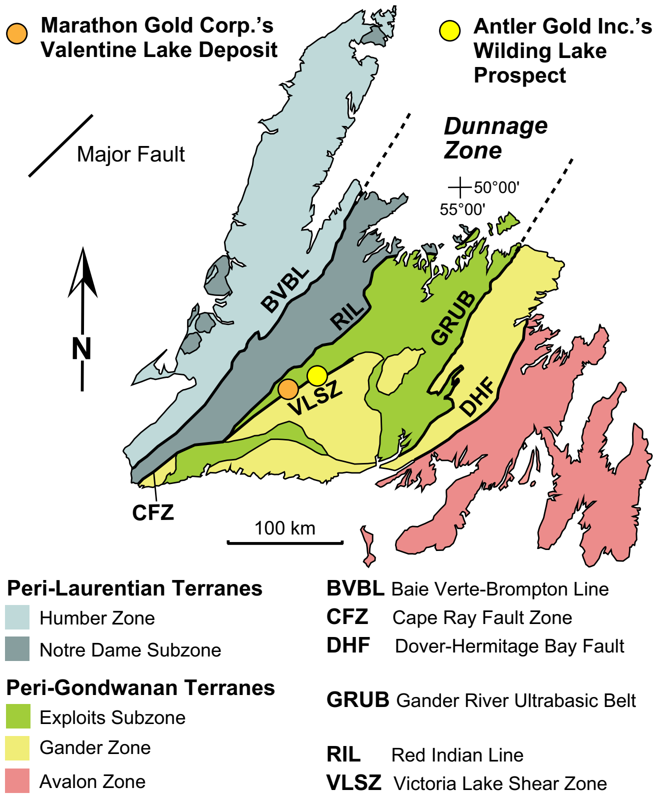


Figure 1. Generalized geological map of the Newfoundland Appalachians showing the distribution of pre-Silurian tectonostratigraphic zones and the locations of Marathon Gold Corp.'s Valentine Lake gold deposit and Antler Gold Inc.'s Wilding Lake gold prospect. Map *adapted from* Colman-Sadd et al. (1990) and Hibbard et al. (2006).

The supplementary Open File report (Honsberger et al., 2020a) that accompanies this Targeted Geoscience Initiative volume consists of two poster sheets that allow for enlargement and full viewing of the trench maps. Poster Sheet 1 of 2 presents a geological and structural overview of the Wilding Lake gold prospect and includes a detailed trench map and discussion of the smaller Alder Zone. Poster Sheet 2 of 2 presents a detailed trench map of the Elm Zone and summarizes the geological and structural features thereof. Readers are referred to the supplementary Open File report (Honsberger et al., 2020a) for a comprehensive lithological and structural synthesis of the Wilding Lake gold prospect in central Newfoundland.

GEOLOGICAL SETTING

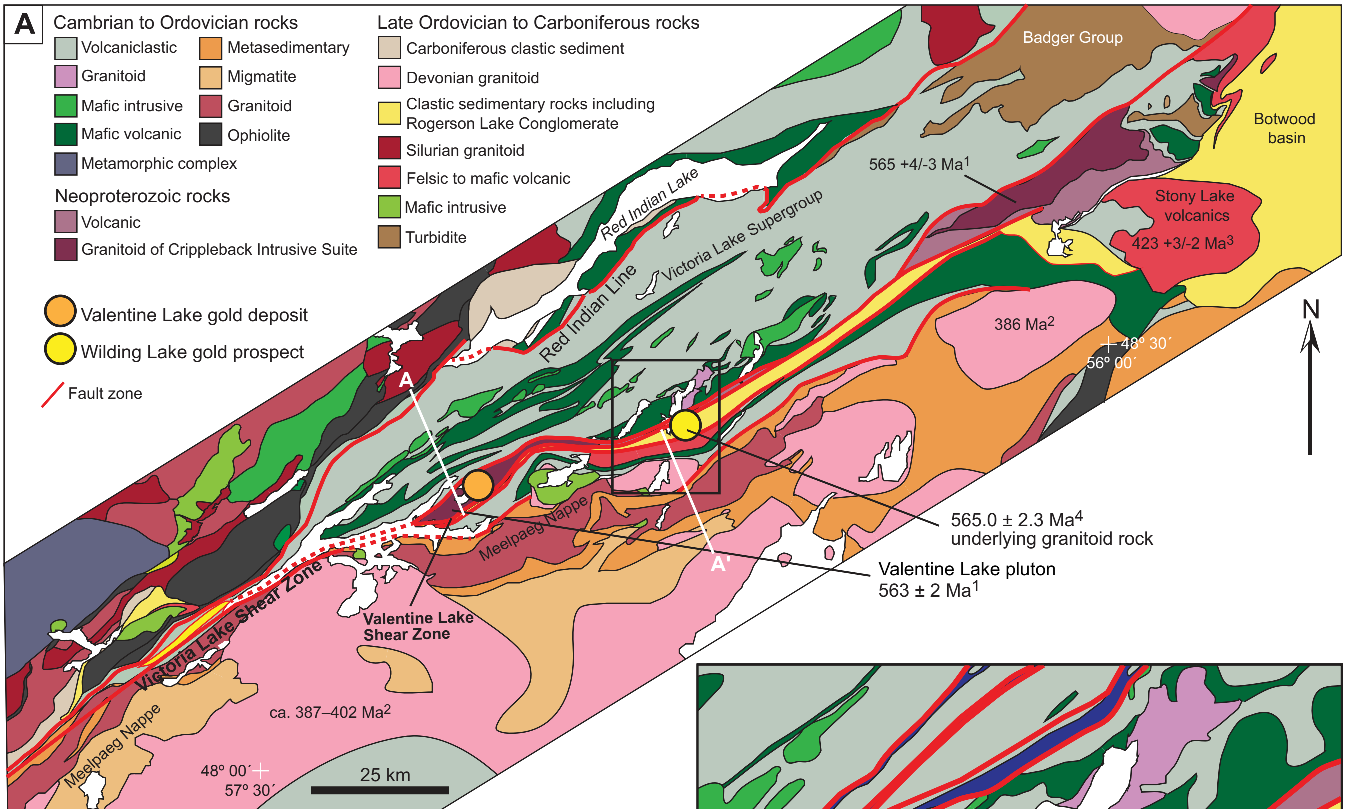
The Island of Newfoundland (Fig. 1) occupies the northeastern portion of the northern Appalachian Orogen in Canada, which is subdivided into tectonostratigraphic zones based on geological, paleontological, and geochemical contrasts in pre-Silurian rocks (Williams, 1978). The Humber Zone underlies western Newfoundland and consists of basement and cover rocks of the early Paleozoic Laurentian margin. The Dunnage Zone spans central Newfoundland and consists of accreted peri-Laurentian (Notre Dame subzone) and peri-Gondwanan (Exploits subzone) arc terranes, juxtaposed along a major east-verging fault zone, the Red Indian Line (Williams et al., 1988). The Notre Dame subzone contains magmatic arc rocks that intruded the paleogeographically low-latitude microcontinent of Dashwoods (Waldron and van Staal, 2001). The Exploits subzone comprises Cambrian to Ordovician continental and oceanic arc- and back-arc complexes derived from Ganderia at higher latitudes on the opposite side of the Iapetus Ocean from the Dashwoods microcontinent and Laurentia (Williams et al., 1988; van Staal et al., 1998; Zagorevski et al., 2007). The Gander and Avalon zones represent peri-Gondwanan microcontinental fragments, accreted, respectively, to composite Laurentia during the Silurian to Early Devonian Salinic and Devonian Acadian orogenies (Dunning et al., 1990; van Staal and Barr, 2012; van Staal et al., 2014).

