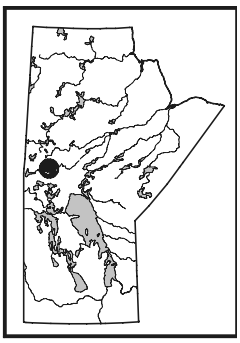
GS-1 GEOCHEMISTRY AND METAL MOBILITY DURING SILICIFICATION OF THE 1.89 GA WELCH LAKE PRIMITIVE ARC BASALT, SNOW LAKE ARC ASSEMBLAGE, SNOW LAKE



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INTRODUCTION

During the 2000 field season, a small outcrop of silicified Welch Lake basalt was mapped at 1:10 scale as part of a B.Sc. thesis at the University of Manitoba. The objective of the study is to establish whether the observed alteration is simply a result of redistribution of elements at the outcrop scale or the result of exchange of elements at a larger scale. If the silicification is part of a regional-scale exchange of elements, then a further objective is to establish the amounts of metal mobilized during alteration, in order to assess the potential for the directly overlying sulphidic sedimentary rocks of the 'Foot-Mud horizon' to contain significant base-metal volcanogenic massive sulphide (VMS) mineralization.

REGIONAL SETTING

The study area is located at the west end of the Paleoproterozoic Flin Flon greenstone belt, in a sequence of isotopically juvenile, ca. 1.89 Ga volcanic rocks, more than 6 km thick, belonging to the Snow Lake arc assemblage (Fig. GS-1-1). The Snow Lake arc assemblage, which contains eight Cu-Zn VMS mines in the Snow Lake area, comprises volcanic rocks that display an upward change from relatively more primitive arc, to relatively more mature arc, to ocean-floor basalt (Bailes and Galley, 1996; Fig. GS-1-2). Both the primitive and mature arc sequences are bimodal in composition, comprising basalt, rhyolite and large subvolcanic tonalite plutons. Volcanogenic massive sulphide deposits in both sequences are hosted by rhyolite and spatially associated with regionally extensive zones of altered volcanic rocks (Fig. GS-1-2). The Snow Lake primitive arc, which is composed of low-Ti refractory basalt lavas (Welch Lake formation), boninite lavas, and isotopically juvenile felsic flows and tonalite plutons, has been interpreted by Bailes and Galley (1999) to be the result of high-temperature hydrous melting of refractory mantle sources in an extensional and/or proto-arc environment.

A prominent zone of silicification, the subject of this study, has affected the upper 500 m of the Welch Lake basalt at the top of the primitive arc sequence (Fig. GS-1-2, -3). This zone has a strike length of more than 20 km and is directly overlain by sulphidic sedimentary rocks (Foot-Mud horizon) containing disseminated pyrite and pyrrhotite. Although low in base-metal content, the Foot-Mud horizon represents a significant episode of sulphide deposition in the Snow Lake region.

