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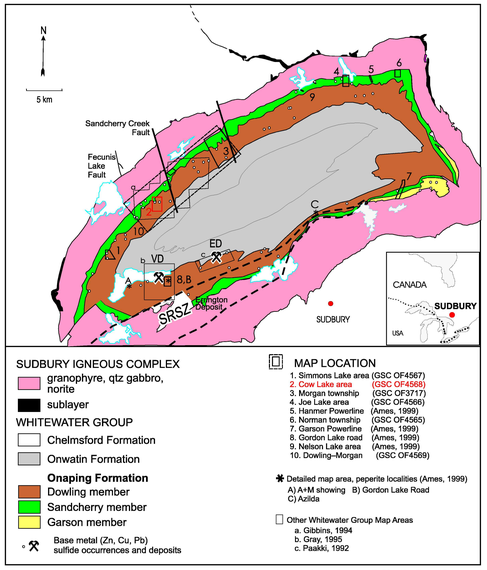

Figure 1. Location and general geology map illustrating the regional distribution of the members of the Onaping Formation. VD, ED = Vermilion and Errington Zn-Pb-Cu-Ag deposits. SRSZ = South Range shear zone.

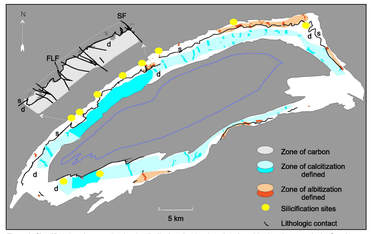

Figure 3. Simplified alteration map showing the distribution of regional semi conformable alteration zones in the Onaping Formation, Sudbury Structure. Alteration zones are inferred (light shades) between defined mapped areas (dark shades). S = Sandcherry member, D = Dowling member. Note the transgressive nature of the carbon contact across the Sandcherry/Dowling member contact on inset map.
Data compiled from this study, unpublished Falconbridge Ltd. Data, Gibbins, 1994, and Gray, 1995.

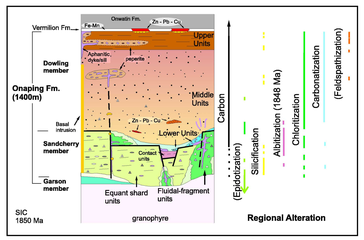

Figure 4. Simplified stratigraphic and alteration section for the Onaping Formation, Sudbury Structure showing the distribution and vertical stacking of regional basin-wide hydrothermal alteration zones. Brackets denote alteration types with poorly constrained regional distribution patterns (modified from Ames et al., 1998).

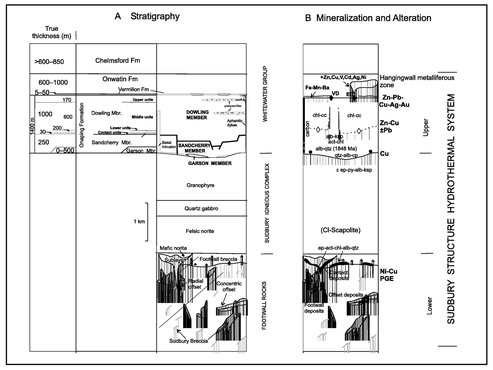

Figure 2. Schematic sections through the Sudbury structure showing: A) Stratigraphic terminology with member and unit thicknesses. The fragmental rocks are intruded by fine grained aphanitic dykes and the xenolithic basal intrusion; B) Distribution of mineralization and alteration, Sudbury structure hydrothermal system. VD, ED = Vermilion and Errington Zn-Pb-Cu-Ag deposits. (Modified after Ames et al., 2002).

Figure 5. NON-GENETIC granulometric classification of fragmental rocks of the Onaping Formation adapted from Fisher (1966). Type 1–5 after Muir and Peredery (1984).