Structurally controlled, orogenic gold deposits in Newfoundland are associated with crustal-scale fault zones within, and along the boundaries of, the Dunnage Zone (Fig. 1). The major fault zones include, from west to east, Baie Verte-Brompton Line (Williams and St. Julien, 1982), Cape Ray fault zone (Dubé et al., 1996; van Staal et al., 1996), Red Indian Line (Williams et al., 1988), and Victoria Lake shear zone (Fig. 1; Valverde-Vaquero et al., 2006). The Cape Ray fault zone separates the Notre Dame subzone from the Exploits subzone in southwestern Newfoundland and, hence, correlates with the Red Indian Line farther to the northeast. The Victoria Lake shear zone is a splay of the Cape Ray/Red Indian Line fault system and separates Dunnage Zone from Gander Zone rocks in central Newfoundland (Fig. 1, 2a; Valverde-Vaquero and van Staal, 2001; Valverde-Vaquero et al., 2006). Key marker lithologies and gold exploration targets along the strike length of the Victoria Lake fault corridor are panels of Late Silurian to Early Devonian synorogenic Rogerson Lake Conglomerate and associated volcanic and plutonic rocks that nonconformably overlie and intrude faulted and imbricated basement terranes of Ganderia (e.g. Dubé et al., 1996; van Staal et al., 1996). The largest known gold deposit in Newfoundland is hosted by Neoproterozoic basement granitoid rocks at Valentine Lake (Valentine Lake pluton of the Crippleback Intrusive Suite: Evans et al., 1990; Rogers et al., 2006) that are juxtaposed against the Late Silurian to Early Devonian Rogerson Lake Conglomerate (Marathon Gold Corp., 2018).

WILDING LAKE GOLD PROSPECT

Exploration History

In 2015, prospecting along new logging roads in the Wilding Lake area (Fig. 2b) led to the discovery of vis-



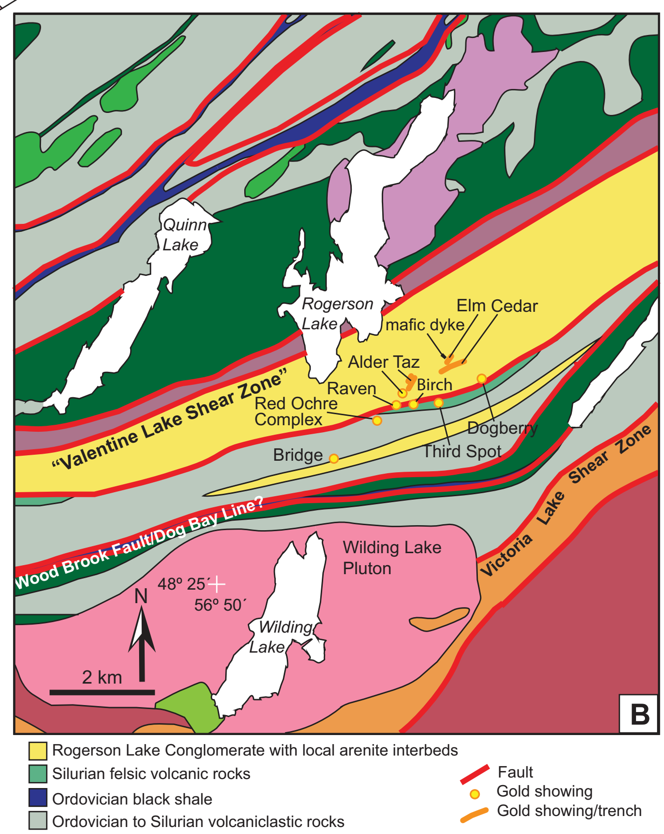


Figure 2. a) Generalized geological map of central Newfoundland, including the gold-mineralized Rogerson Lake Conglomerate belt (yellow sliver), correlative with rocks of the Botwood basin to the northeast. Fault zones are traced by red lines. The traces of the composite cross-section, A-A' (Fig. 3), are shown as white lines. Age data are from Evans et al. (1990)[1], Valverde-Vaquero et al. (2006)[2], Dunning et al. (1990)[3], and Honsberger et al. (2019b)[4]. **b)** Geological map of the Wilding Lake area, with locations and names of gold showings and trenches comprising Antler Gold Inc.'s Wilding Lake gold prospect. Faults are traced by red lines. Complete legend is shown in (a).

ible gold in large quartz boulders. In 2016, additional quartz-tourmaline boulders with visible gold were identified by follow-up prospecting and soil sampling by Altius Resources. In September 2016, Antler Gold Inc. optioned the Wilding Lake property from Altius Resources. Between September 2016 and November 2016, Antler Gold Inc. exposed five new gold showings hosted in the Rogerson Lake Conglomerate (Alder, Taz, Elm, Cedar, and Dogberry zones), as well as three additional showings near the contact with or within felsic volcanic rocks (Birch, Third Spot, and Bridge; Fig. 2b; Antler Gold Inc., 2017a). In 2017, Antler Gold Inc. discovered an additional mineralized zone within feldspar porphyry in contact with the Rogerson Lake Conglomerate. The first phase of channel sampling and drilling was completed by Antler Gold Inc. in 2017, including three drillholes in the Alder Zone and 13 drillholes in the Elm Zone (Antler Gold Inc., 2017b). The Wilding Lake gold prospect includes all of these mineralized zones located in the Rogerson Lake Conglomerate and associated felsic volcanic rocks.

