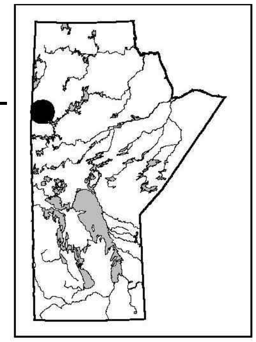
GS-12 STRUCTURAL ANALYSIS OF THE POOL LAKE-BOILEY LAKE AREA, LYNN LAKE GREENSTONE BELT (NTS 64C/11)

by S.D. Anderson and C.J. Beaumont-Smith



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SUMMARY

Deformation structures along the south margin of the Johnson Shear Zone in the Pool Lake–Boiley Lake area of the Lynn Lake greenstone belt are subdivided on the basis of overprinting relationships into seven generations, which are interpreted to result from seven discrete phases of ductile (D_1, D_2, D_3, D_4 and D_5), brittle-ductile (D_6), and brittle (D_7) deformation. The D_1 deformation structures are only observed in the Wasekwan Group, in accord with previous interpretations wherein the earliest deformation in the Lynn Lake belt is considered to predate intrusion of the Pool Lake plutonic suite and deposition of unconformably overlying alluvial-fluvial rocks of the Sickle Group. The D_2 deformation structures are regionally pervasive and are interpreted to record crustal-scale, dextral-oblique transpression. The Johnson Shear Zone, which hosts several significant gold deposits and showings over more than 85 km of strike length, appears to have formed as a result of partitioning of this deformation along the southern margin of the Lynn Lake greenstone belt. In the Pool Lake area, the D_2 structures are transected by a series of discrete, southeast-striking, dextral shear zones that are attributed to D_3 deformation. In contrast, D_3 structures in the Boiley Lake area occur as southeast-trending asymmetrical folds and crenulation cleavage that are consistent with F_3 folding of the Wasekwan Group into the macroscopic S-asymmetrical fold evident on regional compilation maps. The D_4 deformation structures occur as a penetrative, northeast-trending crenulation fabric associated with Z-asymmetrical, steeply northeast-plunging folds. Open folds and north-trending undifferentiated crenulations, possibly associated with the macroscopic warping of the greenstone belt, formed during D_5 deformation. These structures are cut and reactivated by a series of brittle faults and brittle-ductile shear zones that record evidence for sinistral strike-slip shear and are assigned to D_6 deformation. The D_7 deformation structures comprise a late series of north-trending, presumably brittle faults that offset the principal geological units in the west-trending Lynn Lake greenstone belt.

The D_2 shear zones in the Pool Lake area are interpreted to be second- or third-order splays flanking the Johnson Shear Zone and are therefore highly prospective exploration targets. Splay structures tend to be developed over wide areas (>5 km) along the flanks of the primary shear zone, indicating that most of the southern Lynn Lake greenstone belt should possess good exploration potential for mesothermal, shear-hosted gold deposits.

INTRODUCTION

A program of detailed (1:20 000 scale) structural mapping was initiated along the southern margin of the Johnson Shear Zone (JSZ) in the south belt of the Paleoproterozoic Lynn Lake greenstone belt (Fig. GS-12-1). The JSZ (Bateman, 1945) is a regional-scale, northerly dipping, linear deformation zone that has been traced along strike for more than 85 km and hosts several gold deposits and significant showings (Fedikow et al., 1991). The program was initiated in order to reconcile the results of regional- and detailed-scale structural analyses of the JSZ (e.g., Baldwin, 1987; Sherman et al., 1989; Fedikow et al., 1991; Peck and Eastwood, 1997; Peck et al., 1998; Beaumont-Smith and Rogge, 1999; Beaumont-Smith, 2000; Beaumont-Smith and Edwards, 2000) with regional geological patterns and structures evident along the south margin of the shear zone in the Pool Lake–Boiley Lake area (e.g., Gilbert et al., 1980, Map GP80-1-6). This mapping program is part of the ongoing, multidisciplinary, collaborative geoscience project focussed on understanding the deformation history of the JSZ and the structural controls on gold mineralization in the Lynn Lake greenstone belt.

