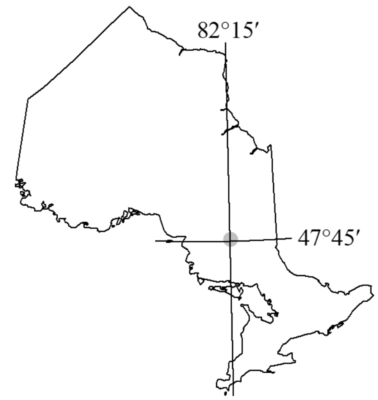
44. Base Metal Mineralization Associated with the Woman River Iron Formation, with a Focus on the Jefferson and Stackpool Prospects, Marion and Genoa Townships, Swayze Area, Abitibi Greenstone Belt



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INTRODUCTION

This work is part of the multi-year Metal Earth project directed by MERC (Mineral Exploration Research Centre, Laurentian University, Sudbury) and supported by the Ontario Geological Survey, to refine the knowledge of the Abitibi greenstone belt. The focus of the current study, the Swayze area, represents the southwestern extent of the Abitibi greenstone belt (Figure 44.1). The Swayze area does not possess the significant economic base- and precious-metal endowment that the eastern portion of the Abitibi greenstone belt does, despite being underlain by the same volcanic sequences (Thurston et al. 2008). To date, 2 base metal occurrences in the study area have been the focus of significant amounts of exploration, along with several auriferous deposits, including the low-grade, high-tonnage Côté deposit (Measured and Indicated Resources of 355.4 million tonnes at 0.87 g/t Au for contained 9.970 million ounces of gold; Oshust et al. 2018, p.1-14; *see* Figure 44.1).

This project focusses on the base metal mineralization in the study area, specifically at the Jefferson, Vencan and Stackpool prospects, where mineralization is hosted within felsic volcanic rocks and ironstone of the overlying Woman River iron formation. The goal of this research is to describe the mineralization and place it within the volcanic, tectonic and deformation history of the Swayze area using detailed geologic mapping, lithogeochemistry and geochronology. Results of the 2018 mapping program are presented in this summary.

REGIONAL GEOLOGY

The Abitibi greenstone belt is located in the eastern part of the Wawa–Abitibi terrane of the southern Superior Province (Percival et al. 2006). It comprises mafic to felsic metavolcanic rocks, with minor ultramafic metavolcanic rocks and linear belts of younger, clastic metasedimentary rocks, which Heather (2001) subdivided into informal groups that he interpreted as correlative with assemblages established for the Abitibi greenstone belt (Thurston et al. 2008, and references therein). More recently, the volcanic and younger sedimentary assemblages of the Abitibi greenstone belt were grouped into chronostratigraphic units, referred to as episodes by Thurston et al. (2008, and references therein). For correlation purposes in this study, the group names defined by Heather (2001) for the Swayze area are contained within parentheses following the episode name assigned by Thurston et al. (2008), where applicable: Pacaud

Summary of Field Work and Other Activities, 2018,
Ontario Geological Survey, Open File Report 6350, p.44-1 to 44-8.

episode (Chester group; 2750–2735 Ma), Deloro episode (Marion group; 2734–2724 Ma), Kidd–Munro episode (Biscotasing group; 2720–2710 Ma), Tisdale episode (Trailbreaker group; 2710–2704 Ma) and Blake River episode (Swayze group; 2704–2695 Ma). Overlying the volcanic episodes in Ontario are 2 episodes of sediment deposition referred to as the Porcupine-type (2690–2682 Ma) and the Timiskaming-type (equivalent to Heather's (2001) Ridout group; 2676–2670 Ma).

The Swayze area is bounded by the Ramsey–Algoma granitoid complex to the south, the Biggs pluton and Kapuskasing Structural Zone to the west, the Nat River granitoid complex to the north, and the Kenogamissi Batholith to the east (*see* Figure 44.1). Regional metamorphism in the area is typically lower greenschist facies; upper greenschist- and amphibolite-facies metamorphism are present locally.

