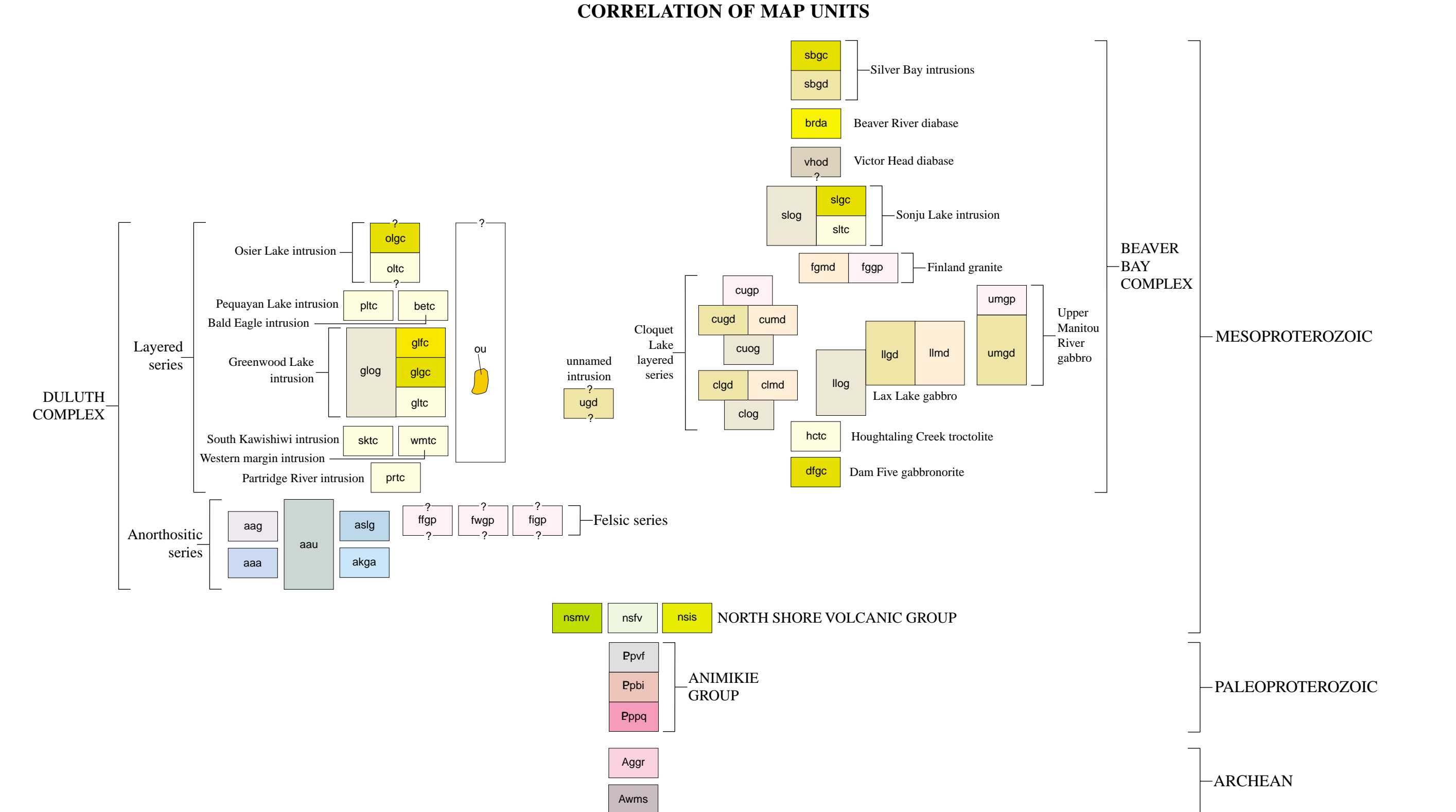


Digitized base modified from 1990 Census TIGER file of U.S. Bureau of the Census (source scale 1:100,000). County border lines modified from Minnesota Department of Transportation files. Digitized base annotated by Minnesota Geological Survey.
Geographic coordinates: National Projection, grid zone 18
1983 North American Datum

SCALE 1:100,000
0 1 2 3 4 5 6 7 8 9 10 KILOMETERS
0 1 2 3 4 5 6 7 8 9 10 MILES

GIS completion and cartography by J.D. Miller, Jr., T.E. Walz, J.P. Miller, and Philip Hancock
Layout by K.S. Powell and R. Lewis
Editing by K.S. Powell



INTRODUCTION

This bedrock geologic map is based on data acquired from outcrop, drilling, and on interpretations of aeromagnetic and gravity data. The color scheme used reflects the rock types. The major intrusive units of the Duluth and Beaver Bay complexes are identified by name and symbol on the index map. The symbols used on the bedrock geologic map indicate the intrusion name and series, and the rock type.

