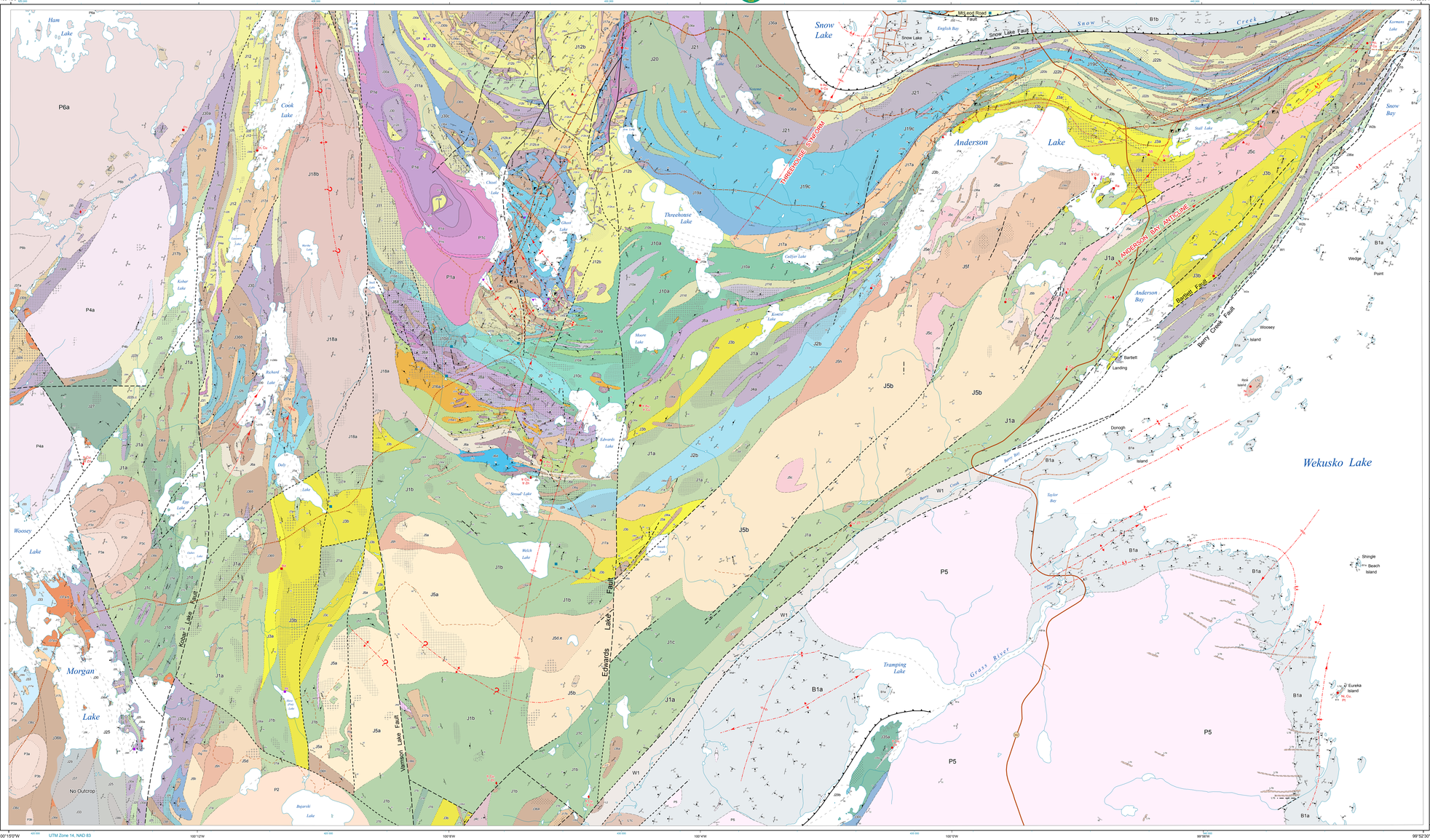

PALEOPROTEROZOIC

LATE TECTONIC ROCKS

INTRUSIVE ROCKS

- **L2** — Quartz-feldspar porphyry
- **L1** — Mafic to intermediate dikes and intrusions
  - a — quartz diorite, diorite
  - b — plagioclase-phyric diorite
  - c — gabbro, pyroxenite