SUMMARY OF MAP AREAS, ONAPING FORMATION

AREA	SIGNIFICANCE	MAP SCALE	REFERENCE
Morgan township North Range	Complete stratigraphic section through north range Onaping Fmn. Type area ***Stratigraphic:*** dominance of fluidal breccia in SM, abundant syn-depositional fault control of units block faulting, unaltered SM depositional environment, DM contact units and DM lower units, basin controlled ash during DM/MU ***Alteration:*** regional carbonate, carbon and disseminated sulphide. ***Mineralization:*** basal zone of silicification overprints albitization. Hellstar alteration localized around fluidal breccia dyke-sill complexes, weak- moderate albitization. Carbon transgresses DM-SM stratigraphic contact. Carbonate (calcite alteration) in upper 2/3rd of OF, with local discordant calcite-dolomit zones associated with fracture-controlled silicification and mineralization ***Mineralization:*** Limerick Cu-Zn showing	1:5000	GSC OF3717 (Ames and Gibson, 2004)
Cow Lake (north of Dowling) North Range	***Stratigraphic:*** Section through Dowling member lower units and middle units, scores beds ***Alteration:*** regional carbonate, carbon and disseminated sulphide. ***Mineralization:*** McKunes and Cow Lake Cu-Zn showings opy-py in amygdales in basal intrusion near top of MU.	1:2000	GSC OF4568 (Ames and Gibson, 2004)
Simmons North Range -West	***Stratigraphic:*** section through DMCT and DMLU thin N/S magnetite-rich mafic dyke abundant intrusions (Basal intrusion) ***Alteration:*** Epidote-pyrite-BaRop zone at DMCT/LU interface, strong carbonate alteration. ***Mineralization:*** Abundant disseminated py-opy-sph associated with discordant basal intrusion pods Simmons Pb-Zn-Cu veins.	1:2000	GSC OF4567 (Ames and Gibson, 2004)
Joe Lake North Range	***Stratigraphic:*** section from granophyre SIC to DMLU, complete section through SM, intrusive fluidal-breccia dyke complex proximal facies, possible transported, slumped fluidal vent complex. Discordant intrusive unit Basal intrusion-former Basal Mix. ***Alteration:*** Type area for Albitization. Regional syn-depositional albitization controlled by fluidal breccia complex, fracture-controlled replacement albitization (1848 Ma). K-feldspar-quartz hydrothermal breccia-local alteration. *"Pocket" of carbon-bearing SM 10 m from granophyre contact	1:2000	GSC OF4566 (Ames and Gibson, 2004) (Ames et al., 1997) (Ames et al., 1998) 1848 +-3Ma/-1.8 Ma
Hanmer powerline North Range	***Stratigraphic:*** SM to top of DMCT. Basal intrusion-discordant near base of exposed OFm. SM- numerous bombs, near DMCT abundant aphanitic dykes, excellent transect through DMCT units ***Alteration:*** Regional basal silicification zone in SM and SI. Increased albitization spatially associated with dykes. Fracture-controlled silicification e-cuts BM/OM contact	1:2000	(Ames, 1999)