The Pool Lake–Boiley Lake area is located approximately 18 km south-southwest of Lynn Lake. Access to the study area is provided via Provincial Road 396 and the Hudson Bay Railway line from McVeigh station. The study area has been the focus of base-metal exploration for a considerable period of time, including an active exploration program in the Boiley Lake area; as such, it is accessible by all-terrain vehicle along numerous drill roads.

GEOLOGICAL SETTING

The Paleoproterozoic Lynn Lake greenstone belt in the study area comprises metamorphosed volcanic, volcaniclastic and sedimentary rocks of the ca. 1910 Ma (Baldwin et al., 1987) Wasekwan Group, intruded by the ca. 1876 Ma (Baldwin et al., 1987) Pool Lake plutonic suite (Gilbert et al., 1980). Both of these units are unconformably overlain by fluvial-alluvial coarse clastic metasedimentary rocks of the ca. 1850 Ma Sickle Group (Norman, 1933; Gilbert et al., 1980).

Metamorphic mineral assemblages in these rocks indicate upper greenschist to middle amphibolite facies peak metamorphism. Microstructural analysis by Beaumont-Smith and Rogge (1999) indicates that the metamorphic peak was achieved subsequent to the main (D_2) phase of regional deformation.

The Wasekwan Group (Bateman, 1945) in the study area is exposed in an elongate, sinuous belt, up to 1.1 km wide, that