EXPLORATION HISTORY

Exploration at the Jefferson prospect began with initial prospecting of the Woman River iron formation in the early 1900s, which led to the discovery of lead-zinc mineralization in 1927. Exploration continued sporadically throughout the rest of the century. In the 1950s, Central Sudbury Lead-Zinc Mines drilled 23 holes before passing the property to the Stackpool Mining Company Limited in 1958. Stackpool

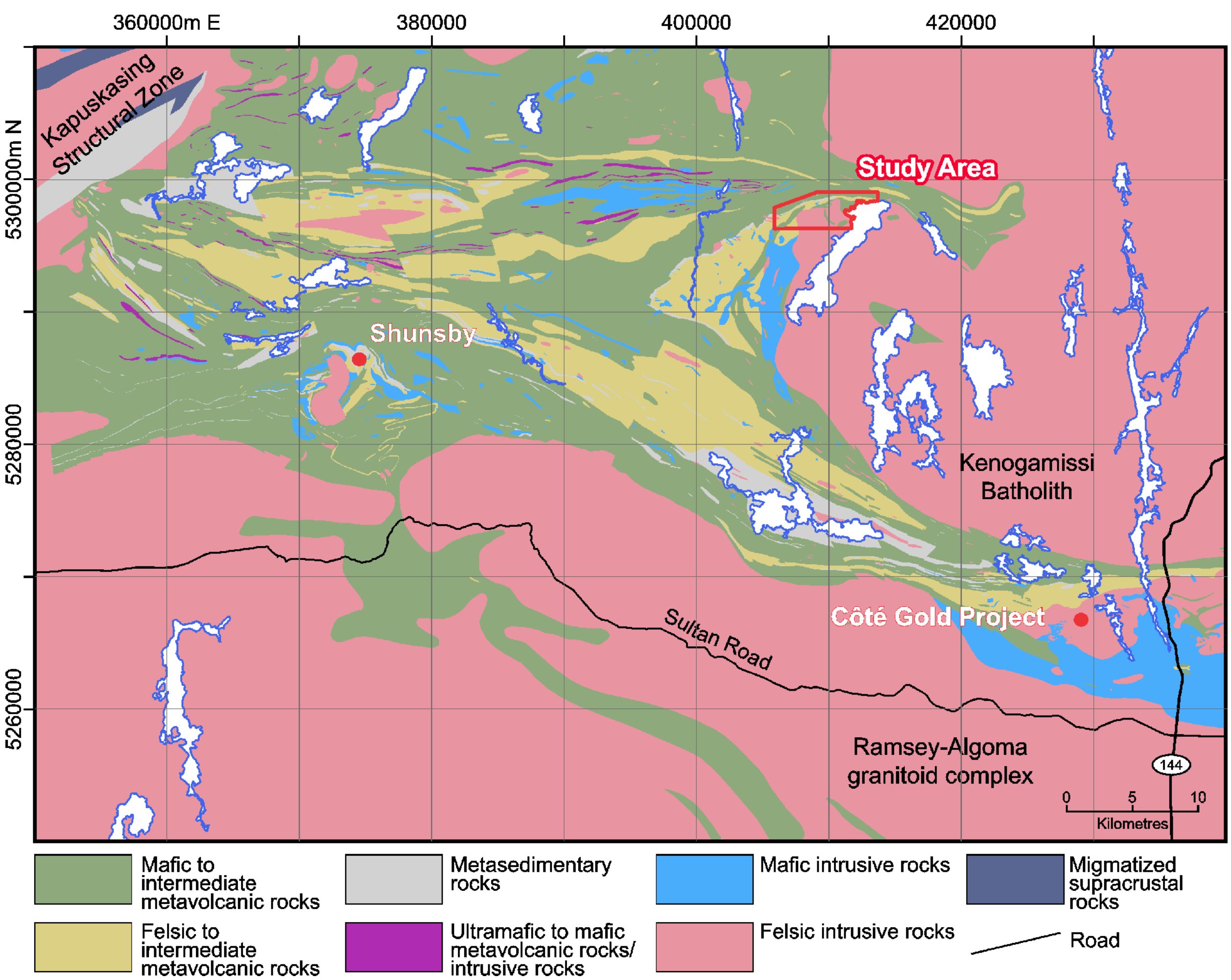

Figure 44.1. Simplified geology map of the southern Swayze area of the Abitibi greenstone belt, displaying the study area (outlined by red box). Location information provided as Universal Transverse Mercator (UTM) co-ordinates using North American Datum 1983 (NAD83) in Zone 17. Geology *modified from* Ontario Geological Survey (2011).