Nelson Lk. West North Range	***Stratigraphic:*** SM to DM. Two orientations of aphanitic dykes of same composition proximal fluidal breccia ***Alteration:*** Intense albitization amphibole alteration of matrix at dyke terminations within SM units	1:5000	Figure A2-4.1a (Ames, 1999)
Nelson East North Range	***Stratigraphic:*** SM near granophyre ***Alteration:*** Basal silicification zone ***Mineralization:*** Unnamed base metal -py gossan	1:5000	(Ames, 1999)
Rockcut Lake North Range (Capreol-Norman Twp)	***Stratigraphic:*** near base of OFm in SM multiple textural phases of the basal intrusion, megabreccia discordant e-cuts fluidal complex ***Alteration:*** regional albitization ***Mineralization:*** regional albitization, east side of lake carbon-bearing SM near the base of OFm. discordant zone of actinolite fractures and albite-quartz alteration haloes	1:2000	GSC OF4565 (Ames and Gibson, 2004)
Gordon Lk Rd South Range	***Stratigraphic:*** Dowling member below Vermilion Zn-Pb-Cu mine, DMUU and local setting for detailed mapping of peperite peperite is extensive (~ 200 x 1000 m) ***Alteration:*** carbonate-epidote	1:5000 1:2000	Figure 2-12 (Ames, 1999)
Gordon Lk Rd peperite South Range	***Stratigraphic:*** dyke intrusive into DMUU formation of blocky peperite ***Alteration:*** peperite-associated silicification, phengitization, carbonatization crosscut by late quartz veins ***Mineralization:*** cpy-sph	1:250	Figures 2-12, A2-5.1 Figure 4-13 (Ames, 1999)
A&M showing peperite South Range	***Stratigraphic:*** dyke intrusive into DMUU early dykes and associated peperite formation, later intrusive andesite lobes formation of globular peperite ***Alteration:*** peperite associated, silicification, chloritization, carbonatization and Fe-Mn oxides.	1:200	Figures 2-12, A2-5.2 and 3 Figure 4-14 (Ames, 1999)
Azilda peperite South Range	***Stratigraphic:*** upper 50 m of OFm. dykes with blocky peperite ***Alteration:*** peperite associated chloritization, phengitization, carbonatization.	Drill hole BA 91-01	(Falconbridge Ltd.)
Detailed maps	Cow Lake base metal showing McKunes base metal showing Simmons base metal showing Ryan base metal showing	1:200 1:100 1:2000 1:200 to 1:25	GSC OF4568 GSC OF4566 GSC OF4567 Figure 5-2 (Ames, 1998)
Dowling-Morgan	***Stratigraphic:*** 15 km strike length of North Range Onaping Fmn, from Windy Lake/hwy 144 to the Sandcherry Creek Fault shows lateral distribution of units and members Type area for Sandcherry member ***Alteration:*** Carbon boundary transgresses SM-DM contact large unit of SM conductive Equant shard unit at High Falls. Regional carbonization in upper ~ 1 km of Onaping Formation. ***Mineralization:*** Numerous replacement type Zn-Cu-Pb showings in DM.	1:10000	GSC OF4569 (Gibbins et al., 2004)