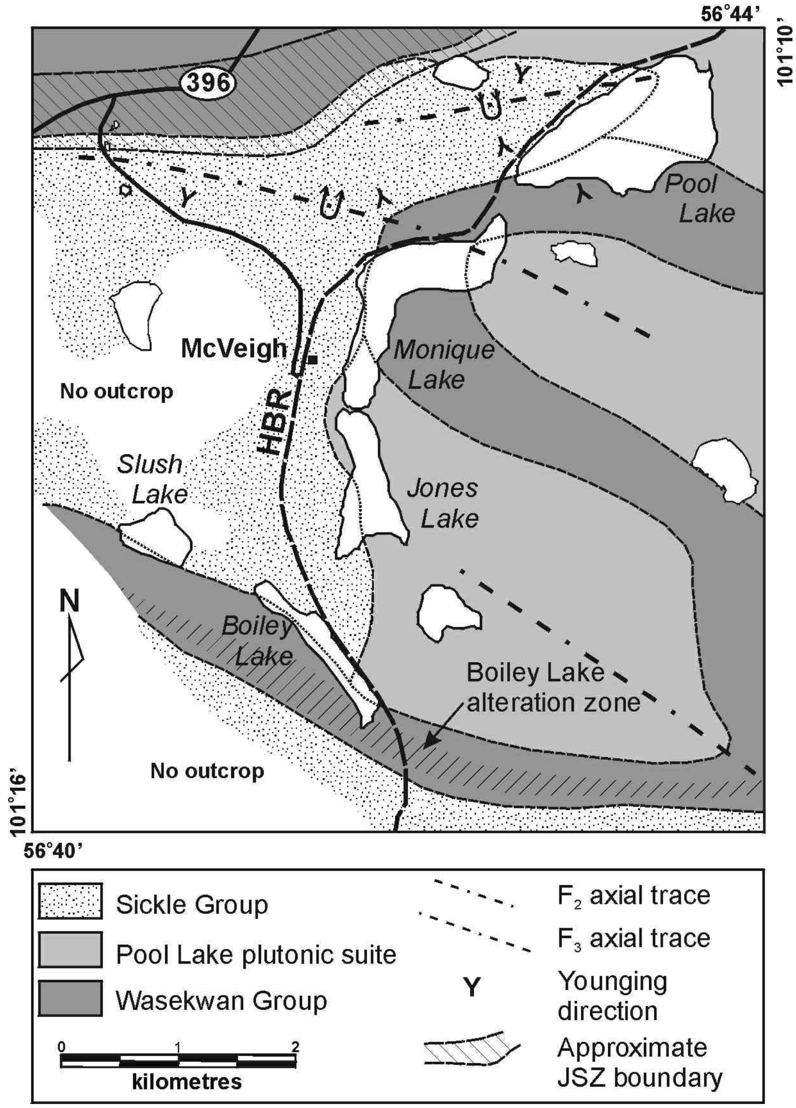

Figure GS-12-1: General geology of the southern Lynn Lake greenstone belt in the Pool Lake-Boiley Lake study area (after Gilbert et al., 1980), showing the location of the Johnson Shear Zone, the Boiley Lake alteration zone, and the axial traces of macroscopic F_2 and F_3 folds. Abbreviation: HBR, Hudson Bay Railway.

is folded into a southeast-trending, macroscopic S-asymmetrical fold along the southern margin of the greenstone belt (Fig. GS-12-1). Along the north limb of the fold in the Pool Lake area, the Wasekwan Group comprises massive and pillowed, porphyritic to aphyric mafic flows intercalated with subordinate mafic volcaniclastic rocks, epiclastic sedimentary rocks, felsic tuff and massive felsic flows. Pillowed mafic flows are particularly well preserved along the south shore of Pool Lake, where younging criteria indicate that these rocks are upright and young to the north. The stratigraphy of the southern fold limb is dominated by coarse mafic volcaniclastic breccia and epiclastic sedimentary rocks that host a distinctive, semiconformable biotite-garnet-chlorite±anthophyllite±magnetite±kyanite±staurolite±cordierite alteration zone associated with massive-sulphide mineralization (Gale, 1983; Ferreira, 1993).

The Wasekwan Group is intruded by quartz diorite plutons of the Pool Lake plutonic suite (Gilbert et al., 1980). Quartz diorite is exposed over large areas in the eastern and northeastern portions of the study area. These rocks are light grey, medium grained, equigranular and homogeneous. The contact relationships between the quartz diorite and the Wasekwan Group were not observed directly. In one location along the southeast shore of Pool Lake, however, the Wasekwan Group is intruded by quartz diorite dykes that are visually similar to the adjacent quartz diorite pluton of the Pool Lake suite.

On a regional scale, intrusion of the Pool Lake suite is constrained to predate regional D_2 deformation (Gilbert et al., 1980), since D_2 structures are well developed in the nonconformably overlying conglomerate units of the Sickle Group (*see* below). In the Pool Lake exposure, however, the regional S_2 fabric in the Wasekwan Group is cut at a low angle by the quartz diorite dykes. These dykes are boudinaged in S_2 and contain a weak S_2-parallel fabric. These relationships may indicate early- to syn-D_2 intrusion of the quartz diorite dykes, or that the regional fabric is a composite S_1/S_2.

The Sickle Group (Norman, 1933) comprises polymictic, pebble to cobble conglomerate interstratified with subordinate medium- to coarse-grained, pebbly, arkosic sandstone and rare laminated siltstone. Primary sedimentary structures, including graded beds, trough cross-bedding, ripple cross-laminations and soft-sedimentary folding, are common. Bedding-cleavage relationships and the younging criteria greatly facilitate mapping of large-scale fold closures in the Sickle Group.

Norman (1933) proposed that the Sickle Group rests with angular unconformity on rocks of the Wasekwan Group and Pool Lake plutonic suite. The contact between the Sickle Group and quartz diorite of the Pool Lake plutonic suite is exposed along the southern edge of a large stripped outcrop approximately 1.0 km north of the southwest end of Pool Lake. As described by Milligan (1960), polymictic cobble conglomerate immediately adjacent to the contact contains several well-rounded pebbles and cobbles of quartz diorite that are identical in appearance to the adjacent, stratigraphically underlying, quartz diorite pluton.

