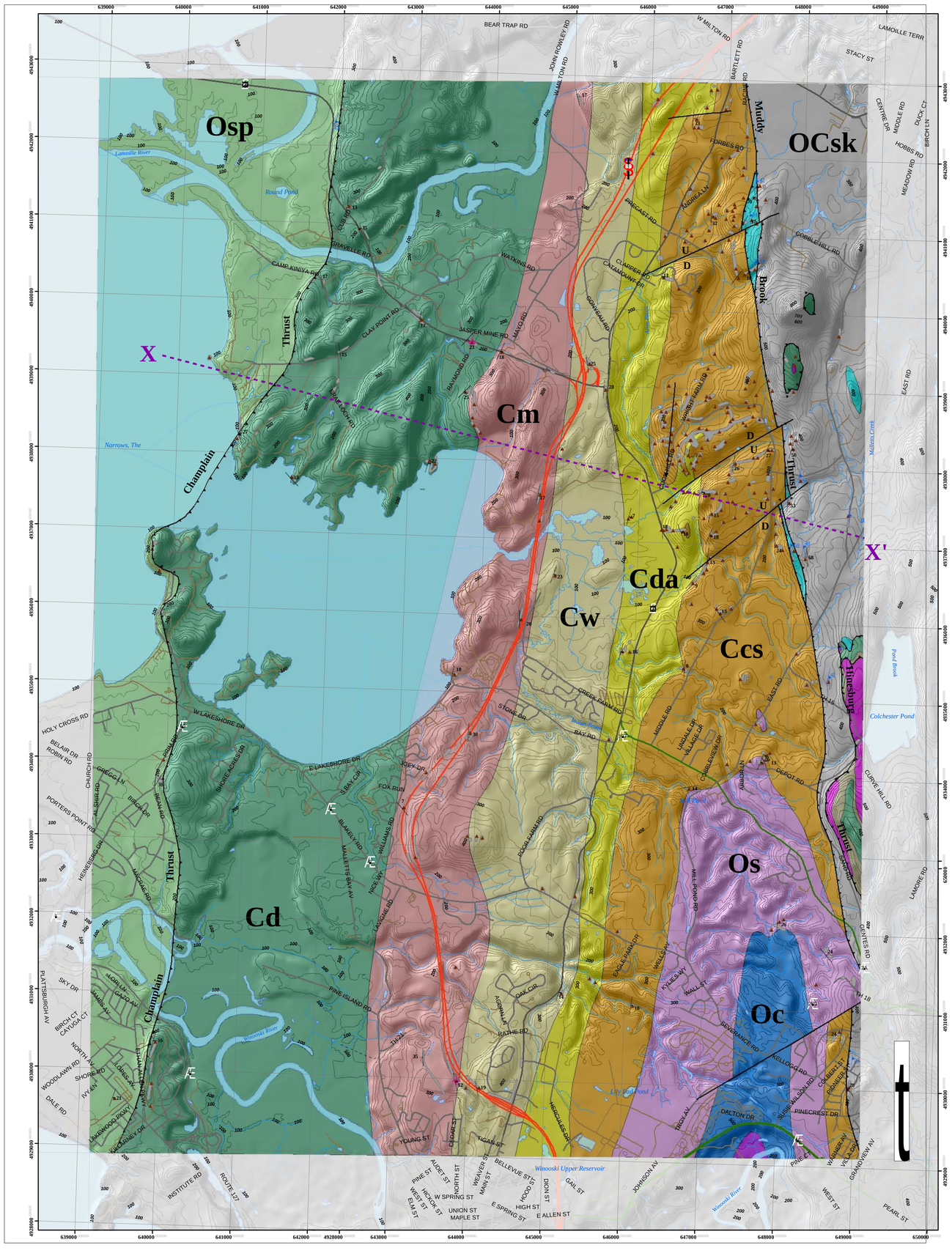


Description of Map Units

Cretaceous

E Lamprophyre Dike; dark gray to black, fine-grained, igneous rock frequently with biotite and/or amphibole phenocrysts; usually magnetic.

Ordovician

Osp — **Stony Point Shale**
Black calcareous shale with thin interlayers of gray limestone.

Ob — **Bascom Formation**
Gray limestone with brown dolomitic sandy ribs.

Oc — **Cutting Formation**
Massive gray dolostone.

Os — **Shelburne Formation**
White marble locally interlayered with gray dolostone.

Ordovician- Cambrian

OCskl — **Skeels Corners Formation**
"Pinstriped" limestone member; gray limestone with a "pinstriped" fabric defined by dark insoluble layers. Found along/near the Muddy Brook Thrust.

OCsk — Undifferentiated member; black phyllite with thin, light brown weathering, dolostone layers.