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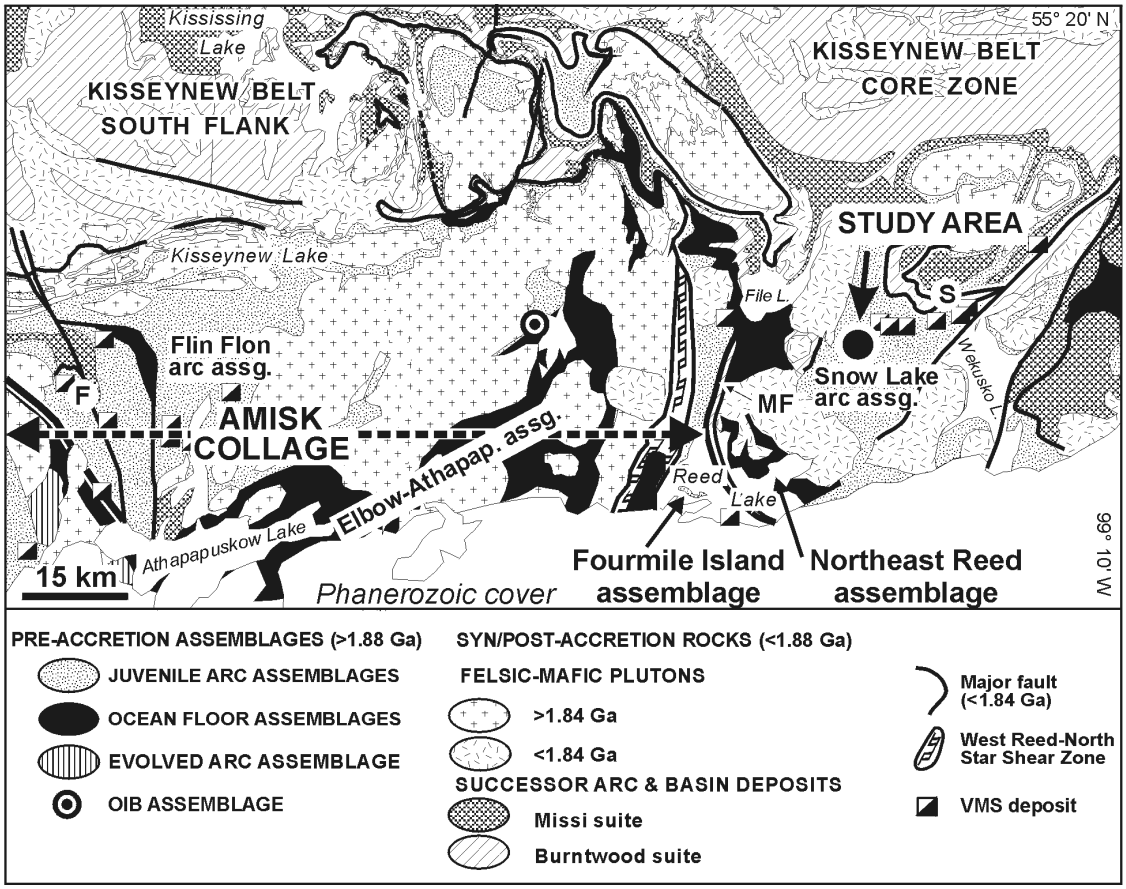

Figure GS-1-1: Simplified geological map of the central and eastern portion of the Flin Flon Belt, showing major tectonostratigraphic assemblages and plutons, and locations of mined VMS deposits. Abbreviations: F, Flin Flon; S, Snow Lake; MF, Morton Lake Fault Zone. Black dot shows location of the study area in the Snow Lake arc assemblage at the east end of the Flin Flon Belt.

