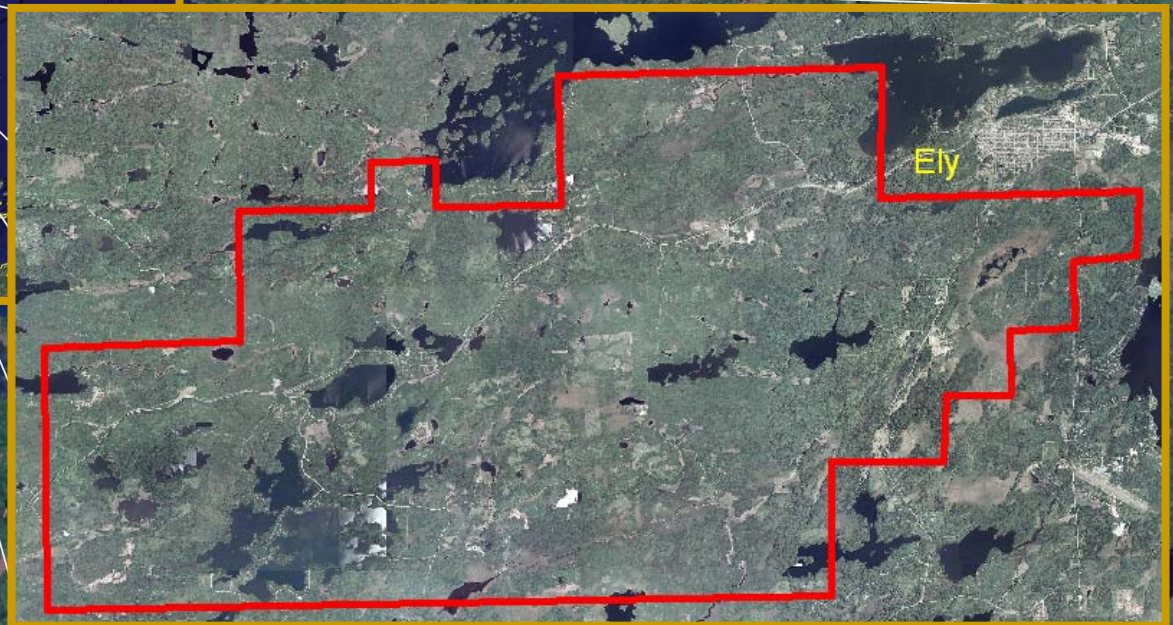
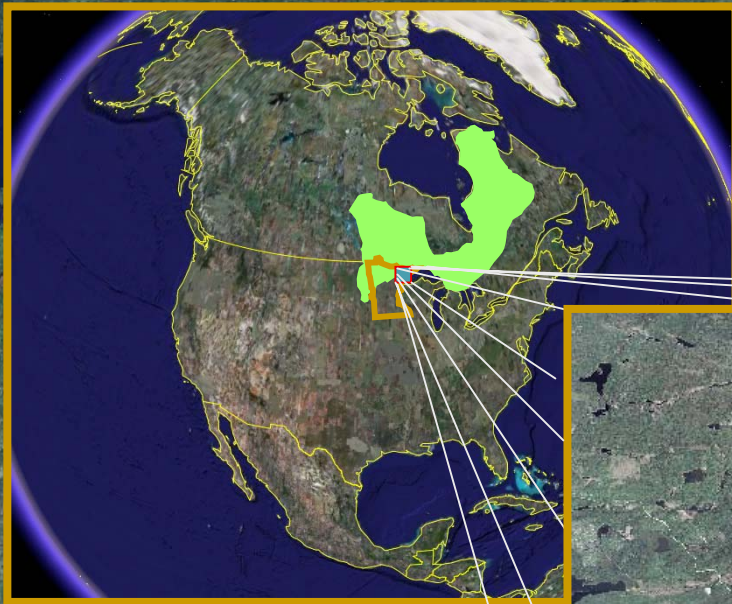