Cambrian

Ccs — **Clarendon Springs Formation**
Massive, gray, granular, tan-weathering dolostone with a brecciated texture; breccia fragments may include gray dolostone, black carbonaceous limestone, chert, and crossbedded dolomitic sandstone; weathered masses often have a "brain" texture. Solution generated paleokarst features are prevalent locally. Dolomitic sandstone layers occur near the base and top of this formation. Rounded sand grains found throughout.

Cda — **Danby Formation**
Tan-weathering dolomitic sandstone frequently with well developed cross beds; white quartzite layers are locally found that filled in irregular solution features; interlayered with massive dolostone near the top of the formation; rounded sand grains occur throughout.

Cw — **Winooski Formation**
Tan to white- weathering well-bedded gray dolostone with well developed stylolites; rounded sand grains occur throughout.

Cm — **Monkton Formation**
Reddish-brown, well-bedded, ferrugenous sandstone frequently with cross beds, mud cracks, and worm burrows; may also have a white color; interbedded with tan dolostones at the top of the formation.

Cd — **Dunham Formation**
Tan-weathering well-bedded dolostone with a pink and yellow mottled texture; red jasper breccias occur near the base of the formation.

Ccu — **Cheshire Formation**
Upper member; light gray dolomitic quartzite and dark gray, shaly, dolomitic siltstone (description modified from Dorsey et al.,1983).

Ccl — Lower member; gray, thinly laminated argillaceous quartzite (description modified from Dorsey et al.,1983).

* The map pattern of lithologies east of the Hinesburg Thrust is modified from Dorsey et al. (1983).

Geologic Map Symbols

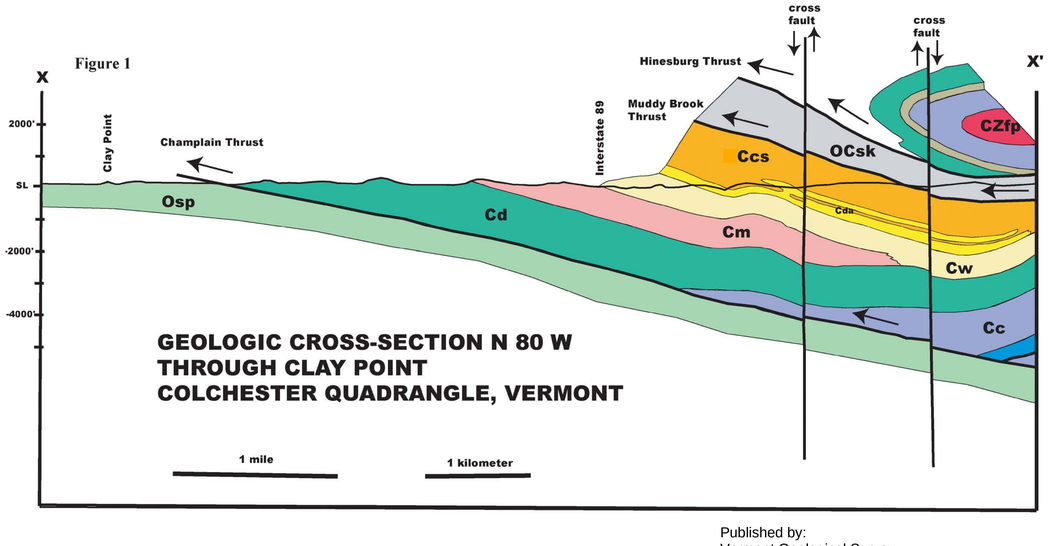
- Thrust Fault (teeth on upper plate).
- D / U — Normal Fault (D=down, U=up).
- Syncline
- Anticline
- 45 — Strike and Dip of Bedding (S0)
- 45 — Cleavage (S1)
- Large Outcrops
- Field Station

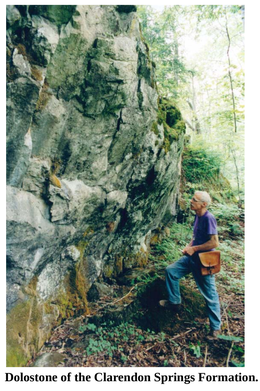
Geographic Symbols

Surface Water
- Lake or Pond
- Stream

Roads
- Interstate
- US Highway
- Vermont State Highway
- Town Highway
- Other Road
- Legal Trail

Figure 1




Dolostone of the Clarendon Springs Formation.

Scale- 1:24,000
Contour Interval- 20'

Kilometers: 0 0.5 1 2 3

Miles: 0 0.5 1 2

Bedrock Geologic Map of the Colchester Quadrangle

Authors: Jonathan Kim and Peter Thompson (2001)


Mesozoic dike in the Monkton Formation.