drilled 50 diamond-drill holes. This drill program led to the first discovery of significant copper mineralization ("3.3 m core intersection of 1.55% Cu, 3.30% Zn, 0.44 ounces Au/tonne (Aussant, C., Scherba, C. 2006)"[sic] as cited by Yarie 2014, p.6-16). The property was then acquired by Falconbridge Limited in the 1990s, which completed a bedrock geology mapping program, an airborne geophysical survey and, in 1993, a drill program. The drilling intersected in one drill hole "2.7% Zn over 9.12 m and 1.6% Zn over 13.83 m; another [diamond-drill] hole had 1.7% Zn over 17.2 m (Aussant, C., Scherba, C. 2006)"[sic] as cited by Yarie 2014, p.6-16). In 2006, Vencan Gold Corporation (now Red Pine Exploration Inc.) undertook a drill program and airborne electromagnetic, ground gravity, induced polarization and ground magnetic surveys over the property. As a result of this work, the Vencan Zinc showing was discovered. Follow-up drilling resulted in intersections of "4.22% Zn over 16.85 m (including 7.27% Zn over 8.50 m)" (Yarie 2014, p.6-16). The Jefferson prospect was last drilled in 2014 by Red Pine Exploration Inc., and cores from more than 24 drill holes are still on site.

GEOLOGY OF THE WOMAN RIVER IRON FORMATION AND METAVOLCANIC UNITS

Metasedimentary Rocks

Metasedimentary rocks, principally the Woman River iron formation (WRif) and associated, fine-grained clastic sedimentary rocks, define a single stratigraphic interval within the volcanic rocks of northern Genoa and Marion townships. The WRif and associated argillaceous sedimentary rocks presumably mark a time gap between major volcanic episodes and, therefore, represent an interval for potential syngenetic base metal mineralization (e.g., Thurston et al. 2008).

The WRif has a strike length of 20 km (labelled as "Chemical sedimentary rocks" on Figure 44.2) and comprises several lithofacies. These include alternating bands of silicate- and oxide-facies iron formation interbedded with thin discontinuous parallel bands of siltstone (Photos 44.1C and 44.1E), and sulphide-facies ironstone composed of thinly bedded mudstone intercalated with massive pyrite and pyrrhotite (*see* Photo 44.1E).

The most easterly exposure of the WRif is up to 7 m thick (*see* Figure 44.2) and can be traced up to 100 m along strike. West of the Kenogamissi Batholith, the WRif comprises beds of chert, iron-oxide minerals (e.g., magnetite) and iron-silicate minerals (e.g., siderite, greenalite) intercalated with thin, discontinuous parallel beds of siltstone and an underlying section of metres-thick, sulphide-facies iron formation (*see* Photo 44.1E). Overlying the WRif is garnetiferous argillite (*see* Photo 44.1C). The argillite occurs as 1 to 3 m thick beds intercalated with 3 to 6 m thick beds of mafic tuff, and is intruded and dilated by gabbroic sills and later quartz-feldspar porphyry dikes and sills. The WRif throughout the western portion of Marion Township has a relatively continuous thickness of 3 to 4 m, and occurs as several discontinuous parallel bands that have been tectonically thickened by faulting and folding. The WRif strikes northwest and dips steeply to the north. This iron formation, as interpreted by Heather (2001), maintains its significance as a stratigraphic marker; however, the structure interpreted by Heather (2001) has not held up to more recent, detailed mapping (Gemmell, Szumylo and Mowbray, this volume, Article 8).

Metavolcanic Rocks

Mafic to intermediate metavolcanic rocks are the dominant rock type within the northern sections of Marion and Genoa townships (*see* Figure 44.2), where these rocks constitute the hanging wall of the Woman River iron formation. They range from dark green to light green, and are typically cryptocrystalline to very fine-grained, massive and lesser pillowed and/or variolitic lava flows (Photo 44.1B). Minor sections of intercalated felsic tuff (Photo 44.1F) and mafic flows (Photo 44.1H).