PROTEROZOIC
MESOPROTEROZOIC

Mesoproterozoic rocks in this region include massive and volcanic rocks, and minor amounts of sedimentary rock associated with the 1.1 Ga Midcontinent Rift. The order in which intrusive bodies of the Duluth Complex and the Beaver Bay Complex formed is generally well constrained. U-Pb ages indicate that the oldest rocks of the Duluth Complex are about 3 million years older than the youngest rocks of the Beaver Bay Complex (11). The extent of any overlap in intrusive activity between the two complexes is not known. The prefix P is omitted from all Mesoproterozoic unit abbreviations in this description, as well as from the map.

BEAVER BAY COMPLEX—Mafic to felsic rocks that form multiple discrete intrusions that are part of an intrusive igneous suite emplaced into stratigraphically high parts of the North Shore Volcanic Group.

Silver Bay intrusions—Gabbroic rock; massive to well-foliated; forms small (<2 km long) elongated intrusions into the upper parts of the Beaver River dike; well-exposed (9); marginal gabbro (dgg) provides a U-Pb age of 1095.8 ± 1.1 Ma (11).

Beaver River dike—Diabase dike and sill swarm; well-exposed (8, 10).

Victor Head dike—Diabase sill; 50-65 m thick; segmented by the Beaver River dike (9).

Snajva Lake intrusion—Mafic layered intrusion; well-differentiated; 1-1.5 km thick; sheetlike intrusion emplaced beneath the Finland granite; poorly exposed; projected into the map area on the basis of aeromagnetic pattern linked to good exposure in the Finland quadrangle to the east (10); gabbroic cumulates (stg) provide a U-Pb age of 1096.120 ± 0.8 Ma (11).

Olivine gabbro; includes augite troctolite; forms the noncumulate extension of the intrusion; inferred from aeromagnetic data and outcrop near its southern extent.

Finland granite—Monzonite to granophytic granite; massive; incompletely exposed; cuts the Lax Lake gabbro; extent inferred from sparse outcrop and aeromagnetic signature.

Upper Manitowish intrusion—Felsic to mafic monzonite rock; inferred on the basis of sparse outcrop and projection of aeromagnetic data from the Cabot Lake quadrangle to the east (9).

Chagoy Lake layered series—Mafic to felsic intrusive rock; forms multiple, nested, half-saucer-shaped intrusions; poorly exposed; inferred from aeromagnetic data, scattered drill-hole data and sparse outcrop; subdivided into an upper and lower series that define crude differentiation cycles; cumulate textures are documented for both the upper and lower series in drill core from the northern part of the unit, but are rare in drill core and outcrop in the southern part of the unit.

Lax Lake gabbro—Mafic to intermediate, noncumulate intrusives; rock complex contains several rock types; commonly altered; moderately well-exposed (8, 10).

Hoaghalung Creek troctolite—Troctolite macrocline; projected into map area on basis of aeromagnetic data linked to outcrop in the Cabot Lake quadrangle to the east (9); intrudes the Dam Five gabbroite.

DESCRIPTION OF MAP UNITS

Dam Five gabbroite—Gabbroite; forms a southeast-dipping sheet; intruded by the Hoaghalung Creek troctolite; projected into map area on basis of aeromagnetic data linked to outcrop in the Cabot Lake quadrangle to the east (9).

Gabbroic cumulates; contain cumulus orthopyroxene.

UNNAMED INTRUSION
Gabbro to diorite; this southeast-dipping sheet of altered gabbro.

DULUTH COMPLEX—Intrusive igneous suite of mafic to felsic rock; subdivided into four series, three of which the layered series, the anorthositic series and the felsic series are present in the area mapped; emplaced into stratigraphically lower parts of the North Shore Volcanic Group.

Layered series—Mafic layered intrusions; form multiple discrete intrusive bodies, each of which displays uniform internal structure, cumulate rock textures, and cryptic compositional layering, indicative of in situ differentiation; contains similar rock types that are assigned to different intrusions, such as the contact between similar rock types of the Bald Eagle intrusion and sills (troctolite of the South Kawishwi intrusion), are located on the basis of directional changes in the geophysical strike that are ascribed to different trends of compositional layering.