Lithological and Structural Setting

The Wilding Lake gold prospect occurs within a gold-mineralized structural corridor that trends northeast from Cape Ray for more than 200 km across central Newfoundland and includes Marathon Gold Corp.'s Valentine Lake gold deposit (Fig. 1, 2a). The crustal-scale, regional thrust-fault architecture displays a change in vergence from northwest directed to southeast directed across the Dunnage Zone (e.g. O'Brien, 2003), with economic gold mineralization preserved in the Rogerson Lake Conglomerate, felsic igneous rocks, and basement granitoids across the transition in vergence (Fig. 3). The steeply northwest-dipping "Valentine Lake shear zone" juxtaposes mineralized Neoproterozoic granitoids against panels of the Late Silurian to Early Devonian Rogerson Lake Conglomerate that occur in the overall footwall of the Victoria Lake shear zone (Fig. 3). The Victoria Lake shear zone forms the basal thrust of the Early Devonian Meelpaeg metamorphic nappe, which exhumes high-grade rocks of Ganderia and displaces them towards the northwest over lower grade rocks of the Dunnage Zone (Fig. 2, 3; Valverde-Vaquero et al., 2006). The nonconformable contact between basement granitoids and overlying Rogerson Lake Conglomerate at Valentine Lake (Fig. 3) has been referred to as the Valentine Lake thrust fault in previous publications (e.g. Lincoln et al., 2018), implying crustal-scale thrust motion along this contact. We prefer the term "Valentine Lake shear zone" (Fig. 3) because field relationships in the Valentine Lake area do not presently support major thrusting between basement granitoids and the Rogerson Lake Conglomerate (Honsberger et al., 2020b; S. Dunsworth, pers. comm., 2019).

Southeast of the Wilding Lake prospect, the Wood Brook Fault (Valverde-Vaquero et al., 2006) juxtaposes Late Silurian synorogenic sedimentary and volcanic rocks with older volcanic and volcaniclastic rocks of the eastern-most Dunnage Zone; hence, it correlates with the Dog Bay Line (Williams, 1993; Williams et al., 1993) in north-central Newfoundland (Fig. 3). The Dog Bay Line is interpreted to represent the terminal suture of the Iapetus Ocean and is considered to separate Silurian peri-Laurentian cover rocks from Silurian peri-Gondwanan cover rocks (Williams et al., 1993; Pollock et al., 2007). Farther south, the Late Silurian Wilding Lake pluton (*see* Honsberger et al., 2020b) intrudes, at depth, the contact between metasedimentary rocks and granitoids of the Gander Zone and overlying volcaniclastic rocks of the easternmost Dunnage Zone (Fig. 3). The entire panel of rocks, including the Wilding Lake pluton, is buried in the overall footwall of the Victoria Lake shear zone, the first-order structure that exhumed high-grade rocks towards the northwest following peak metamorphism in the earliest Devonian (Dunning et al., 1990; Dubé et al., 1996; Valverde-Vaquero et al., 2006). Northwest of the "Valentine Lake shear zone", metamorphosed and deformed mafic and felsic volcanic rocks (±sedimentary rocks) of the Neoproterozoic to Ordovician Victoria Lake Supergroup are imbricated along a steep, southeast-directed thrust system (Fig. 3; Rogers et al., 2005).

In the Wilding Lake area, Late Silurian to Early Devonian synorogenic sedimentary-volcanic rock sequences nonconformably overlie Neoproterozoic basement granitoids. These upper crustal sequences contain gold-mineralized Rogerson Lake Conglomerate and felsic volcanic rocks, and are spatially associated with altered mafic dykes and Late Silurian granitoid intrusions (e.g. Wilding Lake pluton, Fig. 2, 3). Primary sedimentary structures preserved within the Rogerson Lake Conglomerate sequence, including well bedded sandstone, are consistent with an overall stratigraphic younging direction towards the southeast; however, additional high-precision detrital zircon geochronology is required to determine if the contact between the Rogerson Lake Conglomerate and overlying felsic volcanic rocks is stratigraphic or tectonic (*see* "?" on Fig. 3). High-precision U-Pb chemical abrasion – thermal ionization mass spectrometry (CA-TIMS) zircon dating of tonalite from a drill core sample indicates that the underlying granitoid is 565.0 ± 2.3 Ma (Honsberger et al., 2019b), which correlates with the Neoproterozoic Crippleback Intrusive Suite at Valentine Lake (Valentine Lake pluton, 563.0 ± 2 Ma) and elsewhere in central Newfoundland (Evans et al., 1990; Rogers et al., 2006).

Structurally Controlled Vein Sets

High-grade gold mineralization of the Wilding Lake prospect is associated with at least four generations of structurally controlled vein sets that cut the Rogerson Lake Conglomerate, synorogenic volcanic and plutonic rocks, altered mafic dykes, and underlying granitoid rocks. The main quartz vein systems exposed by trenching, the Alder (Fig. 4, 5) and Elm zones (Fig. 6), are fault-fill (V_{1b}) and extensional (V_{1a}) vein systems that occur within moderately southeast-dipping reverse sinistral shear zones (Honsberger et al., 2019a). In the Elm Zone, the main fault-fill shear veins (V_{1b}) are up to two metres thick (Fig. 6a) and laminated, and accompanying southeast dipping extensional veins (V_{1a}) that emanate from the main shear veins are well exposed (Fig. 6b, 7). In the Alder Zone, the main shear vein comprises a network of discrete, thin, subparallel, interconnected quartz veins that together form a larger vein that is up to ~1 m thick (Fig. 5b). In both trenches, an early, generally east-west-striking foliation (S_1) in the Rogerson Lake Conglomerate displays sinistral kinematics, as it is rotated counter-clockwise into parallelism with the main fault-fill veins to form S_2 foliation (Fig. 4, 5a, 6a, 7). South-southwest- to south-southeast-plunging slickenlines are consistent with north-northeast- (Elm Zone) to north-directed (Alder Zone) hanging-wall motion along the main fault-fill shear veins (Fig. 5a,e,f, 7). Channel sampling reveals that gold concentrations peak across the main fault-fill