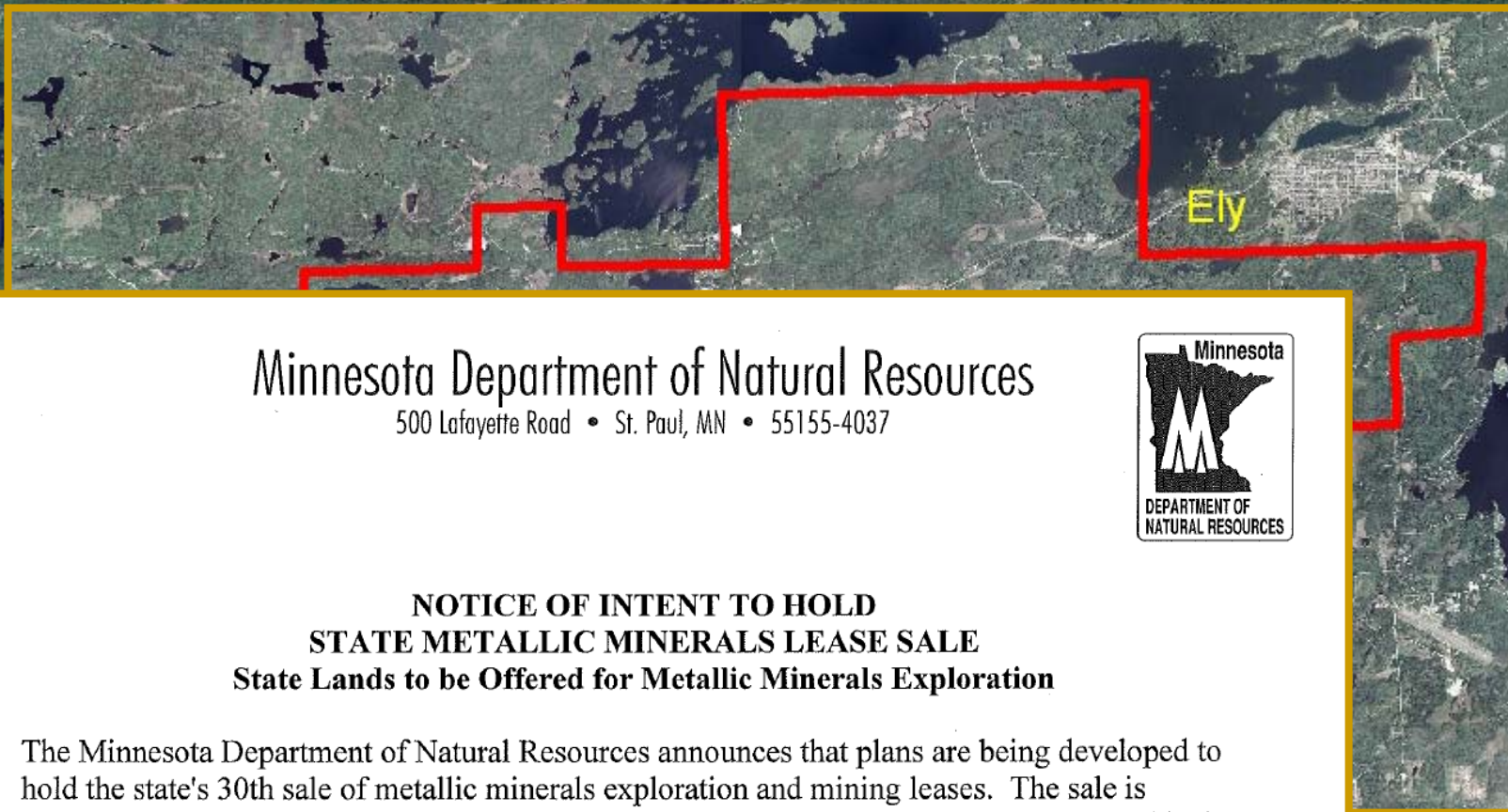