Oxide-bearing ultramafic intrusive body—oxide-bearing diorite, clinopyroxene and peridotite; irregularly shaped; cuts across the troctolite cumulates of the layered series; known largely from aeromagnetic drilling targeted on aeromagnetic anomalies; includes intrusions known as Section 17, Longson, Skibo, Longson, Section 22 and Water Lake (14, 15).

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Kariakid Lake gabbroic anorthosite; projected into map area on basis of aeromagnetic data (9) linked to outcrop in the Cabot Lake quadrangle to the east.

Anorthositic series—Intermediate to felsic intrusive rocks; forms isolated bodies in the roof zone of the Duluth Complex; age relations with anorthositic series and layered series rocks are unclear.

Upper Manitowish intrusion—Felsic to mafic monzonite; micrographic to intergranular; known from sparse outcrop; regional extent inferred from aeromagnetic and gravity data.

Granophyte of the Fairbank & Britton quadrangles; inferred exclusively from aeromagnetic and gravity data.

Granophyte of the Inland area; documented from one drill core; regional extent inferred from aeromagnetic data.

Tholeiitic plateau lava flows and minor intrusions—Tholeiitic plateau lava flows and minor intrusions; well-exposed in vicinity of Lake Superior (8, 10); inferred from variable and locally high intensity aeromagnetic signatures in areas of no outcrop; where present as isolated inclusions in rocks of the Beaver Bay and Duluth Complexes the mafic volcanic rocks are metamorphosed to fine-grained mafic hornfels.

Felsic volcanic rocks; known from two drill cores; regional extent inferred from moderate intensity aeromagnetic signatures and projection of units from the Cabot Lake quadrangle to the east (9).

Interflow volcanoclastic rocks; commonly stratified; extensively reworked; associated with mafic hornfels.

PALEOPROTEROZOIC
ANIMIKIE GROUP

Virginia Formation—Argillaceous siltstone, carbonaceous shale, mudstone, and graywacke; well-bedded; nonpyroclastic; adjacent to the Duluth Complex.

Bowling Green Formation—Iron-bearing interbedded chert and slate; well-bedded.

Pokangama Quartzite—Quartz arenite; locally cross-bedded.