TECTONITE

- **W2** — Felsic tectonite
  - a — felsic mylonite, felsic phyllonite
  - b — highly recrystallized felsic breccia
- **W1** — Mafic tectonite: mylonite, phyllonite

LATE SUCCESSOR-ARC INTRUSIVE ROCKS (includes rocks of unknown age)

- **P6** — Ham pluton
  - a — medium- to coarse-grained biotite-hornblende granodiorite and tonalite
  - b — up to 30% xenoliths
  - c — partly assimilated xenolith of country rocks
- **P5** — Wekusko and Tramping plutons: medium- to coarse-grained hornblende-biotite granite and granodiorite
- **P4** — Woosey pluton
  - a — foliated to gneissic, medium-grained biotite-hornblende granodiorite
  - b — aphanitic leucotonalite
  - c — aphanitic leucotonalite
- **P3** — Epp-Morgan intrusive complex
  - a — medium-grained equigranular granodiorite
  - b — medium-grained biotite-hornblende granodiorite
  - c — agmatitic hornblende-phyric tonalite, abundant xenoliths
  - d — hornblende-phyric quartz diorite
  - e — gabbro, quartz diorite, hornblende-phyric quartz diorite and intrusion breccia
  - f — hornblende-phyric tonalite dike complex and spatially associated altered volcanic rocks
- **P2** — Bujarski pluton: medium- to coarse-grained hornblende tonalite, up to 10% small mafic xenoliths
- **P1** — Chisel layered ultramafic intrusion (age unknown)
  - a — lower and upper peridotite
  - b — pyroxenite
  - c — lower gabbro
  - d — middle gabbro
  - e — upper gabbro
  - f — upper margin zone, gabbro-pyroxenite

BURNTWOOD GROUP

- **B1** — Greywacke, siltstone, mudstone, and derived paragneiss
  - a — greywacke, siltstone and mudstone
  - b — garnet-biotite gneiss estauorlite; bedding well preserved

SNOW LAKE ARC ASSEMBLAGE

UNDIVIDED INTRUSIVE ROCKS (may include rocks younger than Snow Lake arc assemblage)

- **J37** — Fine-grained leucotonalite, quartz diorite intrusions
  - a — equigranular
  - b — plagioclase-phyric
- **J36** — Gabbro, diorite, quartz diorite
  - a — fine- to medium-grained
  - b — medium-grained
  - c — coarse-grained
  - d — plagioclase-phyric
  - e — pyroxene-phyric, pyroxene-plagioclase–phyric
  - f — quartz diorite, meta-tonalite, tonalite
  - g — magnetiferous diorite, quartz diorite, tonalite
  - h — dike complex

SNOW CREEK SEQUENCE

- Tramping Lake basalt
  - **J35** — a — aphyric massive flows with rare aphyric pillowed flows
  - b — interflow pyritic mudstone
- **J34** — Snow Creek basalt: aphyric massive flows, minor pillowed flows and local gabbroic-textured flows

CHISEL SEQUENCE

Undivided Lower and Upper Chisel Sequence

- **J33** — Paracongloomerate, minor greywacke and mudstone
- **J32** — Fine-grained quartzofeldspathic metamorphic rocks, mainly derived from felsic volcanic rocks
  - a — quartz-phyric
  - b — fragmental
- **J31** — Dacite and rhyodacite tuff, lapilli tuff
- **J30** — Mixed mafic and felsic heterolithic volcanic breccia
  - a — breccia composed mainly of mafic fragments, minor mafic tuff and lapilli tuff
  - b — breccia composed mainly of felsic fragments
  - c — intermediate and mafic tuff and lapilli tuff
- **J29** — Mafic monolithic to weakly heterolithic volcanic breccia
  - a — dominantly aphyric clasts, minor intermediate to felsic clasts
  - b — dominantly pyroxene-phyric and pyroxene-plagioclase–phyric clasts, minor intermediate to felsic clasts
  - c — mafic tuff and lapilli tuff
- **J28** — Fine-grained mafic gneiss, mainly derived from mafic flows
- **J27** — Pyroxene-phyric flows, pyroxene-plagioclase–phyric flows, includes pillowed and massive flows
- **J26** — Plagioclase-phyric mafic pillowed and massive flows
- **J25** — Aphyric mafic pillowed and massive flows