SM - Sandcherry member EQ - Equant shard units FL - Fluidal fragment unit DM - Dowling member CT - Contact units LU - Lower units MU - Middle units UU - Upper units

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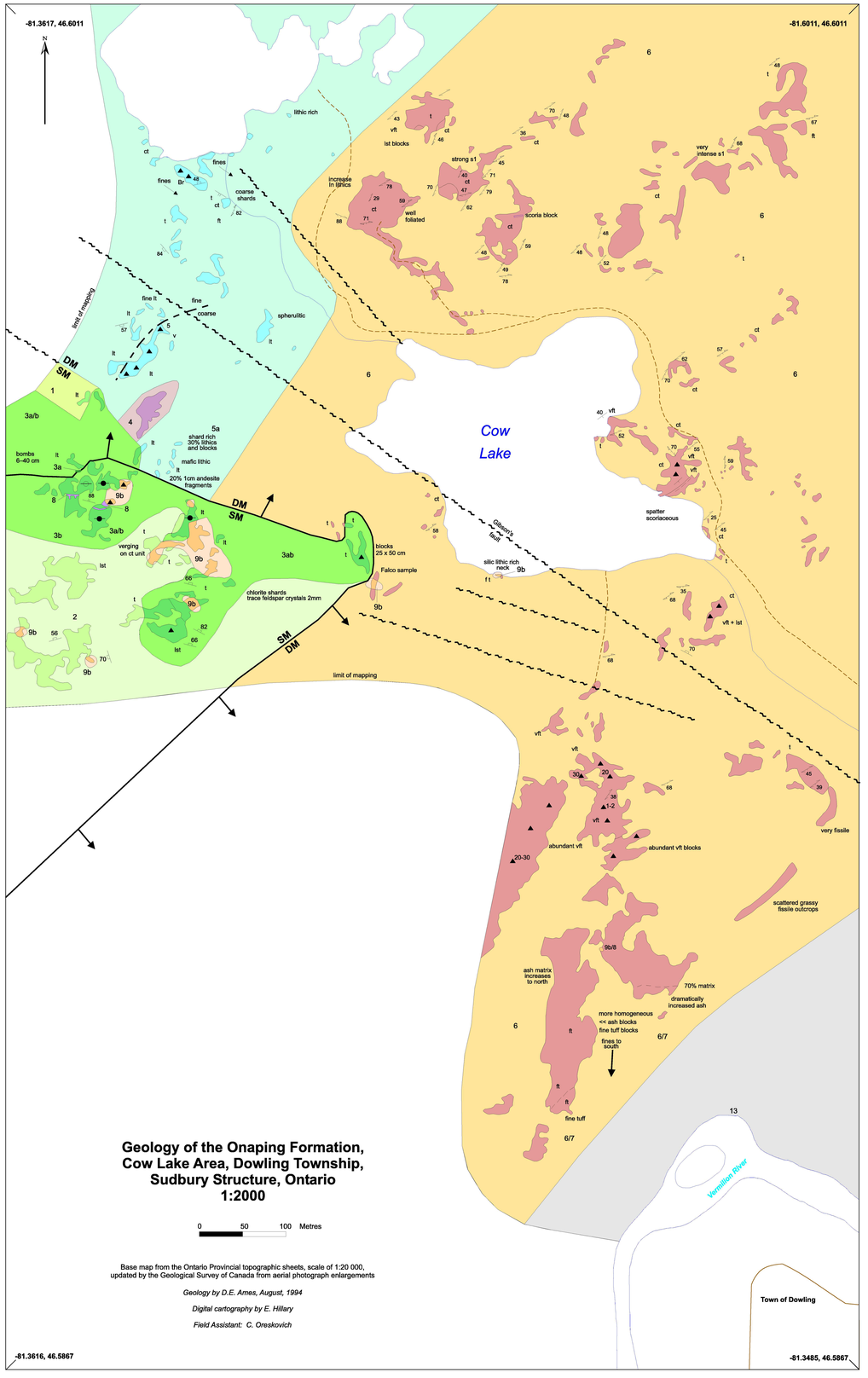

Geology of the Onaping Formation, Cow Lake Area, Dowling Township, Sudbury Structure, Ontario
1:2000

0 50 100 Metres

Base map from the Ontario Provincial topographic sheets, scale of 1:20 000, updated by the Geological Survey of Canada from aerial photograph enlargements

Geology by D.E. Ames, August, 1994

Digital cartography by E. Hillary

Field Assistant: C. Oreskovich

LEGEND

(See Figure 2 for context within entire Onaping Formation stratigraphy)

13 *Drift covered area*

PALEOPROTEROZOIC
SUDBURY STRUCTURE
WHITEWATER GROUP
ONAPING FORMATION
Syn-Onaping intrusive rocks

9b *Basal intrusion: quartz diorite- fine-grained sugary-textured, commonly xenolith-rich up to 85%, 20-35% albite laths, 15-25% pyroxene/amphibole lathes in a quartzo-feldspathic matrix*
b) discordant

8 *Aphanitic dykes and sills: andesite; fine grained, aphyric, commonly flow banded, spherulitic, amygdaloidal, typically < 50 cm wide, up to 15 m wide, sharp or peperitic margins, typically 340 and/or 020o trend*

DM DOWLING MEMBER (~ 25-30% lenticular to plate-like shards, > 60% matrix, commonly carbonaceous)