# State Metallic Minerals Lease Sale Minnesota's Vermilion Gold District





# State Metallic Minerals Lease Sale Notice of Intent



## Minnesota Department of Natural Resources

500 Lafayette Road • St. Paul, MN • 55155-4037



### **NOTICE OF INTENT TO HOLD STATE METALLIC MINERALS LEASE SALE State Lands to be Offered for Metallic Minerals Exploration**

The Minnesota Department of Natural Resources announces that plans are being developed to hold the state's 30th sale of metallic minerals exploration and mining leases. The sale is tentatively scheduled for January of 2009. The lease sale plans are being announced at this time in order to give mining companies, public interest groups and all other interested parties additional time to review the areas under consideration.

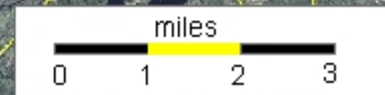


# State Metallic Minerals Lease Sale

This portion of the lease sale area is accessible by a state highway and covered by boreal forest.

Ely

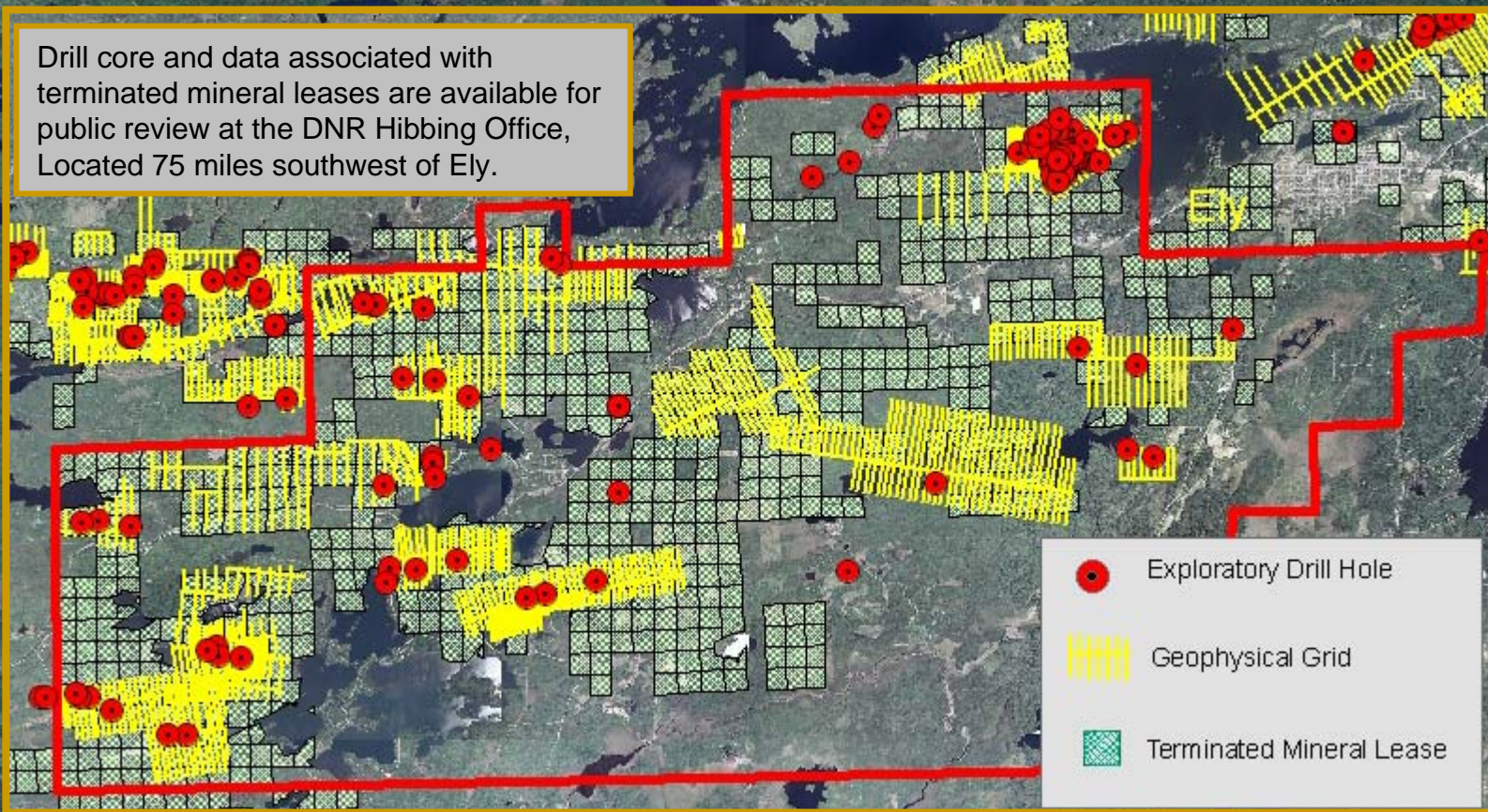
Scale 1:100,000





# State Metallic Minerals Lease Sale Minnesota's Vermilion Gold District

Drill core and data associated with terminated mineral leases are available for public review at the DNR Hibbing Office, Located 75 miles southwest of Ely.