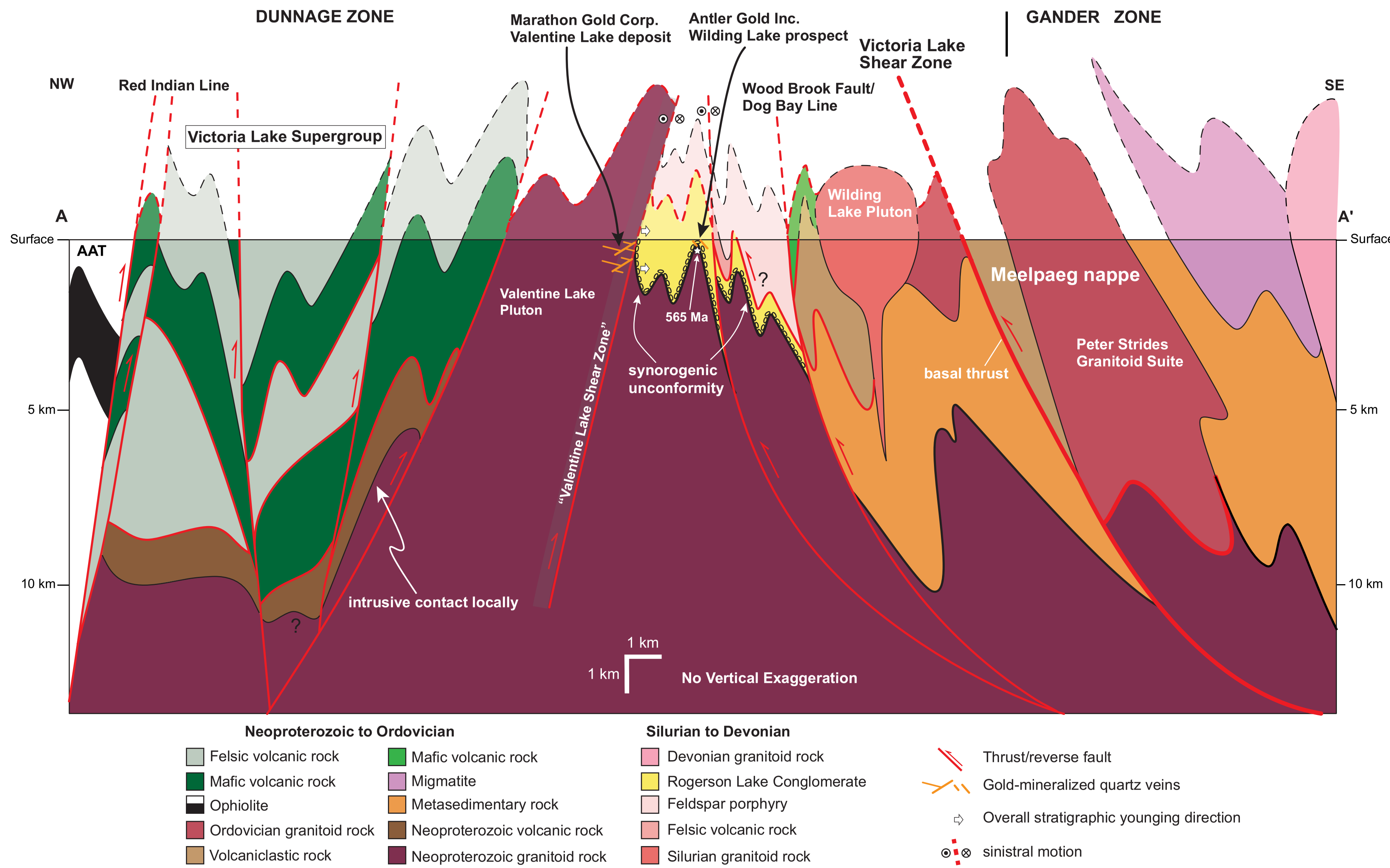


Figure 3. Interpreted composite cross-section representing ~40 km strike length along the gold-mineralized structural corridor between Valentine Lake and Wilding Lake (Fig. 2a), based on field work in the present study, the geological maps of Rogers et al. (2005), Valverde-Vaquero et al. (2005), and van Staal et al. (2005), and the geophysical-based cross-section presented in van Staal and Barr (2012). The section was drawn by "stitching" mineralized rocks of the Valentine Lake pluton with mineralized rocks of the Wilding Lake prospect along the "Valentine Lake shear zone" (thick, grey zone). Antler Gold's Inc.'s Alder and Elm zones (trenches indicated by orange lines) preserve shear vein-hosted gold mineralization in the Rogerson Lake Conglomerate. The underlying tonalite body was sampled between a depth of 296 and 290 m (white star) along a vertical drillhole. U-Pb zircon geochronology constrains the age of this body to 565 ± 2 Ma (Honsberger et al., 2019b). Gold mineralization at both Valentine Lake and Wilding Lake occurs in the overall footwall of the Victoria Lake shear zone, which is highlighted by a thicker red fault line. An overall southeast stratigraphic younging direction of the Rogerson Lake Conglomerate sequence is indicated by the white arrows. Abbreviation: AAT = Annieopsquotch Accretionary Tract