Upper Chisel Sequence

Intrusive rocks

- **J24** — Plagioclase- and plagioclase-pyroxene–phyric gabbro and diorite (feeders for Threehouse basalt and basaltic andesite), locally amygdaloidal
- **J23** — Pyroxenite, melagabbro and gabbro (feeders for Threehouse basalt and basaltic andesite)
  - a — pyroxenite, melagabbro
  - b — gabbro
  - c — amygdaloidal

Supracrustal rocks

- **J22** — Undivided rhyolite and rhyodacite
  - a — quartz- and quartz-plagioclase–phyric
  - b — aphyric and sparsely porphyritic
  - c — fragmental
  - d — quartzofeldspathic gneiss
- **J21** — Heterolithic mafic volcanic breccia
  - a — mainly plagioclase-phyric clasts, minor intermediate to felsic clasts
  - b — dominantly pyroxene-phyric and pyroxene-plagioclase–phyric clasts, minor intermediate to felsic clasts
- **J20** — Threehouse mafic volcaniclastic rocks
  - a — pyroxene- and pyroxene-plagioclase–phyric pillowed and massive flows
  - b — pyroxene- and pyroxene-plagioclase–phyric pillowed and massive flows
- **J19** — Threehouse basalt and basaltic andesite
  - a — mafic tuff and lapilli tuff, minor tuff breccia
  - b — monolithic mafic breccia, porphyritic clasts dominate
  - c — heterolithic mafic breccia, porphyritic clasts dominate

Lower Chisel Sequence

Intrusive rocks

- **J18** — Richard intrusive complex
  - a — equigranular and quartz-megacrystic, medium-grained biotite leucotonalite
  - b — equigranular, fine- to medium-grained biotite leucotonalite, associated aplite dikes
  - c — equigranular, fine-grained biotite leucotonalite
  - d — equigranular hornblende-biotite tonalite
  - e — hornblende mesotonalite
  - f — aplite
- **J17** — Quartz porphyry, quartz-plagioclase porphyry (includes younger intrusions)
  - a — phenocrysts <5 mm
  - b — phenocrysts larger >5 mm
  - c — dike complex
  - d — mesocratic, quartz-plagioclase-hornblende porphyry
  - e — aphyric to sparsely quartz-phyric
- **J16** — Dacite dike complex (feeders for Powderhouse dacite)
  - a — plagioclase-phyric, plagioclase-quartz–phyric
  - b — dike complex
  - c — dacite, unknown affiliation
- **J15** — Gabbro, diorite, quartz diorite, fine- to medium-grained (feeders for Moore basalt)
- **J14** — Hornblende-phyric diorite, pyroxene- and pyroxene-plagioclase–phyric diorite (includes younger intrusions)
  - a — hornblende-phyric diorite (feeders for Cabosse andesite)
  - b — pyroxene- and pyroxene-plagioclase–phyric diorite and quartz diorite, may contain quartz phenocrysts
  - c — intrusion breccia

Supracrustal rocks

- **J13** — Balloch basalt: aphyric massive basalt and basaltic andesite, minor pillows and amoeboid pillow breccia
- **J12** — Rhyolite and rhyodacite: includes Chisel, Ghost, Photo and Cook rhyolite complexes
  - a — quartz and quartz-plagioclase–phyric
  - b — aphyric and sparsely porphyritic
  - c — fragmental
  - d — quartzofeldspathic gneiss
  - e — quartz-feldspar quartz amygdules >1 cm diameter
- **J11** — Powderhouse dacite: tuff, lapilli tuff
  - a — dacite tuff, minor lapilli tuff
  - b — heterolithic felsic and mafic breccia
  - c — stratified felsic tuff and lapilli tuff
  - d — dacite and rhyodacite flows
- **J10** — Moore Lake basalt: basalt and basaltic andesite flows
  - a — aphyric and sparsely plagioclase-phyric massive flows, minor breccia
  - b — porphyritic massive and pillowed flows
  - c — amoeboid pillow breccia
  - d — pillow-fragment breccia
  - e — heterolithic mafic breccia
  - f — mafic tuff, lapilli tuff
- **J9** — Cabosse andesite: amphibole-phyric massive and pillowed flows
- **J8** — Edwards mafic volcaniclastic rocks
  - a — heterolithic mafic breccia, (plagioclase-phyric clasts dominate), minor felsic clasts, minor mafic tuff and lapilli tuff
  - b — mafic tuff and lapilli tuff, minor breccia
- **J7** — Snell basalt: plagioclase- and plagioclase-pyroxene–phyric basalt, basaltic andesite and andesite; includes gabbroic-textured flows
- **J6** — Stroud breccia: felsic breccia, lapilli tuff and tuff; contains clasts of Sneath intrusive complex
  - a — heterolithic and monolithic felsic breccia, lapilli tuff and tuff
  - b — quartz-megacrystic felsic breccia
  - c — heterolithic felsic breccia, up to 50% intercalated mafic volcaniclastic rocks
  - d — intermediate to mafic tuff and lapilli tuff