Published by:
Vermont Geological Survey
Laurence Becker, State Geologist
Department of Environmental Conservation
Agency of Natural Resources
103 South Main St., Logue Cottage
Waterbury, VT 05671-2420
http://www.anr.state.vt.us/dec/geo/vgs.htm

Research supported by the Vermont Geological Survey, Dept. of Environmental Conservation, VT ANR. This geologic map was funded in part by the USGS National Cooperative Mapping Program. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Base map from VT Statewide Hydro DEM (contours and surface water) and VT Agency of Transportation (roads)
Coordinate System: Vermont State Plane, meters, NAD 83.
Grid overlay on map is Universal Transverse Mercator, Zone 18N, NAD 83.
Digital Cartography by Jonathan Kim
Date: April, 2011

References

Dorsey, R.J., Agnew, P.C., Carter, C.M., Rosencrantz, E.J., and Stanley, R.S., 1983, Bedrock Geology of the Milton Quadrangle, Northwestern Vermont, Vermont Geological Survey Special Bulletin #3, Scale 1:62,500.

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Figure 2: Red sandstones of the Cambrian Monkton Formation along Interstate 89

Figure 3: Contact between the red sandstones of the Cambrian Monkton Formation (below) and the tan dolostones of the Cambrian Winooski Formation (above). Note the interlayering of the red sandstones and tan dolostones near the contact.

Figure 4: Strongly- fractured tan dolostones of the CambrianWinooski Formation along Interstate 89 near Winooski.

Figure 5: Mesozoic dike that intruded the Cambrian Monkton Formation sandstones in Whitcomb Quarry

Figure 6: Cambrian Danby Formation with cross-bedded dolomitic sandstones below and overlying white quartzite above. Quartzite appears to have filled in an irregular erosional surface.

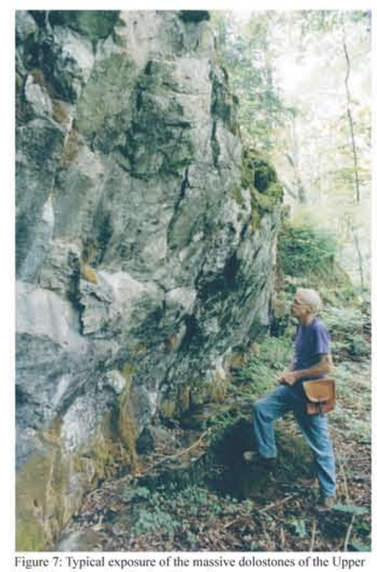

Figure 7: Typical exposure of the massive dolostones of the Upper Cambrian Clarendon Springs Formation.

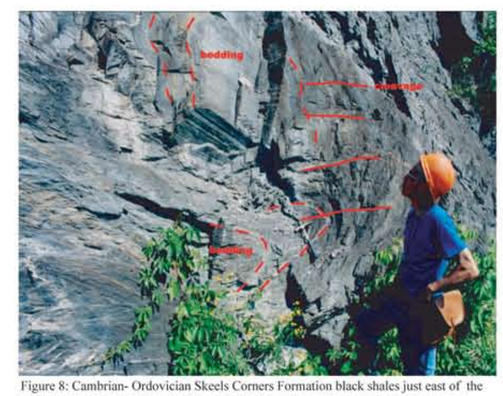

Figure 8: Cambrian- Ordovician Skeels Corners Formation black shales just east of the Muddy Brook Thrust. Note bedding, tight folds and associated axial planar cleavage.