Felsic to intermediate volcaniclastic rocks, with lesser *in situ* brecciated and massive flows, constitute the footwall of the WRif through Marion and Genoa townships. The volcaniclastic rocks are represented as white to light greyish green tuff to fine-grained tuff with lesser lithic and vitric lapilli tuff (Photo 44.1A). They are typically bedded, with beds up to 10 cm thick.

The volcanic rocks in the hanging wall and footwall to the WRif were sampled for U/Pb zircon geochronology analyses to constrain the age of deposition of the iron formation.

Intrusive Rocks

Plutonic intrusive rocks, located throughout the eastern portion of the map area (*see* Figure 44.2), are composed of fine- to medium-grained granodiorite to tonalite, with mafic to intermediate phases of gabbro to monzonite (Photo 44.1G).

Metre-scale intermediate to felsic porphyritic dikes trend west-northwest and intrude the Marion and Trailbreaker groups (*see* Figure 44.2), indicating that they are younger than 2705 Ma. The porphyritic dikes (*see* Figure 44.2: "mafic intrusive rocks") are composed of anhedral plagioclase and quartz phenocrysts, 1 to 5 mm in size, in a plagioclase-rich groundmass that is commonly sericitized and strongly deformed. The contacts of the intrusions, where observed, are sharp, with thin (<1 cm) chill margins.

Gabbroic to dioritic intrusions are most abundant west of the Kenogamissi Batholith, where they form swarms of sills and dikes (Photo 44.1I). These intrusions range from 1 up to 15 m in thickness (*see* Figure 44.2). The sill and dike complex is best developed in the felsic footwall to the Woman River iron formation. Peperite developed along the margins of gabbroic sills that intrude sedimentary rocks of the iron formation implies a synvolcanic timing for the intrusive event (Photo 44.1J).