# Vermilion Gold District History

1865-1866	<b>Non-Productive Vermilion Gold Rush</b> Discovers far more iron ore than gold
1884 - 1963	<b>Vermilion Range Iron Mining</b> 100 million tons of iron ore from District
1960's – 70's	<b>Regional Airborne Geophysical Surveys</b> Airborne Input EM Surveys Identify Anomalies
1980 - 1992	<b>Ground-based Exploration and Drilling</b> Work on more than 20 distinct prospects
1992 - 2008	<b>Limited Metallic Mineral Leasing and Exploration</b>





# Vermilion Gold District – Why take another look?

- ❖ Located Within Wawa Subprovince, Superior Province
  - ❖ Same Archean greenstone belt terrane as Hemlo and other world-class gold deposits located in Ontario, Canada
- ❖ Economics
  - ❖ Gold prices at or near historic highs
- ❖ Maps and Models Produced Since 1992
  - ❖ Bedrock geology and mineral potential maps
  - ❖ New mineralization models
- ❖ Historic drill core and exploration data available for public review.
- ❖ New DNR Project Work



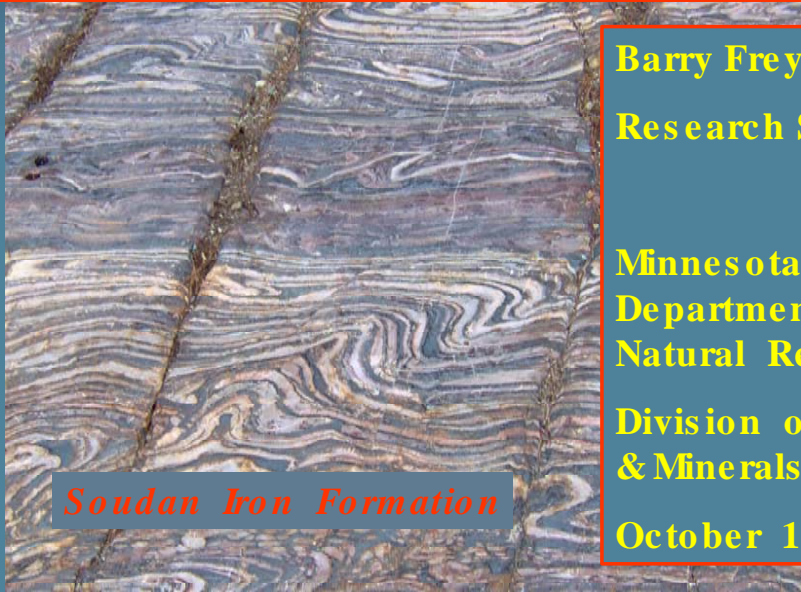
# Minnesota's Vermilion Gold District

## New Results – See Separate Presentation

**Project 373**

***Vermilion Greenstone Gold***

***New Results from Drill Holes***



***Soudan Iron Formation***

**Barry Frey**

**Research Scientist 2**

**Minnesota  
Department of  
Natural Resources**

**Division of Lands  
& Minerals**

**October 1, 2008**





# Minnesota's Vermilion Gold District

## New Results

Prospect	Au Mineralization Type	XRF Au Interval *	Au Association
Raspberry	Intrusion Hosted	To 230 ppm Au	Pb (galena), Quartz veins, Rutile; Fe, As, Mn, Cr, Se, Sn
Raspberry	Shear zone related (remobilization?)	To 67 ppm Au	Pb (galena), Quartz veins, Rutile?; Pb, Ag, Se
Foss Lake	Algoma BIF related Au	To 28 ppm Au	Fe Oxide to Sulfide-graphite transition; As, Ba, Pb
Foss Lake	Shear zone related	To 16 ppm Au	Pyrite; Hg, As, Cu, Cr, Mo
Eagles Nest Shear	Shear zone related	To 9 ppm Au	Pyrite; Mn, Sr, Ba, Mo?, Cu?
Murray Shear	Volcanic Hosted Massive Sulfide	To 148 ppm Au	Sphalerite, pyrrhotite?; Cr, Zn, Sb, Cd, Hg