Representative Lithologies in the Colchester Quadrangle

Authors: Jonathan Kim and Peter Thompson

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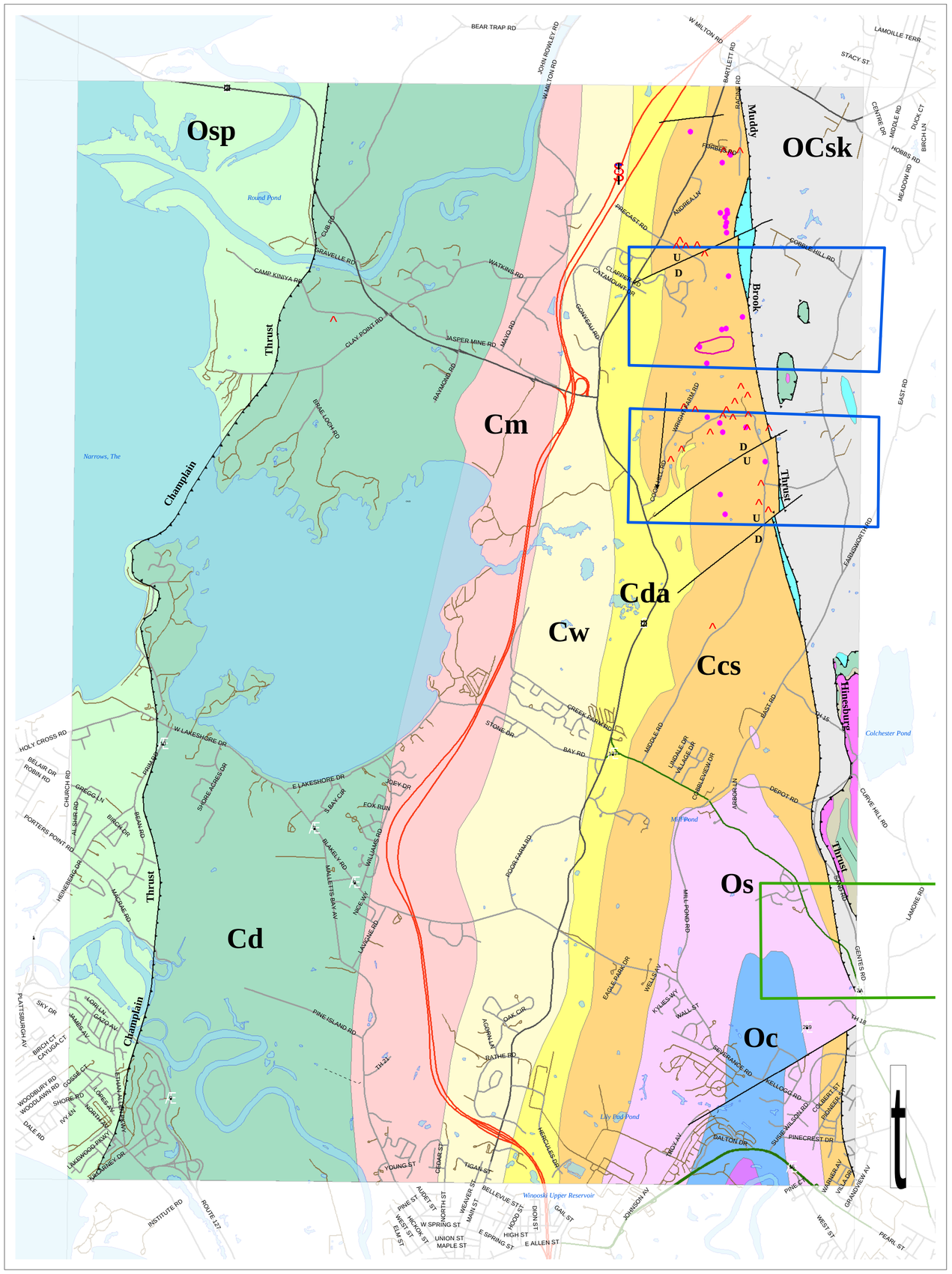


Scale- 1:24,000
Contour Interval- 20'

Kilometers
0 0.5 1 2 3

Miles
0 0.5 1 2

Compilation of Radioactivity Data for the Colchester Quadrangle

Authors: Jonathan Kim and Peter Thompson (2001)

Radioactivity Data

- ^ Gross Alpha Level in Bedrock Well >/= 15 pCi/liter (EPA MCL)(Vermont Dept. of Health data archives)
- N.U.R.E. "Preferred" airborne Uranium anomaly (Texas Instruments, 1975)
- N.U.R.E."Secondary" airborne Uranium anomaly (Texas Instruments, 1975)
- Ground-based radiometric anomaly area (Vanacek and Dorsey, 1983; McKeown, 1951))
- # Ground-based radioactivity reading > 100 total counts/second (Kim and Thompson, 2002)

References:

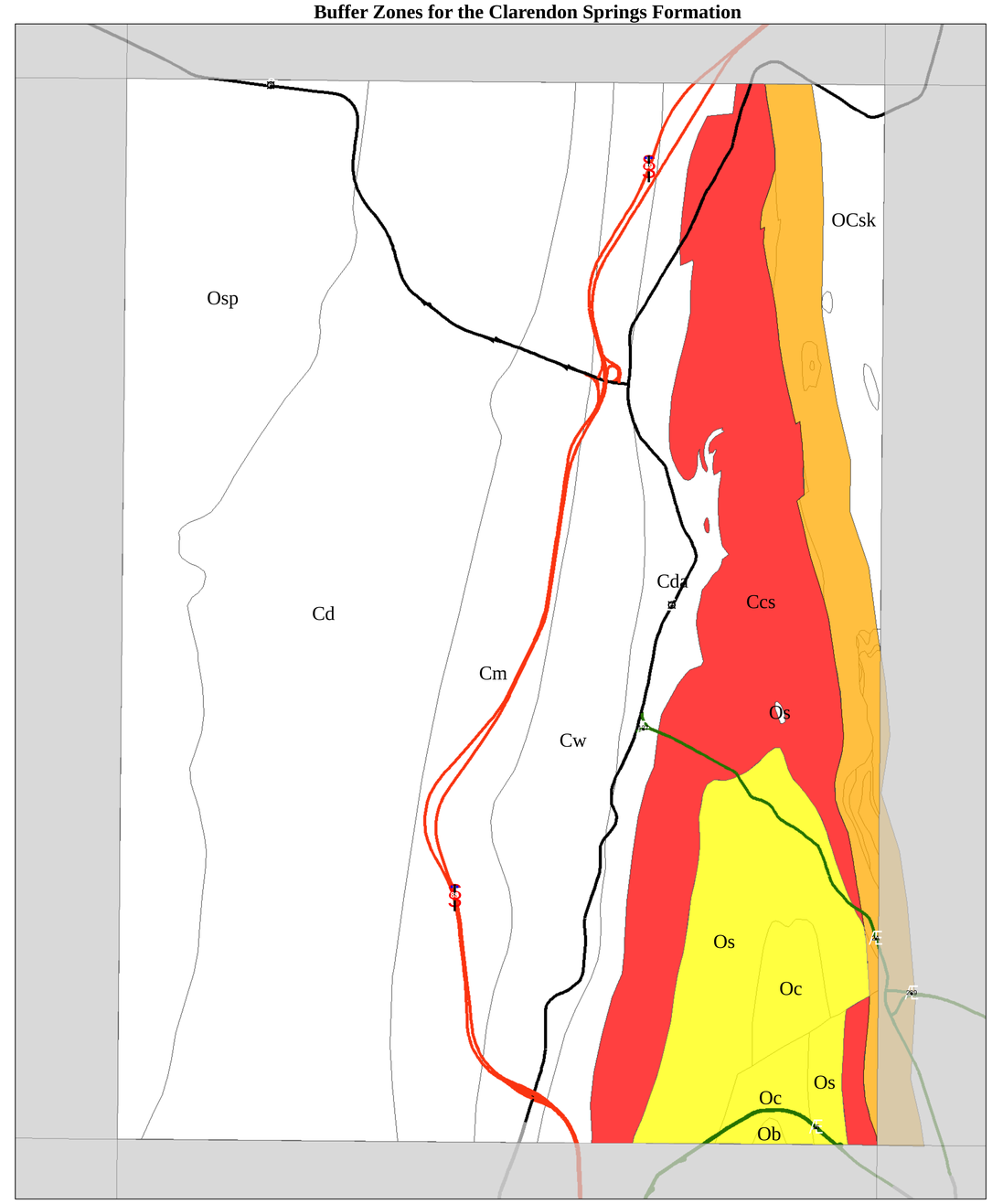
Kim, J. and Thompson, P., 2002, Bedrock and Radionuclide Mapping in the Colchester Quadrangle, Vermont: Geological Society of America Abstracts with Programs, v. 34 #1, p. A17.

McKeown, F.A., 1951, Reconnaissance of radioactive rocks of Vermont, New Hampshire, Connecticut, Rhode Island, and southeastern New York, U.S. Geological Survey Report TEI-67, for U.S.A.E.C., Oak Ridge, TN, 48 p.

Texas Instruments Inc., 1976, Airborne geophysical survey of a portion of New England: Prepared for U.S. Energy Research and Development Administration, Grand Junction Office, Contract Nos. E(05-1)-1666 and E(05-1)-1667.

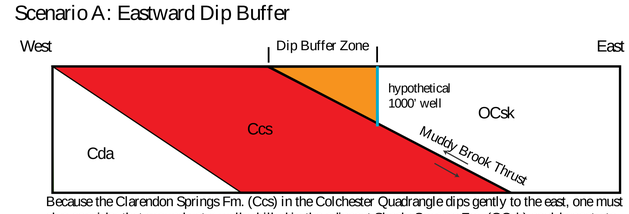
Vanacek, D.M. and Dorsey, R.J, 1983, Geologic and Radiometric Survey of the Sweeney Farm: Milton, Vermont, Vermont Geological Survey Open File Report 1983-2.

Buffer Zones for the Clarendon Springs Formation



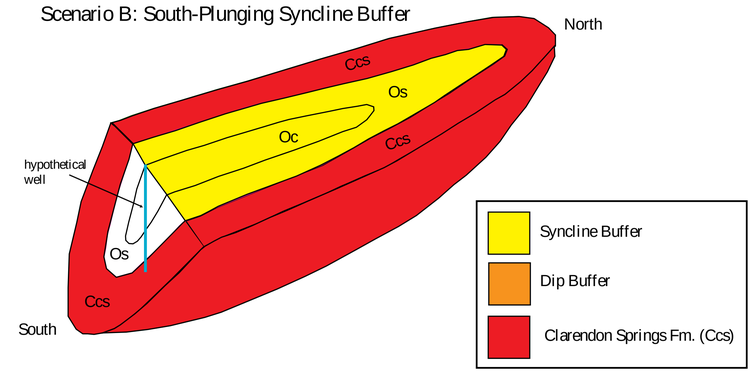
Approximately 30 % of bedrock wells tested in the Clarendon Springs Formation (Ccs) have groundwater with elevated naturally-occurring radioactivity. In addition to drilling directly in Ccs there are two other scenarios shown below and on the map where Ccs could be penetrated even though it was not on the ground surface.