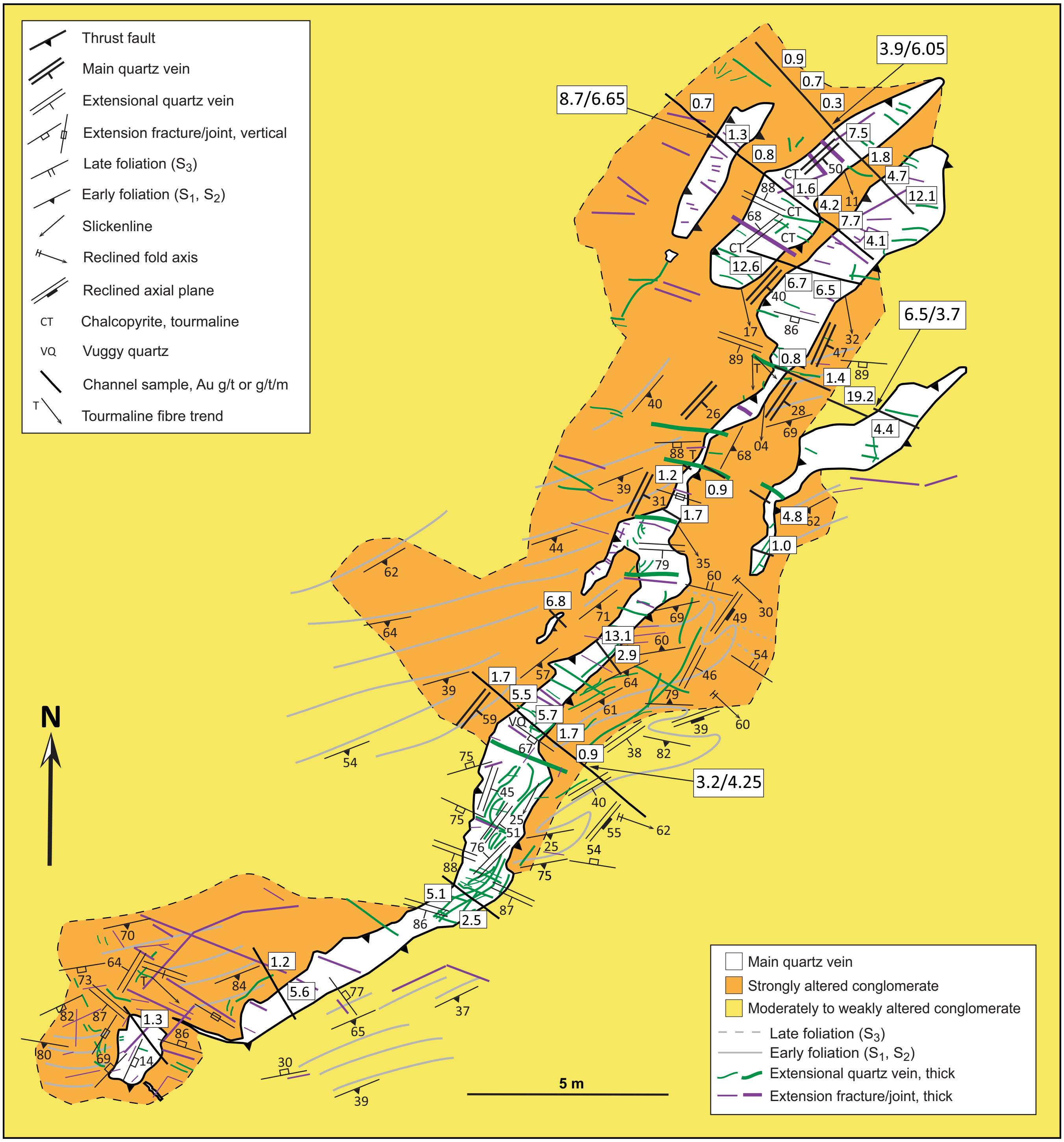


Figure 4. Detailed geological and structural map of the Alder Zone quartz shear vein system. Alteration of conglomerate host rock consists of ankerite-siderite-sericite assemblages. Gold values (grams/tonne/metre), in white rectangles, are from Antler Gold Inc.'s, press release of December 13, 2017.

veins and associated vein sets (Fig. 4), with gold values of up to 19.2 g/t over 0.9 m and 49.92 g/t over 0.98 m for the Alder and Elm zones, respectively (Antler Gold Inc., press release, Jan. 24, 2017).

The main shear vein systems (V_1) are overprinted by steep, generally east-west-striking, mineralized vein sets (V_2 and V_4) and moderately northwest-dipping vein and extension fracture/joint sets (V_3) (Fig. 5–7). In the Alder Zone, steeply south-dipping, tourmaline-bearing V_2 and V_4 vein sets are well developed across the main vein (V_{1b}) and contain less chalcopyrite than V_3 veins (Fig. 5d–f, 7). In the Elm Zone, vertical veins cutting the Rogerson Lake Conglomerate (V_2) contain tourmaline and are exceptionally rich in chalcopyrite

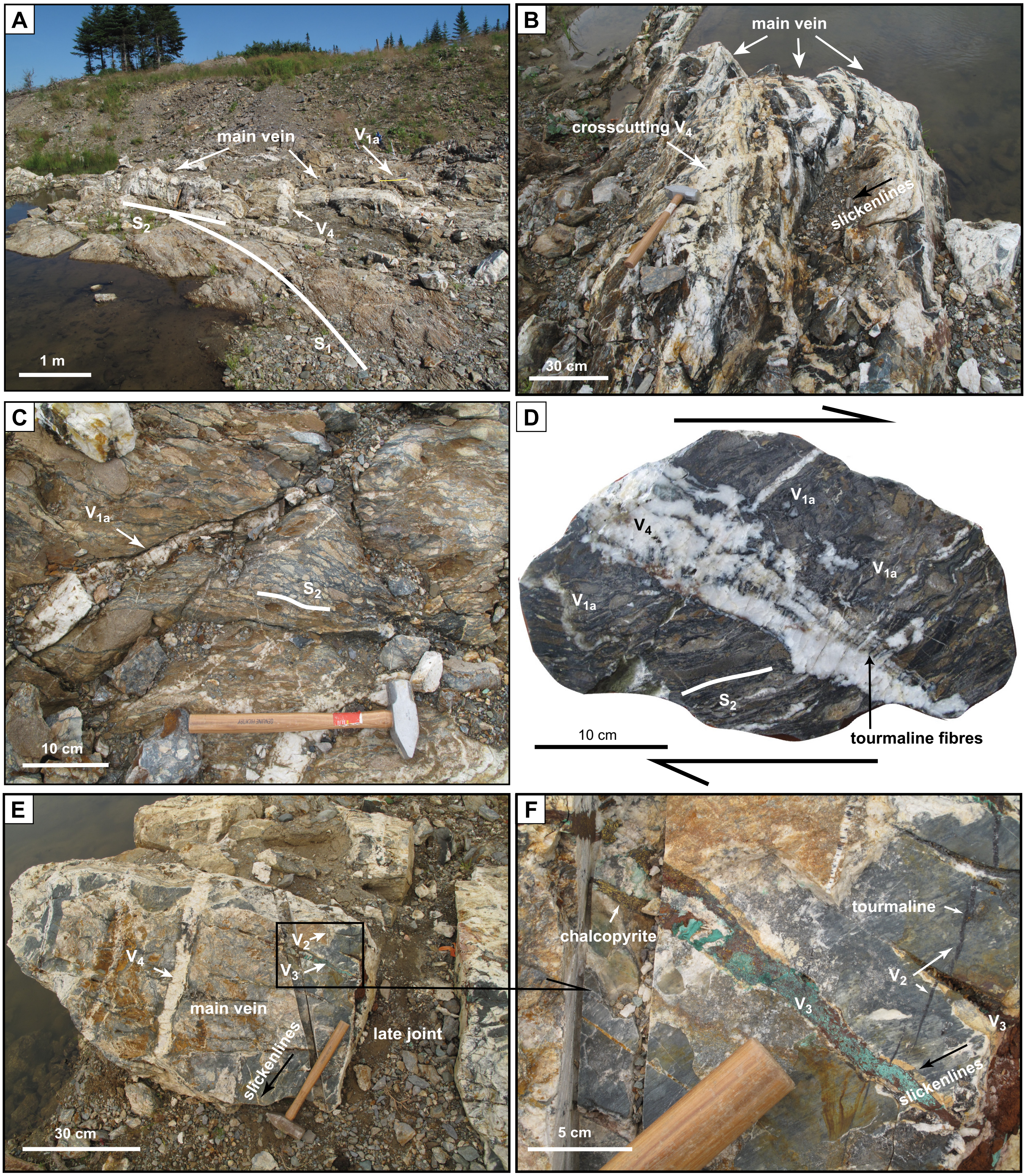


Figure 5. Field and rock photographs of the Alder Zone. *See* Table 1 for definitions of fabric elements (i.e. S_1, S_2, V_{1a}, and V_4) **a)** Main shear vein system, looking east. **b)** Network of fault-fill quartz veins ($V1_b$) comprising the main Alder Zone vein, looking southwest. **c)** Early extensional quartz vein (V_{1a}). **d)** Crosscutting quartz vein (V_4) consistent with dextral motion. **e)** Main Alder Zone vein cut by a chalcopyrite-bearing quartz vein (V_3) and a dextral quartz vein (V_4). **f)** Enlarged rectangular area outline in (e) showing tourmaline veinlets (V_2) cut by chalcopyrite-bearing quartz veins (V_3).