STRUCTURAL ANALYSIS

Mesoscopic deformation structures in the Pool Lake–Boiley Lake area are subdivided on the basis of overprinting relationships into seven generations, which are interpreted to result from seven discrete phases of ductile (D_1, D_2, D_3, D_4 and D_5), brittle-ductile (D_6) and brittle (D_7) deformation.

Structures attributed to D_1 deformation are only locally preserved in the Wasekwan Group in the study area, and were not observed in rocks of the Sickle Group or the Pool Lake suite. The D_1 structures comprise a penetrative S_1 foliation preserved in the hinges of F_2 folds and between S_2 crenulation cleavage planes. The S_1 foliation is defined by a preferred orientation of quartz veinlets and fine-grained biotite and amphibole (Fig. GS-12-2). The apparent absence of D_1 structures in the Sickle Group and Pool Lake suite supports previous interpretations, wherein these rocks are considered to postdate regional D_1 deformation (Gilbert et al., 1980).

Structures attributed to D_2 deformation are regionally developed in the study area (e.g., Beaumont-Smith and Rogge, 1999; Beaumont-Smith, 2000). The S_2 planar fabric is typically defined by a weak preferred orientation of amphibole and biotite in intrusive rocks of the Pool Lake suite. In the Sickle Group, S_2 is typically penetrative, finely spaced and defined by a preferred orientation of fine-grained amphibole and biotite, and flattened pebbles and cobbles in conglomerate. The S_2 planar fabric in the Wasekwan Group is defined by foliated amphibole and biotite, flattened clasts in volcaniclastic and epiclastic rocks (Fig. GS-12-3), and local strongly attenuated pillows. Typically, the S_2 foliation dips steeply north and contains a down-dip to steeply plunging mineral and stretching lineation defined by the long axis of elongate hornblende and biotite grains, and stretched clasts in fragmental rocks. The axial ratios of stretched clasts generally define oblate ellipsoids, consistent with flattening strains.

The S_2 foliation is axial planar to F_2 folds. These folds are tight to isoclinal, inclined, and upright to overturned. The F_2 folds are particularly well defined in the Sickle Group, where S_0/S_2 intersection lineations indicate that the folds plunge steeply north-northeast. Regional-scale F_2 folds with wavelengths ranging up to several kilometres appear to have been transposed along the south margin of the JSZ (Fig. GS-12-1), possibly during the later increments of progressive, ductile, dextral shearing.

The D_2 deformation in the Pool Lake area is thought to be associated with the principal phase of movement along the JSZ (Beaumont-Smith and Rogge, 1999; Beaumont-Smith, 2000). In the study area, shear zones interpreted to record high finite D_2 strain appear to be preferentially developed in Wasekwan Group mafic volcanic rocks, as well as along principal lithological contacts. The D_2 shear zones are typically less than 5 m thick and anastomose on a large scale around relatively low strain domains with well-preserved primary textures and structures. The shear zones are characterized by penetrative crenulation fabrics and mylonitic foliations, locally with well-developed ribbon mylonite and prominent tectonic layering. Isoclinal,

Figure GS-12-2: S_1 fabric, locally containing boudinaged quartz veins, overprinted by penetrative S_2 crenulation cleavage and asymmetrical F_2 folds in Wasekwan Group pillowed mafic flows, south of Pool Lake. Top is north.