Scenario A: Eastward Dip Buffer



Because the Clarendon Springs Fm. (Ccs) in the Colchester Quadrangle dips gently to the east, one must also consider that groundwater wells drilled in the adjacent Skeels Corners Fm. (OCsk) could penetrate Ccs if the well is attempted too close to the Muddy Brook Thrust. Based on the dip of this thrust, a buffer zone was drawn (orange) that delineates the approximate area of OCsk where a well <1000' depth could hit Ccs.

Scenario B: South-Plunging Syncline Buffer



In the southeastern part of the Colchester Quadrangle, Ccs is folded into a south-plunging synclinal structure. In this structure, Ccs sits below the Shelburne Fm. (Os) and the Cutting Fm (Oc). It is possible that wells sited in OC and Os in the yellow buffer zone could unknowingly be drilled into Ccs.

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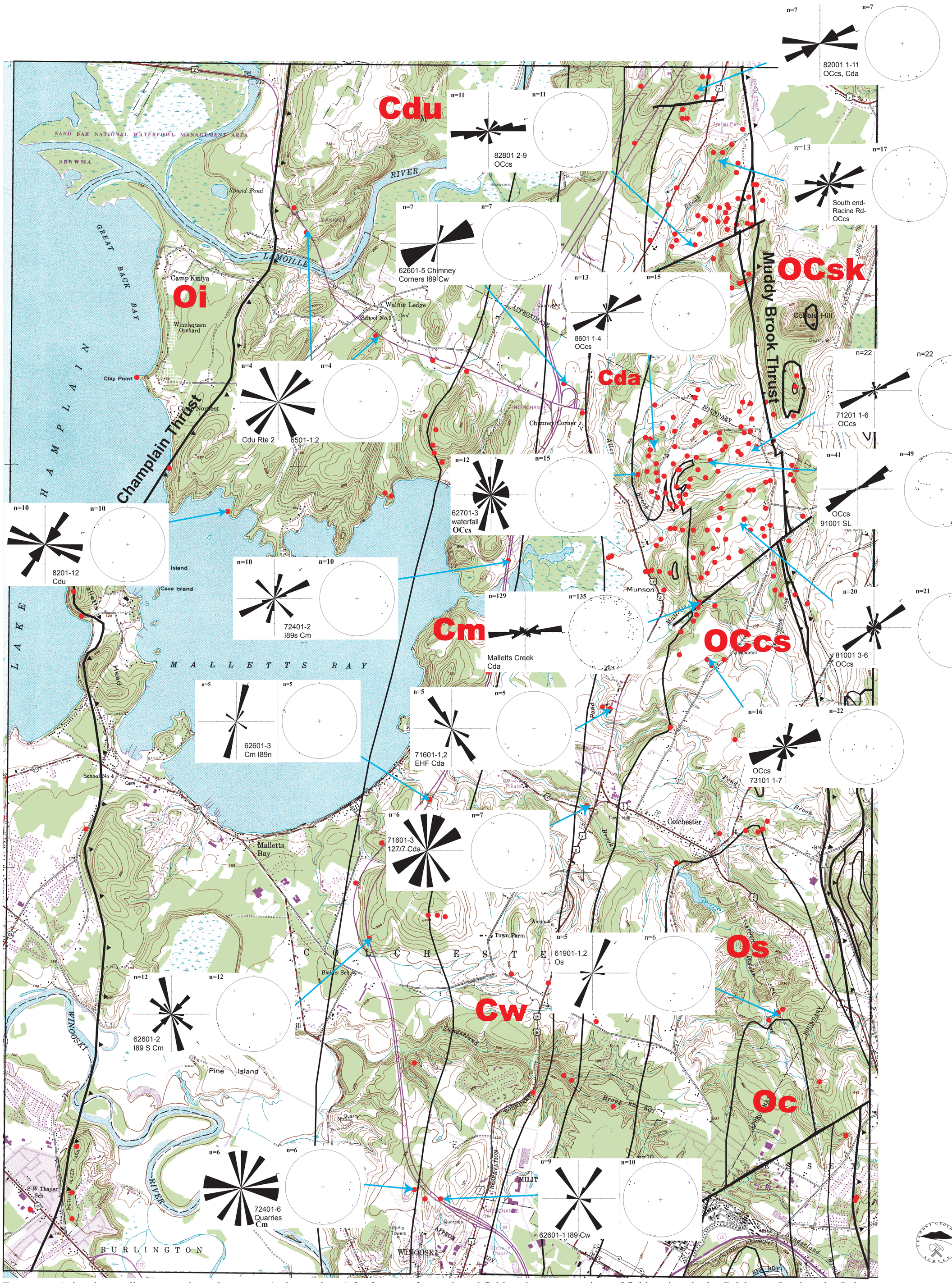
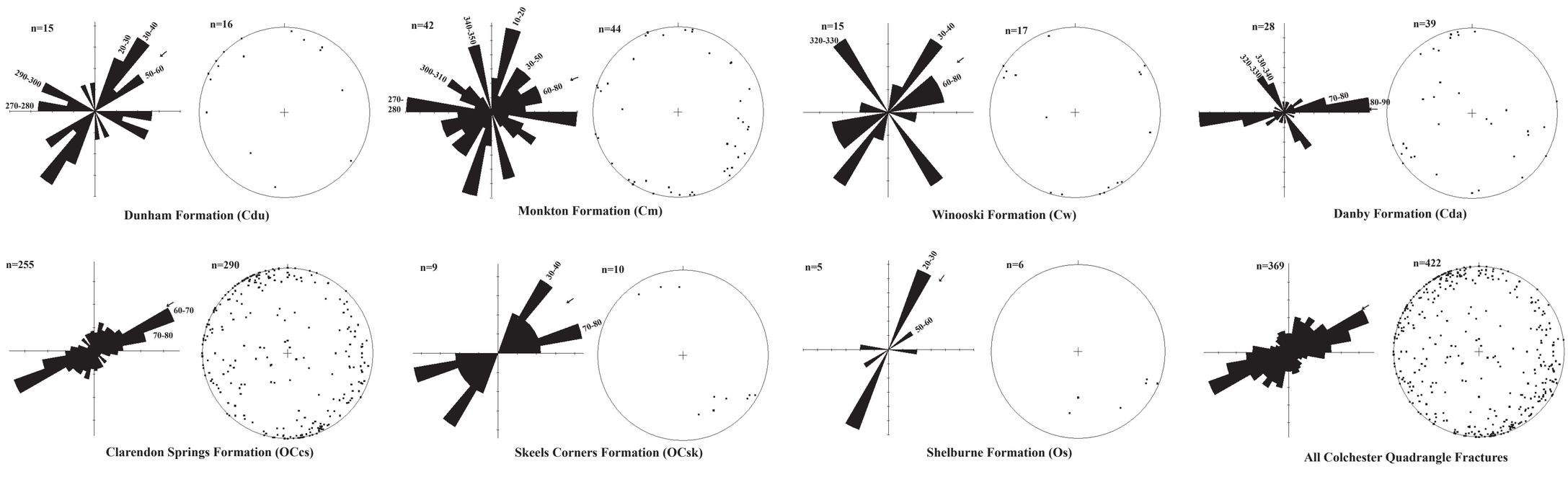