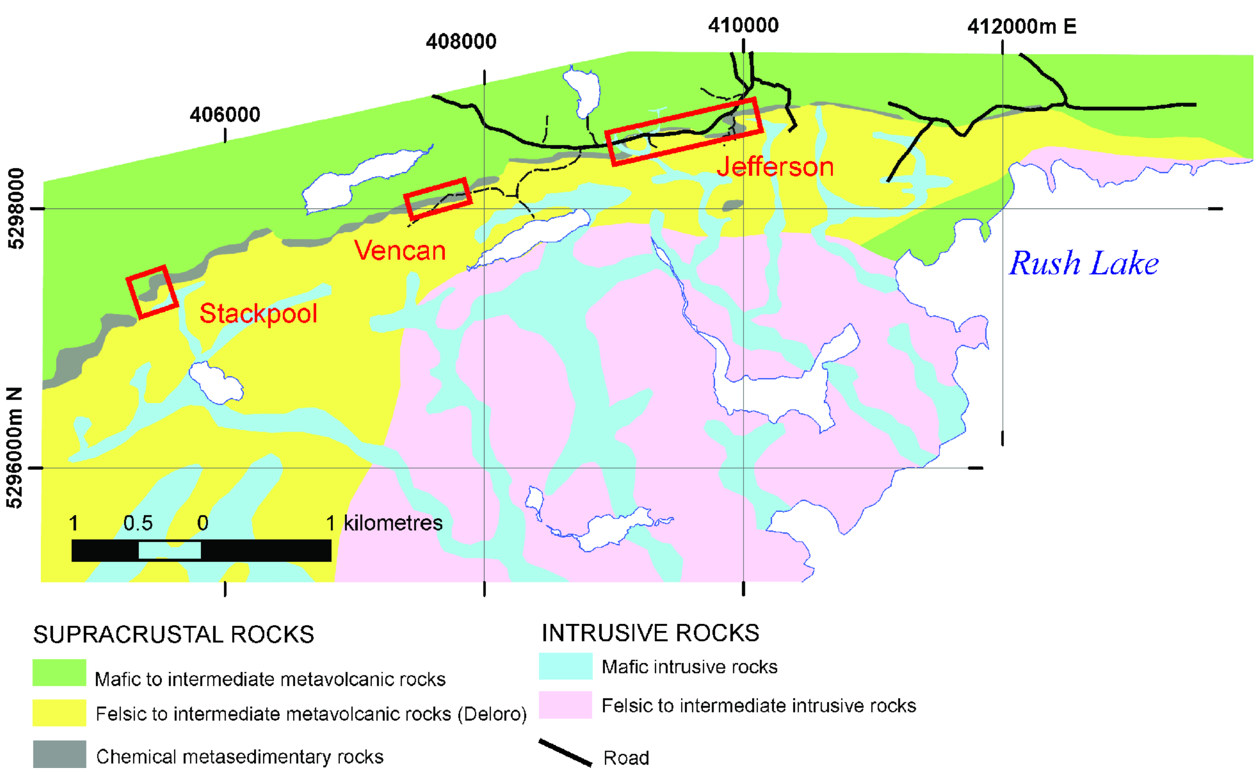

Figure 44.2. Preliminary geological map of the study area in Marion and Genoa townships. Areas of more detailed mapping are outlined in red. Location information provided as UTM co-ordinates using NAD83 in Zone 17.