Figure GS-12-3: S_2 planar fabric defined by flattened clasts in mafic fragmental rocks of the Wasekwan Group south of Pool Lake. Top is north.

rootless and intrafolial F_2 folds are common in these zones. The S_2 fabric contains a pervasive, steeply plunging L_2 mineral and stretching lineation, with local development of L>S tectonites. Sense-of-shear indicators are only well developed in the Y-Z plane of the strain ellipsoid (i.e., roughly the horizontal plane). The shear-sense indicators, including S-C fabrics, porphyroclast systems, and shear bands, consistently indicate dextral shearing. This structural geometry, which is compatible with oblique transpression (e.g., Lin et al., 1998; Lin and Jiang, 2001), is similar to that observed along the main trace of the JSZ (e.g., Beaumont-Smith and Rogge, 1999; Beaumont-Smith, 2000). On this basis, the D_2 shear zones in the study area are considered to represent second- or third-order splays (e.g., Kerrich, 1989) flanking the JSZ.

In the Boiley Lake area, the F_2 folds are upright and tight to isoclinal, with steep to shallow plunges. The associated axial-planar S_2 foliation is a steeply north-dipping, spaced to penetrative crenulation cleavage reflecting varying degrees of transposition. Within the alteration zone south of Boiley Lake, D_2 transposition is best demonstrated by penetrative boudinage and isoclinal folding of quartz-epidote veins that are interpreted to have formed during subseafloor hydrothermal alteration associated with the massive-sulphide mineralization (Fig. GS-12-4).

Figure GS-12-4: Intense transposition of quartz-epidote alteration and veins by the S_2 foliation, Boiley Lake alteration zone. Pencil in bottom right corner for scale.

Beyond the influence of the JSZ in the Boiley Lake area, the penetrative S_2 transposition fabric is overprinted by folds and fabrics that are attributed to D_3 deformation. The F_3 folds are open to tight and asymmetrical, and plunge moderately to the southeast. A penetrative, steeply dipping, S_3 crenulation cleavage strikes northwest and is axial planar to the F_3 folds. Changes in the asymmetry of the mesoscopic F_3 folds and the S_2/S_3 angular relationships around the southern hinge of the macroscopic S-asymmetrical fold that dominates the map pattern in the study area (Fig. GS-12-1) indicate that it is also attributable to the F_3 fold generation. This interpretation is supported by the observation that the S_2/S_3 fabrics are overprinted by regionally penetrative, northeast-trending D_4 fabric elements. In contrast, overprinting relationships in the Pool Lake area indicate that the northern hinge of the macroscopic, S-asymmetrical fold formed during D_2 deformation. In particular, stretched pebbles and cobbles that define the S_2 fabric in the Sickle Group northwest of Monique Lake are axial planar to the S-fold, and are not folded around the northern hinge. The S_2 fabric in this location is typically overprinted by the steeply dipping, southeast-striking, penetrative S_3 crenulation cleavage, and both are cut by D_4 fabric elements. These relationships appear to indicate that the macroscopic S-fold is a composite structure, formed through F_3 refolding of the southern limb of a pre-existing, tight to isoclinal F_2 fold.

In the footwall of the JSZ in the Pool Lake area, the D_2 structures and shear zones in the Wasekwan Group and Pool Lake suite are cut by a series of discrete, less than 1.5 m thick, ductile shear zones that are also attributed to D_3 deformation. These shear zones dip steeply to the northeast and contain a penetrative mylonitic S_3 foliation defined by biotite, amphibole and chlorite. Observed S-C fabrics, asymmetrical transposition of S_2 and offset marker units consistently indicate dextral shearing. The central portions of D_3 shear zones commonly contain less than 30 cm thick, fault-fill–type quartz veins that are folded into trains of tight to isoclinal, upright, steeply plunging folds with a consistent Z-sense of asymmetry (Fig. GS-12-5). These fold trains are wrapped around by the S_3 mylonitic foliation in the centre of the D_3 shear zones. The geometry and kinematics of the D_3 shear zones are analogous to large-scale shear bands, which may have developed in the footwall of the JSZ during a late increment of progressive dextral shearing.