Frequency-Azimuth rose diagrams and equal area nets (poles to planes) for fractures from selected field stations or groupings of field stations in the Colchester Quadrangle. Only steeply-dipping fractures (>60 degrees) are shown on rose diagrams. Plotted using GEOrient software (Holcombe, R., www.holcombe.net.au/software). Field Stations = red dots.

Authors: Jonathan Kim and Peter Thompson

Map Produced: February 28, 2003



Vermont Geological Survey
Dept. of Environmental Conservation
Vermont Agency of Natural Resources
Waterbury, Vermont

Selected Field Photos in the Colchester Quadrangle

Figure 1:Brecciated appearance of many Clarendon Springs Formation outcrops. Breccia fragments are more resistant to weathering than martix. Note en echelon quartz veins.

Figure 2: Chert breccia in Clarendon Springs Formation dolostone

Figure 3: Dolostone fragment breccia in uppermost Clarendon Springs Formation

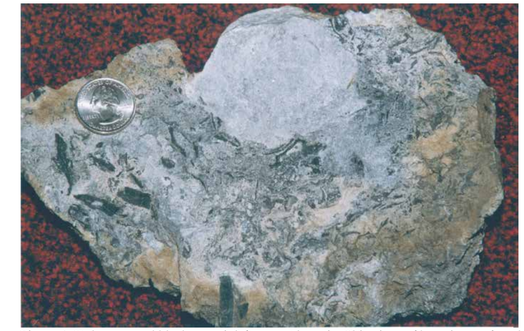


Figure 4: Dolostone and black organic? fragment breccia. This piece of breccia was found to have elevated radioactivity in the field

Figure 5: Breccias filling in cavities on either side of cross-bedded dolomitic sandstone layer

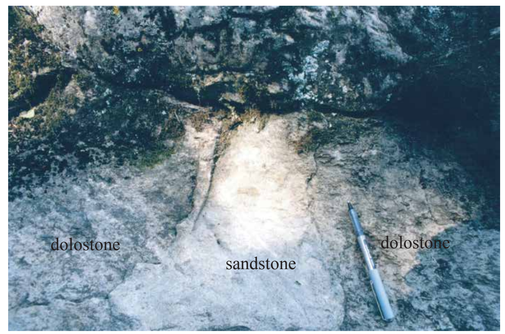


Figure 6: Sand filling in irregularly shaped cavity (paleokarst) in dolostone. This feature can be seen on the left side of Figure 7.