\*2007-08 MnDNR “spot” analyses using handheld XRF





# Minnesota



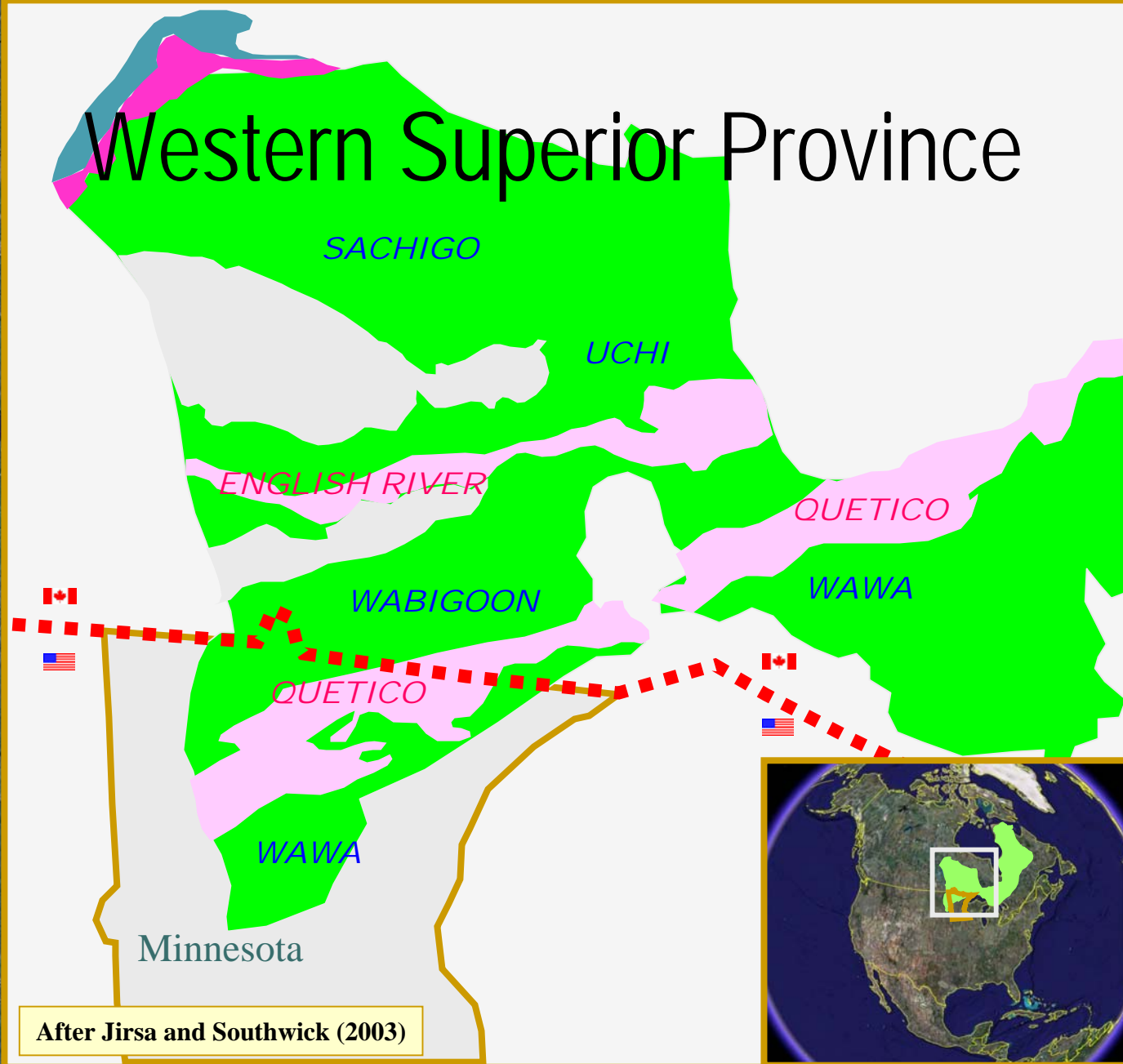