Ductile structures that are attributed to the D_4 deformation have a heterogeneous distribution and geometry. Typically, however, the D_4 fabric element comprises a penetrative, northeast-trending, subvertical S_4 crenulation cleavage that consistently overprints D_2 and/or D_3 structures. In D_2 shear zones in the Wasekwan Group, the S_4 crenulation cleavage is associated with trains of small-scale, northeast-trending, steeply northeast-plunging, Z-asymmetrical folds (Fig. GS-12-6). These F_4 folds are open to isoclinal in profile, and fold the S_2 mylonitic foliation. In one location at the south end of Pool Lake, the short limb of a tight, Z-asymmetrical F_4 fold is transposed by an approximately 15 cm thick ductile shear zone that dips steeply north-northwest. This shear zone contains a mylonitic fabric defined by foliated chlorite, biotite and amphibole. Well-developed S-C fabrics record dextral shearing. Along strike, beyond the influence of the F_4 fold, the shear zone clearly transposes the S_2 foliation. In D_3 shear zones, the mylonitic S_3 foliation is commonly overprinted by a north-northeast-trending, subvertical, spaced crenulation fabric that is also attributed to D_4 deformation (Fig. GS-12-7). The F_4 crenulations lack any consistent sense of asymmetry. Collectively, the geometry of the D_4 structures is interpreted to result from east-southeast–west-northwest shortening, and local reactivation of pre-existing D_2 and D_3 structures.

Structures attributed to D_5 deformation are thought to be associated with the macroscopic north-south warping of the greenstone belt that is evident on a regional scale (e.g., Gilbert et al., 1980, Map GP80-1-6). The wavelength of the warping exceeds the scale of the study area, but mesoscopic D_5 fabric elements are developed throughout the Pool Lake–Boiley Lake area. These fabric elements comprise a collection of open folds and undifferentiated crenulations that generally form north-trending conjugate sets. Rarely, D_5 strain is sufficient to produce weakly differentiated crenulation septa.

Structures assigned to the D_6 deformation are brittle-ductile in character. In Wasekwan Group rocks, these structures

Figure GS-12-5: D_3 shear zone (lower left to upper right in the photograph) crosscutting S_2 foliation in strongly deformed pillowed mafic flows of the Wasekwan Group, south of Pool Lake. The D_3 shear zone contains asymmetrical F_3 folds defined by the quartz vein, and is cut by a brittle, S_2-parallel, sinistral D_6 fault in the upper right portion of the photograph. Top is east.

Figure GS-12-6: Train of asymmetrical F_4 folds developed in mylonitic D_2 shear zone in massive mafic flows of the Wasekwan Group, south of Pool Lake. Along strike to the east (to the right in the photograph), trains of these folds overprint a crosscutting D_3 shear zone, thereby confirming the D_4 timing of the folds. Note that the F_4 fold train is truncated below the pencil by the bounding mylonitic fabric, indicating syn- to post-D_4 reactivation of the D_2 shear fabric.

Figure GS-12-7: Penetrative, mylonitic S_2 foliation (parallel to short edge of photograph) crosscut by a discrete, dextral D_3 shear zone (from lower left to upper right of photograph, as indicated by the course of the boudinaged and folded quartz vein) in pillowed mafic flows of the Wasekwan Group, south of Pool Lake. The S_3 mylonitic foliation is overprinted by a differentiated S_4 crenulation cleavage (parallel to long edge of photograph). Top is east.

comprise S_2-parallel, brittle-ductile faults, less than 10 cm thick, that contain thin seams of cataclasite. These faults consistently record small-scale, sinistral-sense offset of transverse D_3 and D_4 structures. Irregular veins of black to purple, fine-grained to glassy pseudotachylite, observed locally in the Sickle and Wasekwan groups, may be associated with these faults (e.g., Beaumont-Smith, 2000). Northwest of Pool Lake, quartz diorite of the Pool Lake suite contains a series of spaced, less than 1 m thick, brittle-ductile shear zones that dip steeply northwest. The shear zones exhibit marked strain gradients characterized by discrete, spaced shear fractures, along the shear-zone margins, that gradationally intensify toward a central, 5 to 10 cm thick seam of ultramylonite. Asymmetrical fabrics consistently indicate sinistral shearing. The lower strain domains between the shear zones contain arrays of en échelon, locally sigmoidal, quartz-filled tension gashes. The geometry of these tension gashes with respect to the bounding shear zones indicates sinistral strike-slip shear, with a minor component of reverse dip-slip. On the basis of their sinistral kinematics and brittle-ductile style of deformation, these shear zones are correlated with the D_6 faults described above.