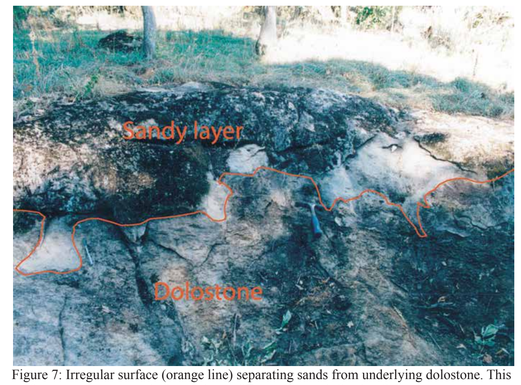


Figure 7: Irregular surface (orange line) separating sands from underlying dolostone. This surface may represent paleokarst. Area of Figure 6 is on left side of photo.

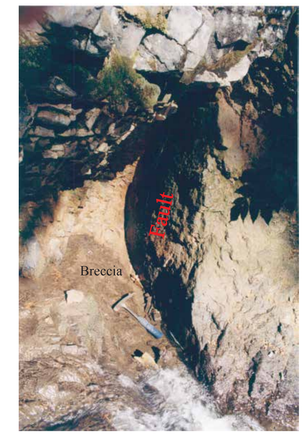


Figure 8: Normal Fault at Malletts Creek in Danby Formation dolomitic sandstones. Fault plane is in shadow. Fault breccia zone underlies hammer.

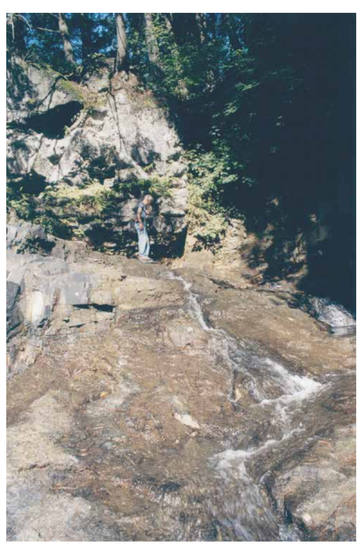


Figure 9: wide angle view of fault. Figure 8 was shot where P. Thompson is standing. Creek is following the en echelon breccia zone

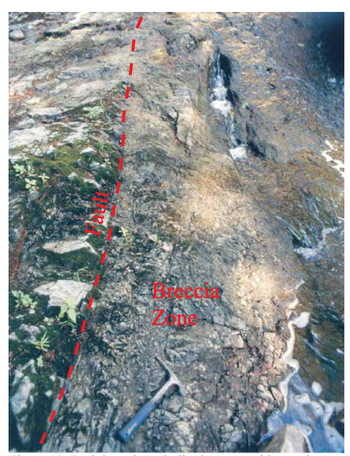


Figure 10: Fault breccia underlies hammer with massive sandstone to left of fault.

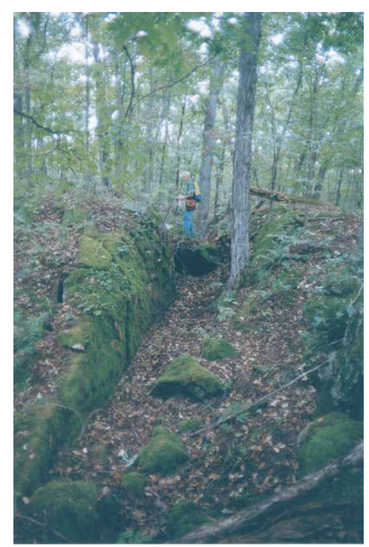


Figure 11: Topography on top of a N 70 E trending bedrock ridge of Clarendon Springs Formation dolostone. Linear outcrop faces and depressions are the result of en echelon fracture zones weathering out.

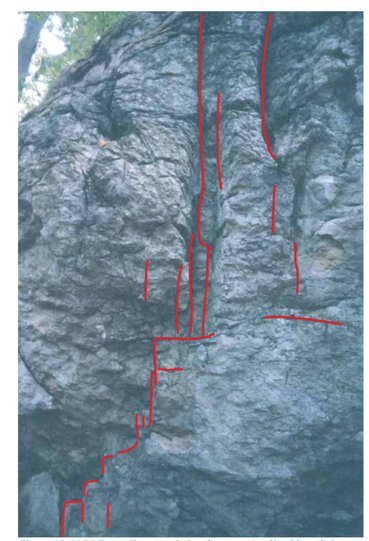


Figure 12: N 70 E trending en echelon fractures (outlined in red) in an outcrop face of Clarendon Springs Formation in the vicinity of Figure 11. South-Southwest is to the left

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