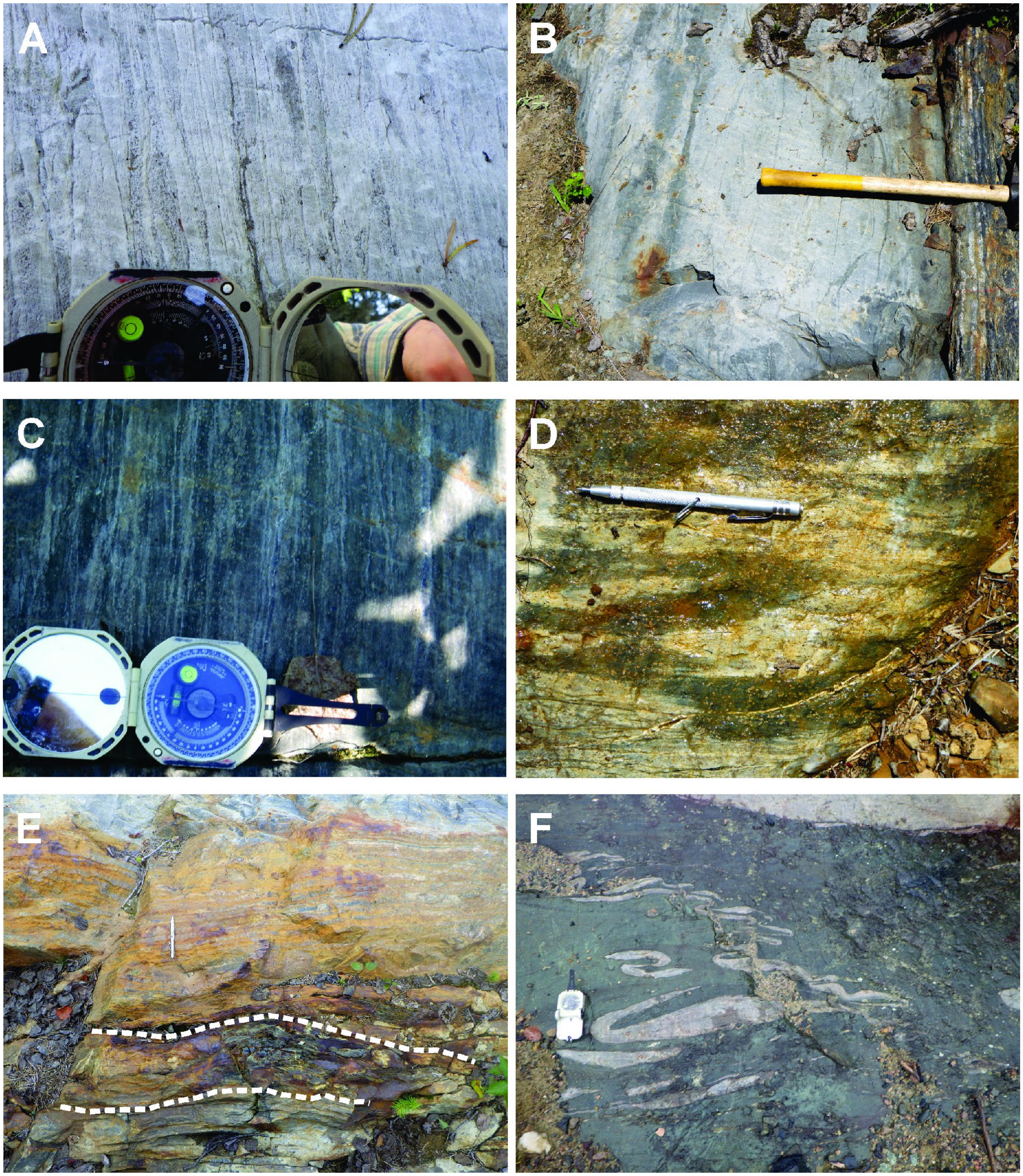

Photo 44.1. Selected photographs of lithological units. Numbers in parentheses refer to Ontario Geological Survey stations with corresponding UTM location. **A**) Vitric tuff (18BM020: UTM 408665E 5298340N). **B**) Mafic pillows overlying oxide-facies iron formation of the Woman River iron formation (18BM025: UTM 408461E 5298470N). **C**) Garnet-bearing argillite (18BM051: UTM 409879E 5298779N). **D**) Hydrothermal alteration of felsic tuff, illustrating the chlorite-garnet alteration assemblage (18BM022: UTM 408466E 5298284N). **E**) Silicate-facies iron formation intercalated with sulphide-facies iron formation (18BM082: UTM 408669E 5298473N). **F**) Intercalated felsic tuff and mafic flows, showing strong dextral folding (18BM063: UTM 412921E 5299147N). Compass for scale in Photos 44.1A, 44.1C and 44.1F is 22 cm long, with sighting arm pointing north; scribe in Photos 44.1D and 44.1E is 8 cm long, with the tip facing north; rock hammer in Photo 44.1B is 87 cm long and is oriented with the handle facing north. All location information provided as UTM co-ordinates using NAD83 in Zone 17.