The latest structures (D_7) to have affected the study area were not directly observed in the field, but can be inferred from an examination of map-scale geological patterns (e.g., Gilbert et al., 1980, Map GP80-1-6). These structures comprise a late series of widely spaced, north-trending faults that truncate and offset map units along the entire east-west strike length of the Lynn Lake greenstone belt.

The sequence of deformation evident in the Pool Lake–Boiley Lake area is essentially the same as that documented along the main trace of the JSZ by Beaumont-Smith and Rogge (1999), Beaumont-Smith (2000), and Beaumont-Smith and Edwards (2000). However, the discrete D_3 shear zones observed in the Pool Lake area have not previously been documented in the Lynn Lake greenstone belt. These shear zones may have developed only in a localized structural domain in the footwall of the JSZ, possibly due to heterogeneous boundary conditions and resultant strain partitioning during progressive dextral shearing. This hypothesis could be tested through additional, detailed structural mapping along the southern margin of the JSZ.

BOILEY LAKE ALTERATION ZONE

The southern limb of the macroscopic S-fold that appears to control the distribution of the Wasekwan Group in the study area contains an extensive, semiconformable alteration zone developed within mafic volcaniclastic and epiclastic sedimentary rocks (e.g., Gale, 1983; Ferreira, 1993). The alteration zone extends discontinuously for more than 8 km between Boiley Lake and Counsell Lake (Fig. GS-12-1), and is associated with massive-sulphide mineralization.

The alteration zone comprises various mineral assemblages, including garnet-chlorite±magnetite, garnet-anthophyllite-chlorite-magnetite, and kyanite-muscovite-biotite-chlorite. The relationship between these assemblages is not fully understood, but differences in bulk rock composition are thought to be responsible for at least some of the variation. The spatial distribution of alteration assemblages is also locally influenced by subhorizontally plunging F_2 folds. In particular, the interaction of shallow F_2 enveloping surfaces with topography locally produces strike-perpendicular fold repetitions of the alteration zone, resulting in a complex, lens-like map pattern of alteration assemblages (Fig. GS-12-8).

The distinctive metamorphic mineral assemblages in the Boiley Lake area are thought to result from regional metamorphism of primary hydrothermal alteration. The metamorphism does not appear to represent a discrete thermal event, but may be a composite of contact and/or regional thermal events. This interpretation is supported by porphyroblast-matrix microstructural relationships that indicate several periods of garnet growth, consistent with protracted porphyroblastesis. The earliest period of garnet growth occurred synchronous with S_2 crenulation-cleavage development. This resulted in the growth of a large number of snowball garnets (Fig. GS-12-9). Snowball garnets are characterized by spiral inclusion trails, indicating that garnet growth involved significant synkinematic rotation of the growing porphyroblast (e.g., Williams and Jiang, 1999). A second population of garnets is characterized by porphyroblast-matrix relationships that indicate post-D_3/D_4 growth. These porphyroblasts have internal foliations continuous with the external matrix foliation and commonly overgrow F_3 and F_4 folds. This sequence of porphyroblast growth is similar to that observed elsewhere in the Lynn Lake belt (see Beaumont-Smith et al., this volume).

The spectacular snowball garnet porphyroblasts in these rocks will be the focus of a detailed petrographic and microstructural study in the near future.