ANDERSON SEQUENCE

Intrusive rocks

- **J5** — Sneath intrusive complex
  - a — quartz-phyric leucotonalite (3-5 mm phenocrysts)
  - b — quartz-megacrystic leucotonalite (10-20 mm phenocrysts)
  - c — quartz-plagioclase porphyry, quartz-phyric fine-grained leucotonalite
  - d — medium-grained equigranular leucotonalite
  - e — fine-grained equigranular leucotonalite
  - f — quartz-megacrystic medium- to coarse-grained tonalite and metatonalite
  - g — tonalite intrusion breccia
  - h — tonalite with abundant mafic xenoliths

Supracrustal rocks

- **J4** — Heterolithic volcanic breccia
  - a — mainly mafic
  - b — mixed mafic and felsic
  - c — mainly felsic
  - d — mafic tuff and lapilli tuff
- **J3** — Rhyolite and rhyodacite: includes Anderson, Konzie, Sneath and Daly rhyolite complexes
  - a — quartz- and quartz-plagioclase–phyric
  - b — aphyric and sparsely porphyritic
  - c — heterolithic felsic breccia
  - d — quartzofeldspathic gneiss
- **J2** — Bronnite and bronnite-like flows: andesite and basaltic andesite
  - a — aphyric
  - b — pyroxene- and pyroxene-plagioclase–phyric
- **J1** — Welch basalt: low-Ti tholeiitic basalt, basaltic andesite and andesite
  - a — aphyric pillowed and massive flows
  - b — sparsely pyroxene-phyric pillowed and massive flows
  - c — plagioclase (±pyroxene)-phyric pillowed and massive basalt flows
  - d — plagioclase-phyric monolithic and pillow-fragment breccia
  - e — plagioclase (±pyroxene)-phyric monolithic and pillow-fragment mafic breccia
  - f — pyroxene (±plagioclase)-phyric pillowed and massive flows

Alteration zones

Alteration pipes and completely altered rocks (includes sulphide-rich veins)

- Kyanite+chlorite+biotite±staurolite±andalusite±garnet±pyrite
- Staurolite+kyanite+biotite±chlorite±garnet±pyrite±pyrite

Quartz+plagioclase–rich rocks derived from a mafic protolith

- >50% quartz+albite±epidote in a matrix of 5–25% garnet, 30–60% actinolite and 3–5% magnetite
- 10–50% quartz+albite±epidote set in a matrix of 5–15% garnet, 30–60% actinolite and 0–3% magnetite

Chlorite+garnet+biotite–rich rocks

- 20–75% garnet+chlorite±staurolite±biotite±actinolite
- 10–20% chlorite+biotite±garnet±magnetite
- 20–40% garnet+chlorite±staurolite localized in rectilinear fracture arrays
- 5–20% garnet+chlorite±staurolite localized in rectilinear fracture arrays
- 5–20% pervasive fine-grained chlorite and actinolite producing patchy dark coloured domains in felsic volcanic rocks

Amphibole–rich rocks

- >40% coarse-grained amphibole±chlorite±staurolite±garnet±sulphide
- 10–40% coarse-grained amphibole±garnet
- 10–20% fine-grained actinolite±garnet±tremolite

Disseminated sulphides

- 0.5–4% pyrite±pyrrhotite±chalcopyrite, commonly accompanied by sericitization
- Rusty weathering, disseminated sulphides

Other alteration types

- Epidote+hematite–rich rocks: bleached rocks with up to 10% combined garnet+biotite±chlorite±magnetite
- Carbonate–rich rocks: iron carbonate–filled fractures related to late, brittle faulting