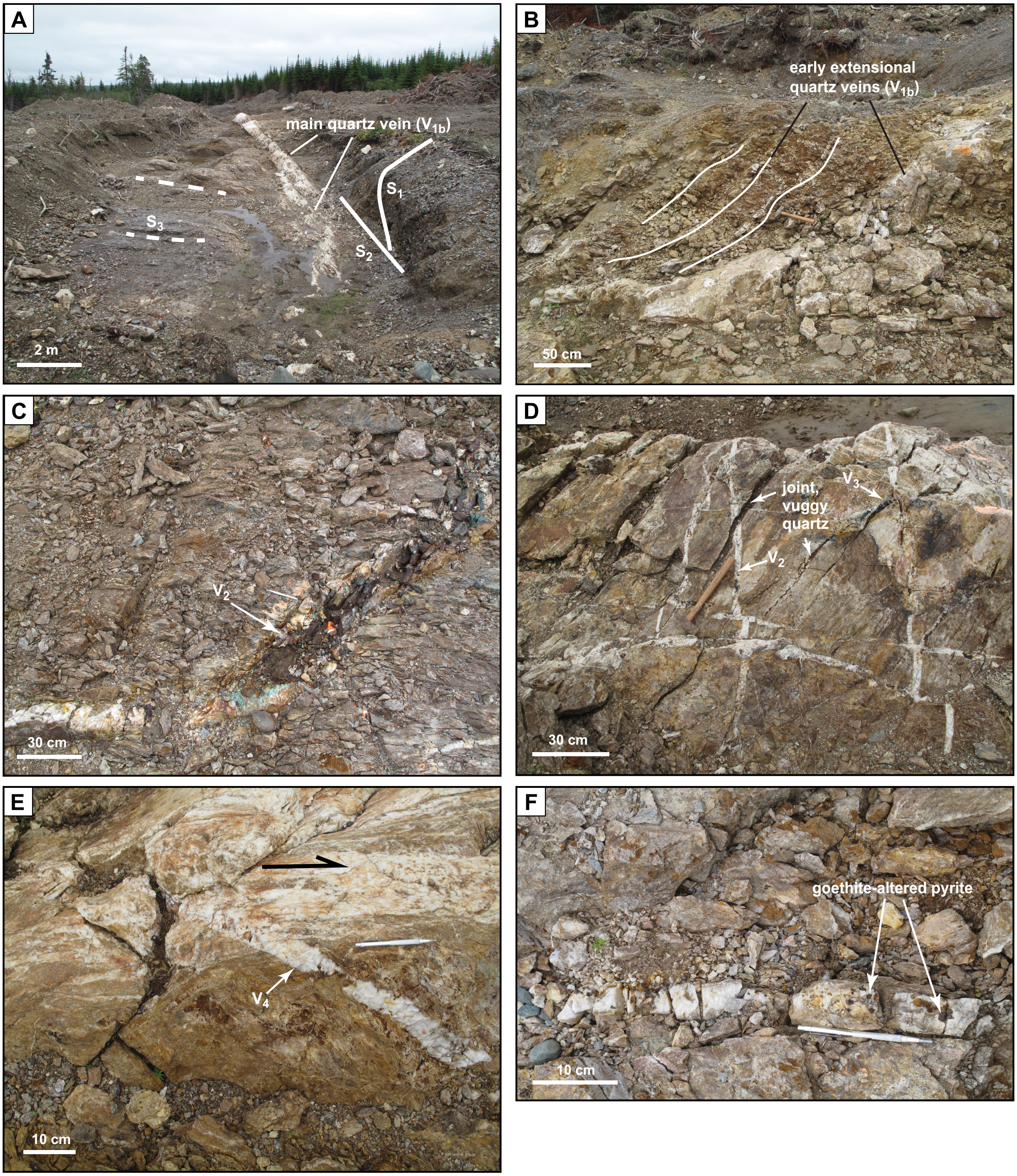


Figure 6. Field photographs from the Elm Zone. *See* Table 1 for definitions of fabric elements. **a)** Main fault-fill quartz vein (V_{1b}). **b)** Early extensional quartz veins (V_{1a}). **c)** Mineralized chalcopyrite-rich vein (V_2) cutting the Rogerson Lake conglomerate. **d)** Main vein cut by a tourmaline-bearing vein (V_2) and joints and V_3 veins filled with vuggy quartz. **e)** Late dextral quartz vein (V_4) cutting strongly altered conglomerate. **f)** Goethite after pyrite in rutile-bearing, dextral quartz vein (V_4). A preliminary U-Pb age of 407 ± 4 Ma has been obtained for rutile recovered from this vein (Honsberger et al., 2020b).

