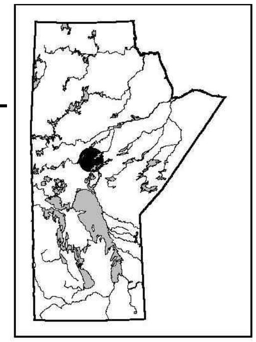
GS-9 HYDRATION OF PIKWITONEI DOMAIN GRANULITE ALONG THE EAST MARGIN OF THE THOMPSON NICKEL BELT (PART OF NTS 63J/16)

by C.D. Lettley[1]



Lettley, C.D. 2001: Hydration of Pikwitonei Domain granulite along the east margin of the Thompson Nickel Belt (part of NTS 63J/16); *in* Report of Activities 2001, Manitoba Industry, Trade and Mines, Manitoba Geological Survey, p. 57-58.

SUMMARY

A study along the east margin of the Thompson Nickel Belt (TNB) was undertaken in order to characterize the metamorphic transition from granulite of the Archean Pikwitonei Granulite Domain to amphibolite-grade gneiss of the Paleoproterozoic TNB. In the summer of 2000, samples of granulite and Paleoproterozoic mafic dykes (Molson swarm), and the equivalents of both these rock types retrogressed to varying degrees through Hudsonian overprinting, were gathered from western Sipiwesk Lake and the Wabowden region (Lettley, 2000). These samples have since been characterized through thin-section petrography, whole-rock geochemical analysis and electron-microprobe analysis. The results have been presented in fulfillment of B.Sc. thesis requirements (Lettley, 2001). A visit to Sipiwesk Lake in the summer of 2001 revealed that the water level in the lake has risen substantially in the past year, submerging most of the outcrop on which this study is based.

RESULTS

Based on mineral-phase stability, the conditions under which the granulite formed are approximated as 850°C and 900 MPa (9 kbar). The following reactions have been identified in the granulites:

a) calcic amphibole + quartz $\rightarrow$ orthopyroxene + Ca-rich clinopyroxene + plagioclase + water

e.g., $4\ Ca_{1.5}Na_{0.5}(Fe,Mg)_{4.5}Al_{0.5}Al_{1.5}Si_{6.5}O_{22}(OH)_2 + 7\ SiO_2 \rightarrow$
$15\ (Fe,Mg)SiO_3 + 3\ Ca(Fe,Mg)Si_2O_6 + 3\ CaAl_2Si_2O_8 + 2\ NaAlSi_3O_8 + 4\ H_2O$

b) orthopyroxene + anorthite ± calcic amphibole $\rightarrow$ garnet + Ca-rich clinopyroxene ± quartz ± albite ± water

e.g., $6\ (Fe,Mg)SiO_3 + 2\ CaAl_2Si_2O_8 \rightarrow 2\ Ca_{0.5}(Fe,Mg)_{2.5}Al_2Si_3O_{12} + Ca(Fe,Mg)Si_2O_6 + 2\ SiO_2$

or

$12\ (Fe,Mg)SiO_3 + 8\ CaAl_2Si_2O_8 + 8\ Ca_{1.5}Na_{0.5}(Fe,Mg)_{4.5}Al_{0.5}Al_{1.5}Si_{6.5}O_{22}(OH)_2 \rightarrow 14\ Ca_{0.5}(Fe,Mg)_{2.5}Al_2Si_3O_{12}$
$+ 13\ Ca(Fe,Mg)Si_2O_6 + 4\ NaAlSi_3O_8 + 8\ H_2O$

Reaction (b) has only taken place in layers of mafic granulite that have a Mg# less than 0.55.

Ambient conditions at the time of Molson dyke emplacement (1883 Ga in Heaman et al., 1986), as identified through deuteric alteration assemblage, were approximately 600°C and 500 MPa (5 kbar).

A hydration front associated with pegmatite and quartz veins is locally readily apparent at the eastern margin of the TNB (Fig. GS-9-1). Amphibolite that is reworked within the TNB can be highly disrupted (Fig. GS-9-2) and mineral assemblages are altered or partly altered by hydration (Fig. GS-9-3). This Hudsonian alteration along the extreme east margin of the TNB