Upper units - UU

7 *Light buff brown weathering tuff with > 70% fine tuff, black carbonaceous matrix, commonly thinly bedded normal to non-graded beds with lenticular amygdaloidal vitric fragments, reworked*

Middle units - MU (< 3% block-sized fragments, black carbonaceous matrix)

6 *Light grayish brown weathering, block and bomb-poor tuffaceous units with 15-25% lenticular chlorite ± calcite altered shards commonly in a black carbonaceous matrix, rare beds of very fine tuff and lapillistone, lapillistone/tuff blocks*

Lower units - LU (Matrix is locally non-carbonaceous, > 3% block-sized fragments)

5a *Buff brownish gray and bluish weathering, 20-30% chlorite altered lenticular vitric shards, 5-20% bluish white and pale green flow banded andesite clasts, minor fine grained clasts of gray to black chert, argillite, quartzite and granitoids, 2% fine subrounded black quartz. Channelized block-rich deposits are reversely graded at base with subrounded lithic and vitric blocks and cored bombs. Sharp lower contacts) conformable, normally graded lapillistone to tuff units containing rounded lithic and vitric blocks and bombs*
a) conformable, normally graded lapillistone to tuff units containing rounded lithic and vitric blocks and bombs

Contact units - CT

4 *Pale bluish green weathering tuff, lapilli-tuff, ~ 25-40% green to dark green chlorite- actinolite altered lenticular shards within a very fine matrix typically weathering a pale bluish green, matrix is locally carbonaceous, < 10-25% flow banded fragments > 2 cm, locally block and bomb-rich base and eutaxitic texture, common andesite blocks and bombs, sharp erosive lower contact*

SM SANDCHERRY MEMBER (~ 60% blocky, altered vitric fragments, < 35% matrix, commonly non-carbonaceous)

Fluidal fragment units - FL

3a *Typical conchoidal chipped weathering pattern, light to medium brown and brownish green weathering, 45-85% fluidal, ribbon-like, flow banded fragments, < 15% equant shards, locally black carbonaceous matrix, commonly associated with aphanitic andesite dykes*
a) massive to autobreccia facies, < 20% matrix, block- and bomb-rich, contorted irregular andesite bombs

3b *b) lapilli-tuff with tabular fragments, 25–40% matrix*

Transitional units - TR

2 *Lapilli-tuff/tuff, 15-30% equant, plate-like altered vitric fragments, 50-60% tabular andesite fragments with flow banding, < 15% fluidal fragments > 6 cm*

Equant shard units - EQ

1 *> 50% pink to pinkish white equant altered vitric fragments commonly fine lapilli-sized in a light green weathering matrix, commonly altered pink (albitization), bleached (silicification) or dark grey (carbon-bearing commonly conductive), < 15% simple, complex and cored bombs, < 10% fluidal fragments, 1-5% accretionary lapilli and 5-15 % lithic blocks*

Note: non-genetic size classification used (Figure 5)

Geological boundary (defined, approximate).....
Area of outcrop.....
Carbon boundary (arrow indicates carbon-bearing).....
Shear zone.....
Tuff.....t
Coarse tuff.....ct
Lapilli-tuff.....lt
Lapillistone.....lst
Fine tuff, very fine tuff.....ft, vft
Vitric.....v
Lithic.....l
Blocks, modal estimate.....5
Bomb, simple, cored.....
Bedding (inclined, vertical, dip unknown, tops unknown).....
Foliation (inclined, vertical, dip unknown).....
Shear foliation (inclined, dip unknown).....
Joint.....
Trench, pit.....
Road, trail.....

OPEN FILE 4568

GEOLOGY

GEOLOGY, ALTERATION AND MINERALIZATION OF THE ONAPING FORMATION, COW LAKE AREA, DOWLING TOWNSHIP, SUDBURY STRUCTURE

ONTARIO

Universal Transverse Mercator Projection
North American Datum 1983 - Zone 17
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2004
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Sheet 1 of 2, Geology

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