ARCHEAN
ANIMIKIE GROUP

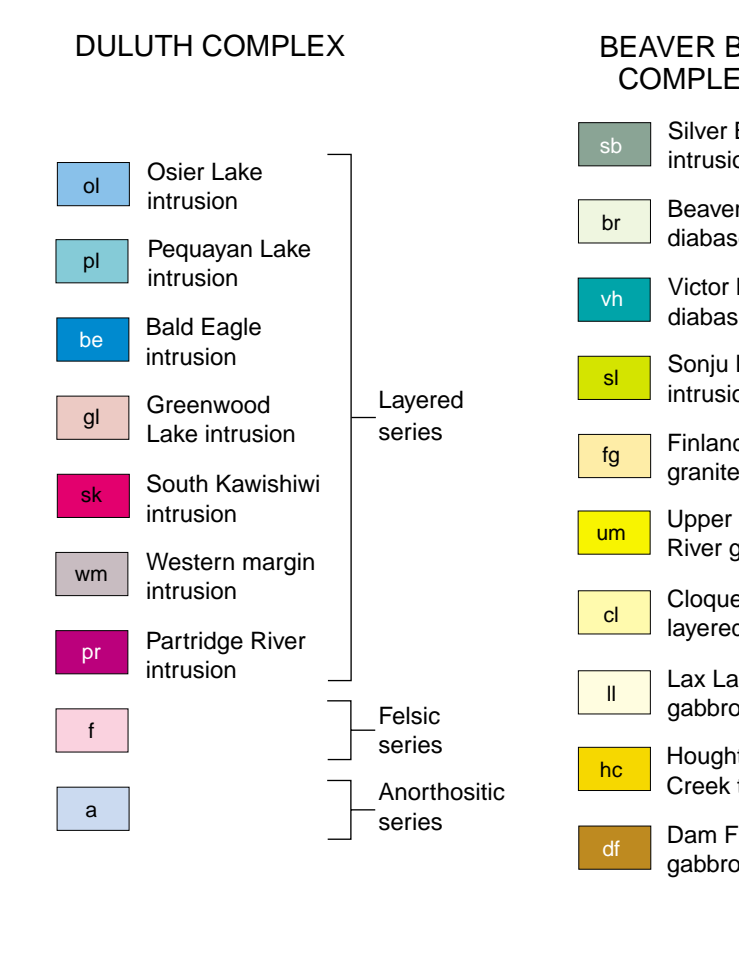
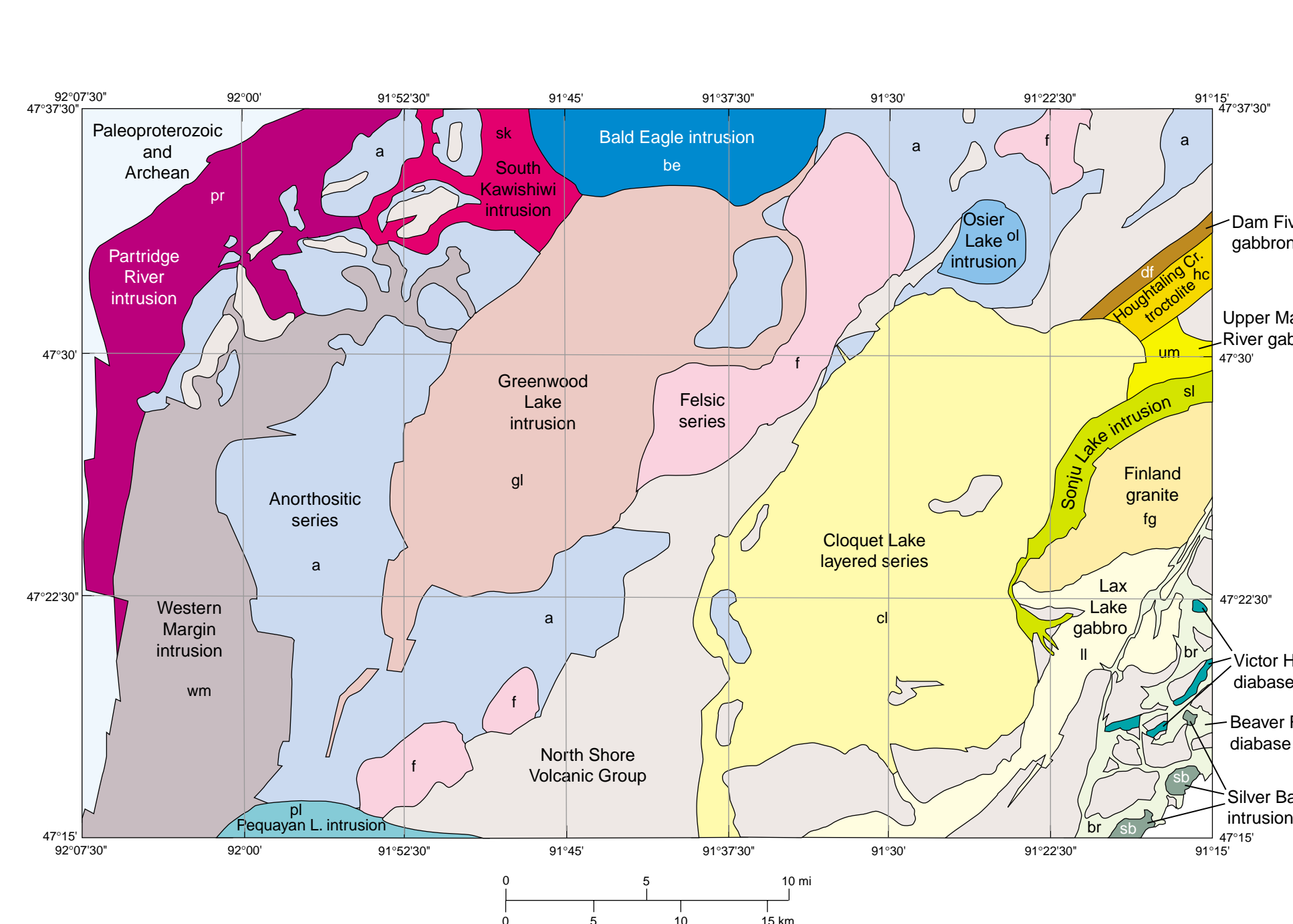
Granite Range Batholith—Granitic rock; quartz monzonite to granite; massive.

Supracrustal rocks of the Wawa Subprovince—Mesosedimentary rock; include meta-argillite, graywacke, and volcanoclastic rock; metamorphosed to greenschist facies (locally higher grade near granite contact); steeply inclined bedding and foliation.