[1] Department of Geology, Brandon University, Brandon, Manitoba R7A 6A9

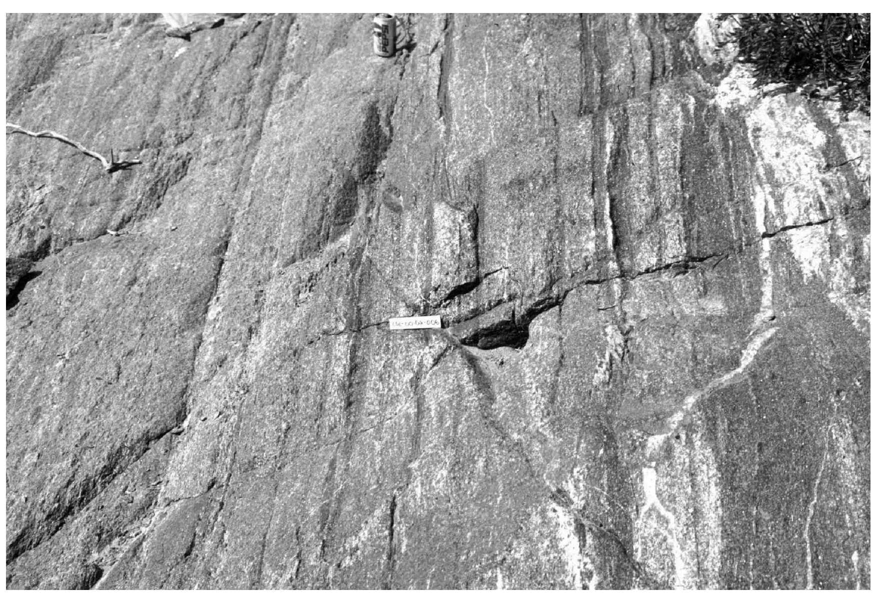


Figure GS-9-1: Boundary between unaltered granulite (left) and statically hydrated material associated with pegmatite veins (right) in the easternmost granulite affected by static hydration associated with pegmatite and quartz veining during Hudsonian overprinting. Individual lithological layers can be traced across such boundaries. Contrast between altered and unaltered granulite was digitally enhanced. Soft-drink can for scale at top of photo.

took place under conditions of approximately 600 to 650°C and 500 MPa (5 kbar). The alteration consists of static, largely isochemical hydration along digitate zones associated with discordant pegmatite and quartz veins. The alteration led to the replacement of pyroxene, largely with calcic amphibole and cummingtonite. A deformational fr?ont and associated pervasive alteration occur less than 1.5 km to the west of the hydration front. In situ melting took place to the west of this front, with postdeformational pegmatite veins situated near the front.

Amphibolite units sampled from reworked basement material in the core of the TNB, near Wabowden, have compositions and rare-earth element distributions that are consistent with that of the granulite at Sipiwesk Lake. This suggests that the TNB amphibolite units were derived from the granulite or related gneiss.

Figure GS-9-2: Amphibolite gneiss found to the west of the deformational front. Note the disrupted nature of the layering and the postdeformational aplite vein that cuts the gneiss. Metal box in background is 20° cm high.

ACKNOWLEDGMENTS

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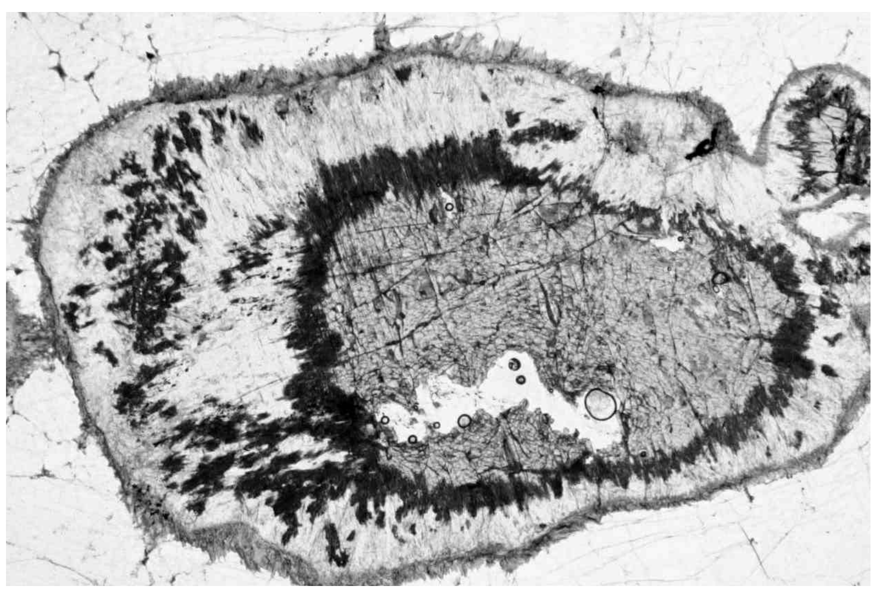

Figure GS-9-3: Incomplete alteration of an orthopyroxene grain from statically hydrated granulite. The dark outer rim is composed largely of biotite, and the inner, pale zone is composed largely of cummingtonite. The dark material within the cummingtonite zone and immediately rimming the orthopyroxene core is in optical continuity with the orthopyroxene. Field of view is 7 mm.