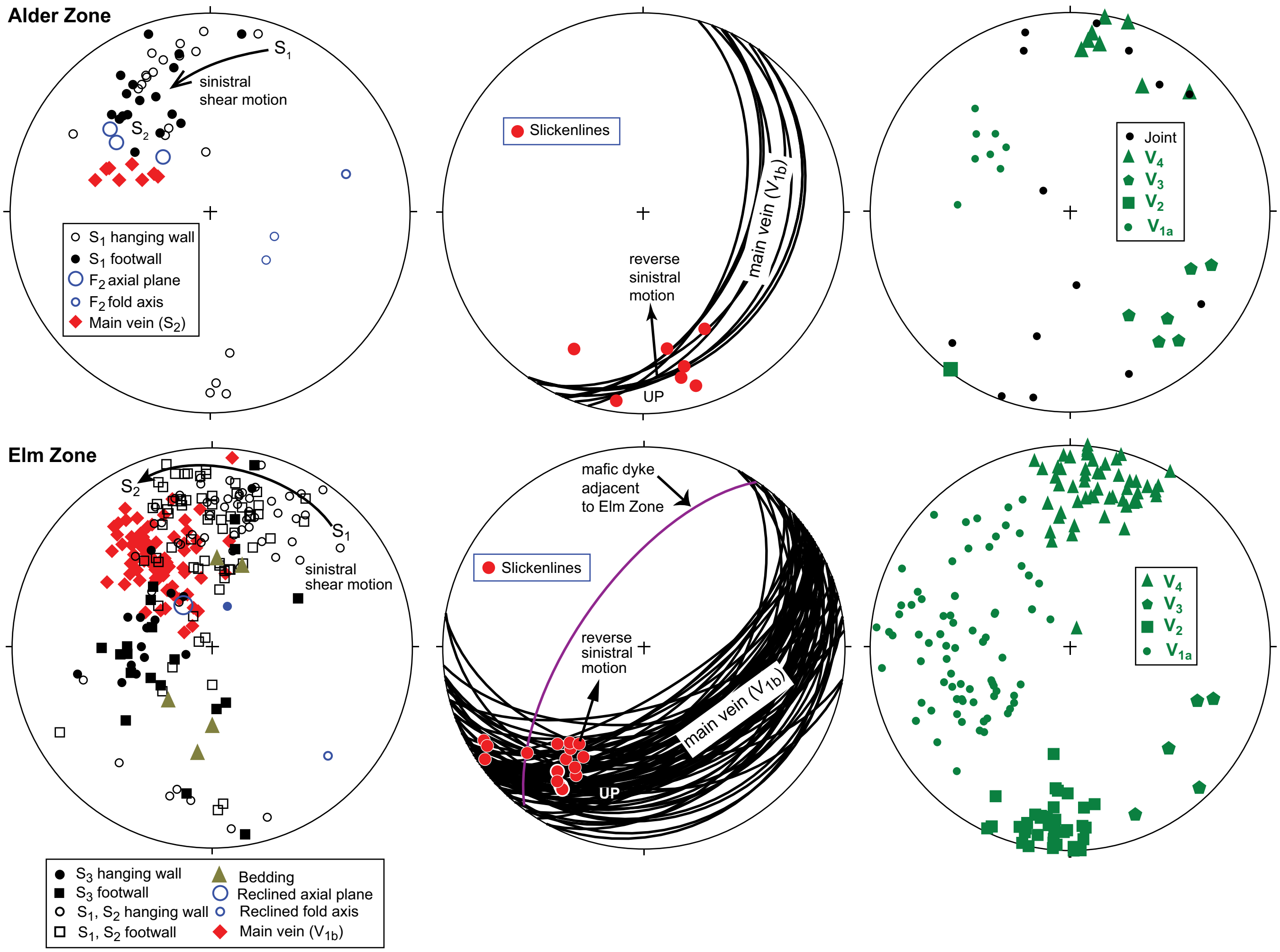


Figure 7. Lower hemisphere equal-area projections of structural elements of the Alder (top row) and Elm (bottom row) zones of the Wilding Lake gold prospect. Poles to planar features have been plotted, with the exception for great circles in the center of the diagrams. The great circles representing the main veins are the compilation of individual vein measurements along different sections of the main quartz veins (V_{1b}). *See* Table 1 for definitions of fabric elements.

Table 1. Summary of deformation phases and quartz vein evolution, Wilding Lake gold prospect, central Newfoundland.

Time	Deformation phase	Fabric element	Tectonic structure	Mechanism of formation
↓	D_1	S_1	East-west-striking early foliation in Rogerson Lake conglomerate	Folding of Rogerson Lake conglomerate and Ganderian basement
	D_2	S_2	Northeast-southwest-striking progressive foliation	Reverse sinistral shearing
		V_{1a}	Initial shallowly dipping extension veins	Reverse sinistral shearing
		V_{1b}	Main shear vein	Reverse sinistral shearing
	D_3	V_2	Northwest-southeast-striking vertical extension veins	Transient horizontal extension
	D_4	V_3	Southwest-northeast-striking extension veins, fracture/joints cutting main vein and mafic dyke	Oblique compression
	D_5	V_4	East-west-striking vertical extension veins	Local dextral strike-slip
	D_6	S_3	Shallowly dipping cleavage	Vertical compression and reclined to recumbent folding

(Fig. 6c), and coarse-grained vuggy quartz occurs with chalcopyrite in crosscutting V_3 vein and fracture sets (Fig. 6d). Adjacent to the Elm Zone, an altered mafic dyke (Fig. 2b) containing chloritoid is oriented subparallel to V_3 veins. Late, steep veins displaying dextral asymmetry (V_4) occur throughout the Alder Zone (Fig. 5d,e) and Elm Zone (Fig. 6e,f) trenches, and locally contain rutile crystals large enough for U-Pb dating (*see* Honsberger et al., 2020b). A shallowly dipping cleavage (S_3) defines the axial planes of locally developed, reclined to recumbent folds that overprint all the structures.

Structurally controlled, vein-hosted gold mineralization is associated with siderite-ankerite-sericite alteration of the Rogerson Lake Conglomerate, felsic volcanic rocks, and mafic dykes, and supergene alteration of pyrite and chalcopyrite in quartz veins. Gold-mineralized vein sets are composed of quartz, pyrite, chalcopyrite, tourmaline, native gold, Ag-poor electrum, bismuth-silver-gold-tellurides, rutile, and secondary goethite, malachite, and acanthite.

DISCUSSION

Evolution of Quartz Veins and Structures

The Wilding Lake gold prospect is characterized by at least six phases of deformation and four generations of structurally controlled quartz vein sets (Table 1). The first phase of deformation (D_1) involved regional folding and the development of an early, east-west-striking foliation (S_1) in the Rogerson Lake Conglomerate. Subsequently, progressive reverse sinistral shearing (D_2) of the Rogerson Lake Conglomerate resulted in the formation of northeast-southwest-striking S_2 foliation and crystallization of the main shear vein systems (V_{1a} and V_{1b}) exposed in the Alder and Elm zone trenches. Foliation attitudes (S_1 and S_2) of the Rogerson Lake Conglomerate exposed in the Alder and Elm zone trenches, combined with south-southwest- to south-southeast-plunging slickenlines on the main shear veins (V_{1b}), are consistent with overall north-directed motion of the hanging-wall conglomerate, with subparallel S_2 foliation and V_{1b} vein surfaces representing the main shear planes in both trenches (Fig. 8).

In this model, involving progressive shearing along a moderately dipping fault plane (Fig. 8), relatively flat-lying extensional veins (V_{1a}) form immediately prior to, and during, the formation of the main fault-fill veins (V_{1b}) (e.g. Robert and Brown, 1986). Numerous laminations in the main quartz shear vein (V_{1b}) of the Elm Zone and the composite nature of the main quartz vein (V_{1b}) of the Alder Zone (Fig. 6b) imply multiple fluid cycles and associated quartz crystallization. The fault-fill and extensional quartz vein systems of the Alder Zone (Fig. 4) and Elm Zone (*see* Honsberger et al., 2020a) trenches are consistent with a "fault-valve" model for orogenic gold mineralization, which attributes gold-bearing fluid transport and quartz vein formation to earthquake-induced fluid-pressure cycling across the brittle-ductile transition (Sibson et al., 1988).