Mineralization

VMS orebody (▲Cu-rich, ▼Zn-rich) - up-plunge location unless otherwise noted

- ▲ **A1** and **A2** - Anderson 1 and 2 (Cu, Zn)
- ▼ **C** - Chisel (Zn, Cu, open pit)
- ▼ **CN** - Chisel North (Zn, Cu; vertical projection)
- ▼ **G** - Ghost (Zn, Cu)
- ▼ **L** - Lost (Zn, Cu)
- ▲ **R1** and **R2** - Root 1 and 2 (Cu, Zn)
- ▲ **P** - Photo Lake (Cu, Zn, Au)
- ▲ **S1-6** and **S8** - Stall 1, 6 and Stall 8 (Cu, Zn)

VMS mineral deposit (●Cu-rich, ●Zn-rich) - up-plunge location unless otherwise noted

- ■ **La** - Lator (Zn, Cu; vertical projection)
- ■ **Li** - Linda (Cu, Zn)
- ■ **M** - Morgan (Zn, Cu)
- ■ **Pe** - Pen (Cu, Zn)
- ■ **Ph** - Phil (Zn, Cu)
- ■ **Rd** - Raindrop (Cu, Zn)
- ■ **Ra** - Ram Zone (Cu, Zn)

Other mineralization types (commodities listed in order of economic significance)

- Mineral occurrence - surface showing without any grade and tonnage
- Drillhole intersection
- Sand and gravel quarry site

Commodity abbreviation (tr = trace amount)

Au	Gold
Cu	Copper
Pd	Palladium
Pt	Platinum
Zn	Zinc

Symbols

Geological boundaries

- Contact - defined
- Contact - approximate
- Contact - assumed
- Contact - gradational
- Contact - underwater
- Fault - defined
- Fault - approximate
- Fault - assumed
- Fault - thrust

Major folds: 1st or 2nd generation (single dots), 3rd generation (3 dots); arrows indicate plunge direction

- anticline, overturned anticline, antiform
- syncline, overturned syncline, synform

Infrastructure

- Highway - paved
- Highway - loose surface
- Subsidiary road - maintained
- Subsidiary road - not maintained
- Street
- Cleared trail
- CN rail line - abandoned
- Transmission line

Other features

- Mine shaft, vertical (in operation, abandoned)
- Mine portal (in operation, abandoned)
- Area of limited or no outcrop

Structure symbols

Layering

- Bedding, facing known (inclined, vertical, overturned)
- Bedding, facing unknown (inclined, vertical, dip unknown)
- Flow contact, facing known (inclined, overturned)
- Flow contact, facing unknown
- Pillows, facing known (inclined, overturned)
- Pillows, facing unknown

Foliation, schistosity (inclined, dip unknown)

- 1st or 2nd generation
- 3rd generation
- 4th generation
- Unknown generation

Cleavage (inclined, dip unknown)

- 3rd generation
- 4th generation
- Unknown generation

Minor fold axial plane (inclination known, unknown)

- 1st or 2nd generation
- 3rd generation
- 4th generation
- Unknown generation

Minor fold axis (M_n-S_n-Z_n-symmetry)

- 1st or 2nd generation
- 3rd generation
- 4th generation
- Unknown generation

Lineations

- Crenulation, intersection lineation (S_1/S_{2-3}, S_2/S_3, S_{2-3}/S_4, undefined age)
- Shape lineation (typically deformed clast), mineral lineation, rodding

Minor faults, shears

- Faults: dextral, sinistral, reverse, sense unknown
- Shears: dextral, sinistral, sense unknown

Published by Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, 2007.

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Suggested reference:
Bailes, A.H. and Galley, A.G. 2007: Geology of the Chisel–Anderson lakes area, Snow Lake, Manitoba (NTS areas 63K16SW and west half of 63J13SE); Manitoba Science, Technology, Energy and Mines, Manitoba Geological Survey, Geoscientific Map MAP2007-1, scale 1:20 000 plus notes.

Geology of the Chisel–Anderson lakes area, Snow Lake, Manitoba (NTS areas 63K16SW and west half of 63J13SE)

0 500 1 000 1 500 2 000 Metres

1:20 000

Geology by A.H. Bailes (Manitoba Geological Survey, 1987-1992) and A.G. Galley (Geological Survey of Canada, 1989-1992)*

* 1:5000 and 1:10 000 scale maps by Bailes and Galley (1993); Bailes et al. (1996) and Bailes (1997) were incorporated into this 1:20 000 scale map. See accompanying notes for references.

GIS processing by L.E. Chackowsky, Manitoba Geological Survey

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