IMPLICATIONS FOR GOLD EXPLORATION

The geometry and localization of lode gold deposits are strongly influenced at all scales by structure (e.g., Hodgson, 1989; Robert et al., 1994). This relationship is particularly evident in mesothermal, lode-gold districts, such as those

Figure GS-12-8: Subhorizontal F_2 fold hinges and mesoscopic across-strike repetition of garnet porphyroblastic biotite-chlorite schist, Boiley Lake alteration zone.

Figure GS-12-9: Snowball garnet porphyroblast, Boiley Lake alteration zone. Inclusion trails in this porphyroblast, as highlighted by the dark, inclusion-poor band through the centre, record approximately 180° of counter-clockwise rotation of the porphyroblast relative to the penetrative S_2 fabric in the matrix.

associated with Precambrian greenstone belts in the Canadian Shield, where the majority of the gold deposits are spatially associated with crustal-scale, brittle-ductile shear zones (e.g., Kerrich, 1989; Robert et al., 1994). These shear zones are thought to represent the primary conduits for upward-migrating, gold-bearing hydrothermal fluids derived from deep-crustal source regions (Kerrich, 1989). Within individual lode-gold districts, however, gold deposits are typically situated away from the primary shear zone and are associated with contemporaneous arrays of relatively minor, subsidiary structures (i.e., second- and third-order splays; Kerrich, 1989; Robert et al., 1994).

These observations are significant in the context of gold exploration in the Lynn Lake greenstone belt, since most of the recent exploration for mesothermal, shear-hosted gold deposits appears to have been focussed within the Agassiz Metallotect (Fedikow, 1984; Fedikow et al., 1989) and along the main trace of the JSZ. As described above, D_2 shear zones in the Pool Lake area are interpreted to be second- or third-order splays flanking the JSZ and are therefore highly prospective exploration targets. Because splay structures tend to be developed over wide areas (>5 km) along the flanks of the primary shear zone (e.g., Kerrich, 1989), most of the southern Lynn Lake greenstone belt should possess excellent exploration potential for mesothermal, shear-hosted gold deposits. Explorationists are therefore cautioned not to overlook viable, though perhaps more subtle, distal exploration targets in favour of those located along the main trace of the JSZ.

Baldwin (1987) reported the presence of free gold in foliation-parallel quartz veins cutting Pool Lake suite quartz diorite, approximately 1 km northwest of Pool Lake. This gold occurrence was re-examined in the present study and the quartz veins were found to be hosted by a discrete, brittle-ductile, sinistral-reverse shear zone (*see also* Sherman et al., 1988, 1989) that is attributed to the D_6 deformation phase on the basis of deformation style, kinematics and overprinting relationships with S_2 and S_3 planar fabrics. The structural setting and characteristics of the gold-bearing quartz veins indicate that the gold mineralization was synchronous with the D_6 deformation phase, in marked contrast to the inferred syn-D_2 timing of JSZ-hosted gold mineralization in the west Gemmell Lake occurrence, approximately 5 km to the west (Beaumont-Smith and Edwards, 2000), and the Burnt Timber deposit, approximately 20 km to the east (Jones et al., 2000). These relationships indicate (at least) two stages of gold mineralization in the southern Lynn Lake greenstone belt: 1) an early stage associated with ductile, dextral-transpressional D_2 shear and development of the JSZ, and; 2) a later stage associated with brittle-ductile, sinistral-transcurrent D_6 shear and reactivation of the JSZ. An example of late-stage gold mineralization is observed in the

Farley Lake deposit in the northern Lynn Lake greenstone belt, where high-grade, gold-bearing, quartz-sulphide veins were emplaced along shallowly southwest-dipping, brittle-ductile, sinistral faults that cut across D_4 fabric elements (Beaumont-Smith et al., 2000). The D_4 fabric elements described by Beaumont-Smith et al. (2000) appear to correlate with the D_5 fabric elements described in the present study, consistent with syn-D_6 (present study) timing for gold mineralization in the Farley Lake deposit.

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