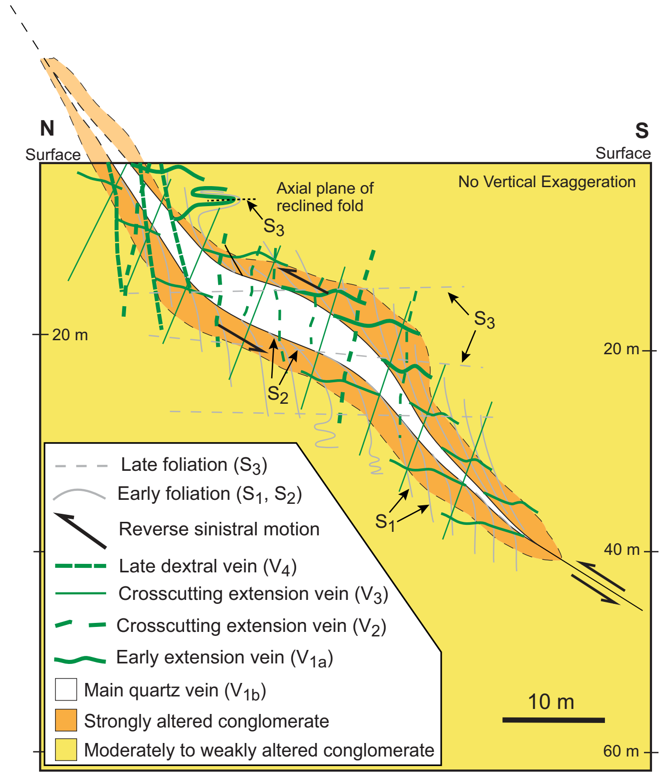


Figure 8. Synthesized, schematic cross-sectional slice through the main shear vein systems and overprinting vein sets, Wilding Lake gold prospect. The plane of the section is oriented subparallel to the overall average reverse sinistral slip vector (slickenlines) in the Alder Zone, which varies locally from south-southwest plunging to south-southeast plunging (Fig. 7). Reverse sinistral shear motion in the Elm Zone is directed towards the north-northeast.

Three distinct vein sets (V_2, V_3, and V_4), each corresponding to different phases of deformation, overprint the main vein systems (V_{1a} and V_{1b}) of the Wilding Lake gold prospect (Table 1). Steep, tourmaline- (Fig. 5e,f) and/or chalcopyrite-bearing veins (V_2, Fig. 6c) indicate transient phases of local horizontal extension (D_3), whereas younger, moderately to steeply dipping extensional veins (V_3, Fig. 5e,f, 6d) are consistent with local extension resulting from oblique compressional deformation (D_4). The attitude of an approximately 1.8 m wide, northeast-trending, altered mafic dyke that occurs northwest of the Elm Zone is subparallel to V_3 veins (Fig. 2b, 7); therefore, V_3 veins may have formed at the same time as intrusion of the mafic dyke. In both the Alder Zone and Elm Zone trenches, steeply south-dipping veins (V_4, Fig. 5d, 6e) display asymmetry that is consistent with local dextral strike-slip motion (D_5). Shallowly dipping, axial planar cleavage (S_3), best developed in the most schistose rocks, implies a late phase of vertical compression and associated reclined to recumbent folding (D6, Table 1).

The deformation history and vein evolution of the Wilding Lake gold prospect in central Newfoundland are attributed to progressive tectonics during latest Silurian to Early Devonian orogenesis (*see* Honsberger et al., 2020b). The main phase of reverse sinistral shearing and quartz vein formation in the Alder Zone and Elm Zone trenches (D_2, Table 1) likely post-dates latest Silurian synorogenic magmatism in the eastern Dunnage Zone (*see* Honsberger et al., 2020b), as latest Silurian felsic volcanic rocks of the Wilding Lake prospect are displaced along Early Devonian thrust faults associated with exhumation of Gander Zone rocks (Valverde-Vaquero et al., 2006; Fig. 3). A preliminary U-Pb rutile age of 407 ± 4 Ma from a V_4 quartz vein in the Elm Zone trench (Fig. 6f) indicates that the last known stage of vein formation with gold mineralization in the Wilding Lake area is associated with Acadian (e.g. van Staal and Barr, 2012) orogenesis.

Implications for Exploration

The main fault-fill and extensional shear vein systems of the Alder Zone (Fig. 4) and Elm Zone (*see* Honsberger et al., 2020a) trenches may continue along trend towards the north-northeast and northeast, respectively, within the Rogerson Lake Conglomerate belt. However, additional quartz shear vein systems are likely to occur closer to the main fault planes bounding the Rogerson Lake Conglomerate belt (Fig. 2b, 3) because these were ultimately the local crustal-scale conduits for gold-bearing, silica-rich fluid flow. Accordingly, the bounding faults of the Rogerson Lake Conglomerate belt can be utilized to guide future exploration efforts farther northeast along strike, where additional gold prospects may be uncovered. Prospective gold exploration targets in the Wilding Lake area include Late Silurian feldspar porphyry and felsic volcanic and plutonic (Wilding Lake pluton) rocks overlying the Rogerson Lake Conglomerate, as well as rheologically favourable Neoproterozoic basement granitoids, which may provide a setting that is similar to that at Valentine Lake.

CONCLUSION

The Wilding Lake gold prospect in central Newfoundland preserves vein-hosted, structurally controlled gold mineralization within the Late Silurian to Early Devonian Rogerson Lake Conglomerate and associated felsic volcanic rocks. At depth, an unconformity preserved between Neoproterozoic basement granitoids of Ganderia and the overlying Rogerson Lake Conglomerate indicates Late Silurian to Early Devonian tectonism. The overall southeast younging-direction of the Rogerson Lake Conglomerate stratigraphy is consistent with truncation and tectonic burial of the upper crustal, synorogenic sequence by a northwest-verging master fault system, which ultimately controlled the formation and preservation of Late Silurian to Early Devonian orogenic gold mineralization.

The Paleozoic structural architecture and setting of the central Newfoundland gold district is remarkably similar to world-class, orogenic-style gold districts, such as the Archean Abitibi greenstone belt (e.g. Bleeker, 2015; Honsberger and Bleeker, 2018), implying that the progression of tectonic processes leading to gold mineralization and preservation in central Newfoundland was fundamentally similar to that of the Abitibi. The results of this focused study, therefore, help to unify age-independent models for structurally controlled, orogenic gold mineralization. Ongoing work involves a detailed step-by-step comparison of a number of features of the Abitibi systems, such as rates of tectonism, details of synorogenic magmatism, possible extensional processes, basin formation, basin collapse, and final thrust burial and preservation.

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