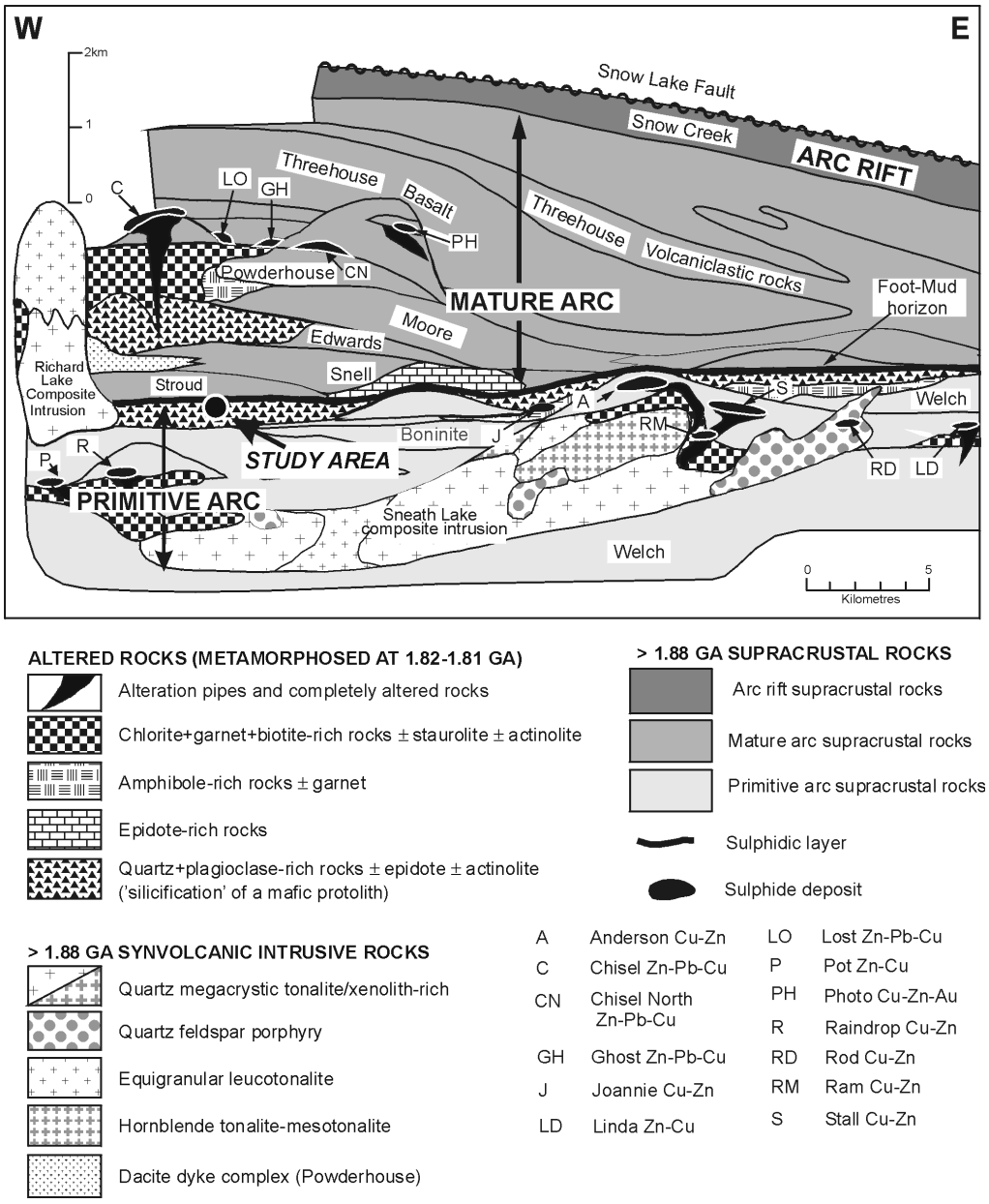

Figure GS-1-2: Schematic cross-section of the Snow Lake arc assemblage, showing distribution of the primitive, mature and arc-rift volcanic rocks, and the overprinting alteration zones. Note the location of the study area at the top of the primitive arc sequence within a regional-scale, conformable zone of silicification.

FIELD MAPPING AND SAMPLING PROCEDURES

The mapping and sampling of the outcrop of silicified Welch Lake basalt was undertaken as follows:

1) The outcrop was carefully cleaned and a 1 m control grid established so that features could be accurately mapped and documented.
2) Primary features in the basalt flow (pillows, interpillow hyaloclastite, amygdales, thermal contraction cracks) were depicted on the map to evaluate their control on alteration.
3) Individual alteration facies, which are presently characterized by distinctive metamorphic mineral assemblages produced during almandine-amphibolite facies regional metamorphism at ca 1.81 Ga, were identified and then mapped.
4) Using a rock saw, samples were collected from each of the alteration facies, including separate sample sets from pillows and interpillow yaloclastite. Late fractures and veins, as well as weathered surfaces and amygdales, were avoided during sample collection.
5) Samples from the pillow core, pillow margin and interpillow hyaloclastite of a relatively unaltered basalt flow in the same section were collected for comparison with the altered basalt samples.
6) The study outcrop and adjacent outcrops were examined for features that could be used to establish the timing of the silicification event. Although the alteration is considered to be synvolcanic, it could also have formed later (e.g. during regional metamorphism).