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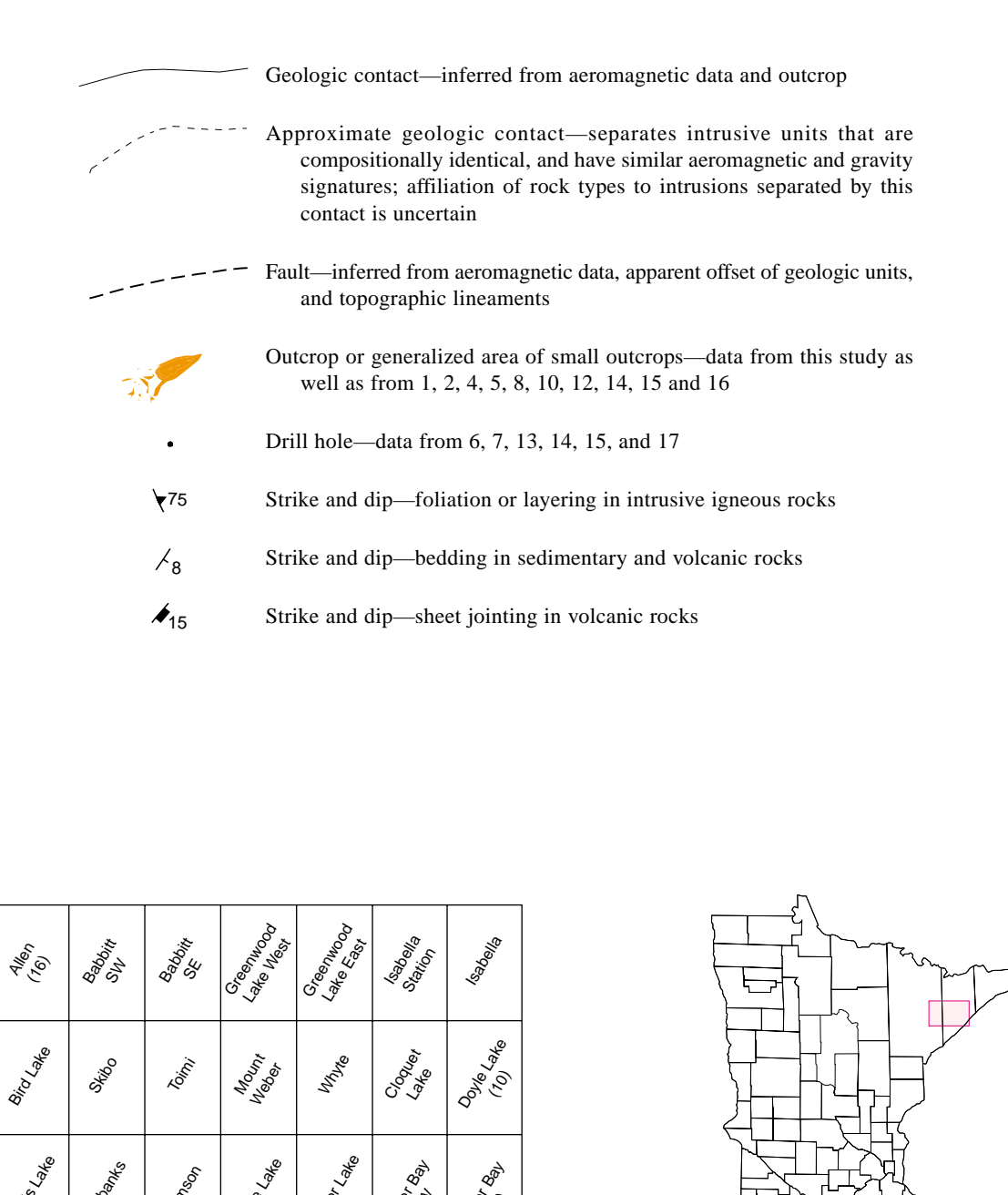
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GENERALIZED GEOLOGIC INDEX MAP SUMMARIZING MAJOR INTRUSIVE UNITS OF THE MESOPROTEROZOIC DULUTH AND BEAVER BAY COMPLEXES
[see correlation and description of map units for lithologic descriptions and temporal relations]

DESCRIPTION OF MAP SYMBOLS



Index to the 7.5 minute quadrangles that cover the mapped area. Numbers in parentheses refer to published 1:24,000 maps (see references).



BEDROCK GEOLOGIC MAP OF THE CENTRAL DULUTH COMPLEX AND WESTERN PART OF THE BEAVER BAY COMPLEX, LAKE AND ST. LOUIS COUNTIES, MINNESOTA

By
James D. Miller, Jr., and Val W. Chandler
1999