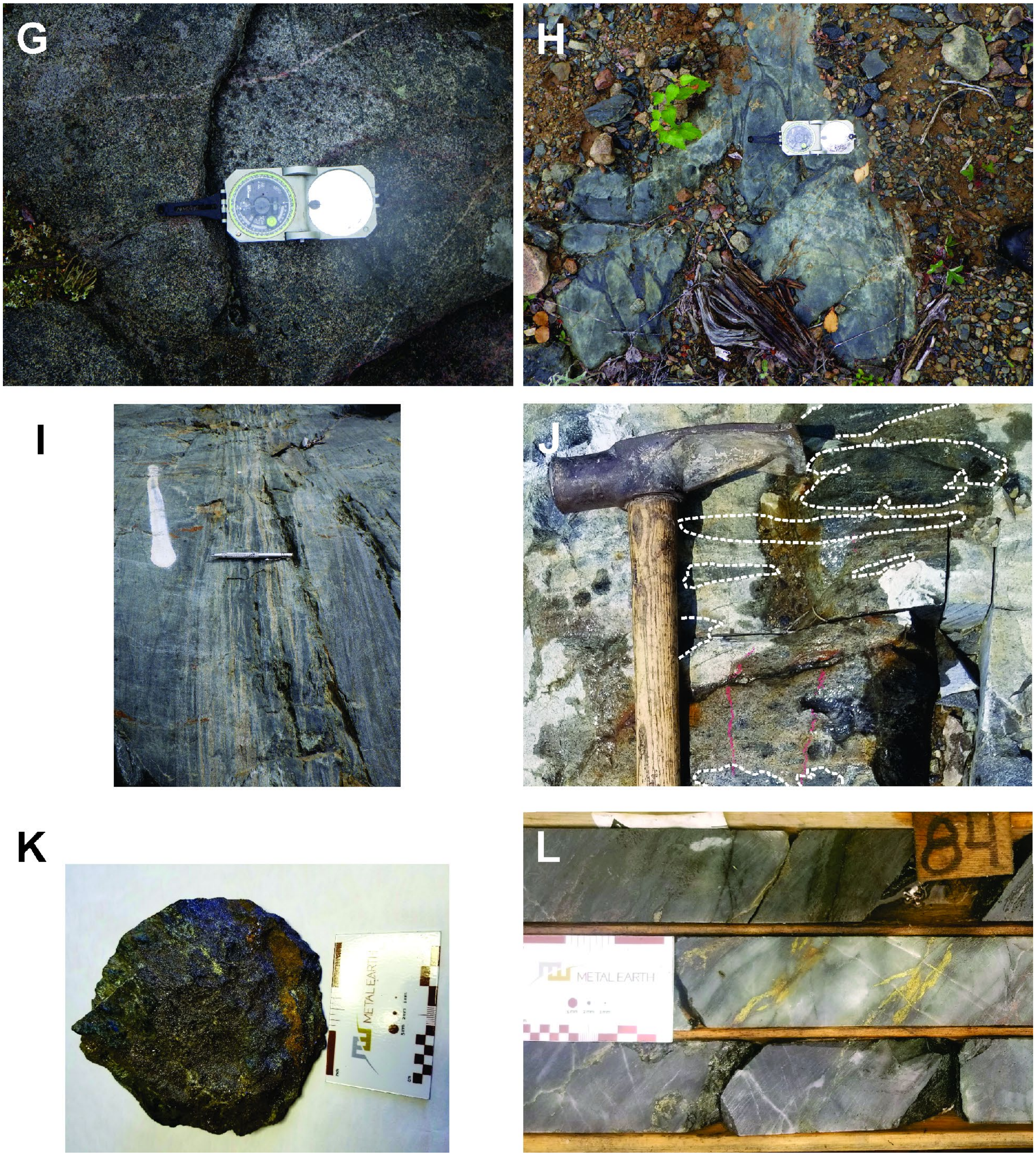

Photo 44.1, *continued*. **G**) Medium-grained gabbro (18BM067: UTM 412711E 5298858N). **H**) Small mafic pillows (18BM072: UTM 412422E 5298986N). **I**) Gabbroic sill dilating oxide-facies iron formation (18BM046: UTM 410333E 5298942N). **J**) Peperite texture, with argillite material outlined (17BM134: UTM 409130E 5298472N). The peperite is found within argillaceous and gabbroic material as 1 to 2 mm fragments.. **K**) Representative sample of chalcopyrite-sphalerite-galena mineralization at the Vencan showing (18BM029: UTM 407855E 5298103N). **L**) Stockwork mineralization of chalcopyrite, galena and sphalerite throughout felsic tuff (from drill-hole CC-14-24: UTM 409960E 5298588N, depth 84 m). Compass for scale in Photos 44.1G and 44.1H is 22 cm long, with sighting arm pointing north; scribe in Photo 44.1I is 8 cm long, with the tip facing north; rock hammer is 87 cm long and the handle is oriented to face north. All location information provided as UTM co-ordinates using NAD83 in Zone 17.

BASE METAL MINERALIZATION AND ALTERATION

Base metal mineralization associated with the WRif is well exposed at the Jefferson, Vencan East and Stackpool trenches (Photo 44.1K), where it occurs within and proximal to the iron formation. Massive to semi-massive pyrite, pyrrhotite and more localized sphalerite, galena and chalcopyrite occur within the WRif as massive and stockwork sulphide zones. The sulphide mineral associations of chalcopyrite-galena-sphalerite and pyrite-pyrrhotite suggest mineralogical zoning. Stockwork mineralization was observed stratigraphically below the WRif, within felsic to intermediate volcanic rocks (Photo 44.1L). Mineralization has been interpreted to be synvolcanic (Yarie 2014); however, the timing relative to deposition of the WRif is not unequivocal and is under study.

Hydrothermal alteration associated with the base metal mineralization occurs throughout the WRif, in the underlying felsic volcanic rocks (Photo 44.1D), and in the immediate hanging wall of the WRif. The alteration manifests as a pervasive chlorite–garnet mineral association. Late iron-carbonate alteration is pervasive and localized to areas of intense deformation.

DISCUSSION

The base metal showings and attendant alteration along the Woman River iron formation may define discrete centres of mineralization for a larger underlying hydrothermal system. The occurrence of alteration in the footwall felsic volcanic and hanging-wall mafic volcanic rocks indicates that it is discordant, and suggests a timing that postdates deposition of the iron formation. Future work will constrain the timing of volcanism, and the timing of alteration and mineralization relative to the Woman River iron formation.

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[Note: incorrectly cited and referenced in Yarie (2014) as "Aussant and Scherba 2006".]

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