DATA AND SAMPLE PROCESSING

The alteration facies on the study outcrop will be digitized so that the areal extent and distribution of the various alteration facies can be readily and accurately established. This, in conjunction with geochemistry of samples from the various alteration facies, will enable us to establish the redistribution of elements during alteration.

Polished thin sections from each of the alteration facies will be examined and analyzed by electron microprobe to provide detailed characterization of the mineral assemblages in each of the alteration facies. Geochemical analyses by ICP–MS will be used to identify the geochemical signature of each of the alteration facies.

a)

Figure GS-1-3: a) Study outcrop, showing silicification affecting a series of pillows, with author for scale. b) Individual pillow, showing the variability in intensity of alteration; each zone is characterized by different mineral assemblages, which permit accurate identification and mapping of the alteration facies.

b)

Mass-balance chemical comparison of samples from the silicified basalt and from relatively unaltered equivalents will provide the basis for determining element redistribution in the various alteration facies. These data, combined with the areal extent of the various alteration facies, will be used to determine whether the silicification 1) resulted from redistribution of elements in a ' closed' system (i.e. outcrop-scale), or 2) was externally introduced during a larger, regional-scale alteration event. The mass-balance change of metals during the silification of the study outcrop will indicate whether or not the alteration process was capable of contributing metals to the directly overlying Foot-Mud horizon.

SUMMARY

Mapping of an outcrop of silicified basalt at 1:10 scale was undertaken as part of a B.Sc. thesis at the University of Manitoba. This thesis study, which will be completed by the spring of 2001, comprises detailed mapping and sampling of the outcrop, and comprehensive mineralogical and geochemical studies of the collected samples. It is designed to fully characterize the nature of the alteration, and to provide an understanding of the silicification event that is more complete than that resulting from regional mapping and alteration studies conducted by Bailes and Galley (1992, 1996), Skirrow and Franklin (1994) and Bailes et al. (1996).

REFERENCES

Bailes, A.H. and Galley, A.G. 1992: Chisel–Anderson–Morgan Lakes (NTS 63K/16E); Manitoba Energy and Mines, Geological Services, Preliminary Map 1992S-1, scale 1:20 000.

Bailes, A.H. and Galley, A.G. 1996: Setting of Paleoproterozoic volcanic-associated massive sulphide deposits, Snow Lake, Manitoba; *in* EXTECH I: A Multidisciplinary Approach to Massive Sulphide Research in the Rusty Lake and Snow Lake Greenstone Belts, Manitoba, (ed.) G.F. Bonham-Carter, A.G. Galley and G.E.M. Hall; Geological Survey of Canada, Bulletin 426, p. 105–138.

Bailes, A.H. and Galley, A.G. 1999: Evolution of the Paleoproterozoic Snow Lake arc assemblage and geodynamic setting for associated volcanic-hosted massive sulphide deposits, Flin Flon Belt, Manitoba, Canada; Canadian Journal of Earth Sciences, v. 36, p. 1789–1805.

Bailes, A. H., Galley, A.G., Skirrow, R.G. and Young, J. 1996: Geology of the Chisel volcanic-hosted massive sulphide area, Snow Lake, Manitoba (part of 63K/16SE); Manitoba Energy and Mines, Open File OF 95-4, 1:5000 scale colour map and marginal notes.

Skirrow, R.G. and Franklin, J.M. 1994: Silicification and metal leaching in subconcordant alteration zones beneath the Chisel Lake massive sulphide deposit, Snow Lake, Manitoba; Economic Geology, v. 89, no. 1, p. 31–50.