# Archean Superior Province



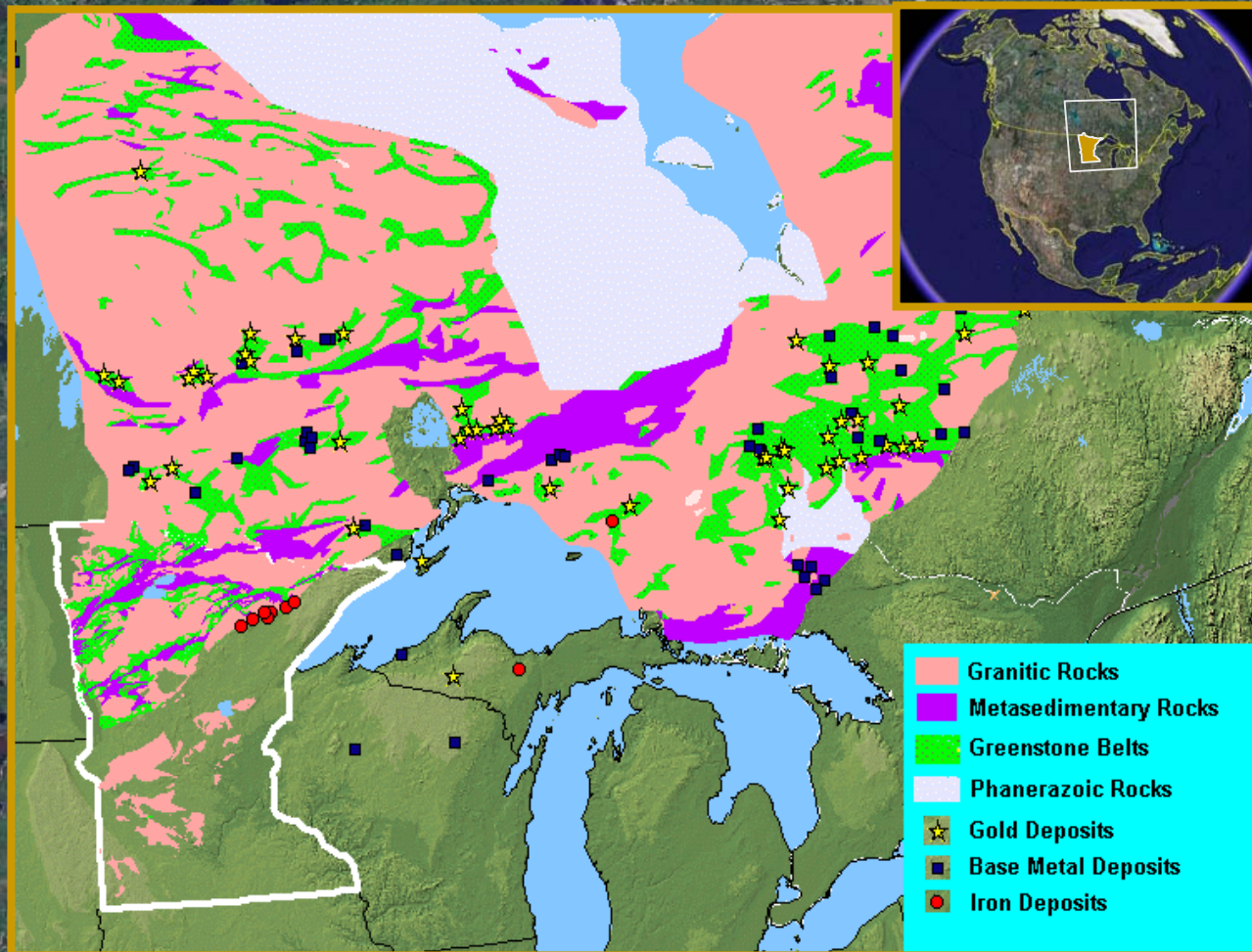


# Western Superior Province



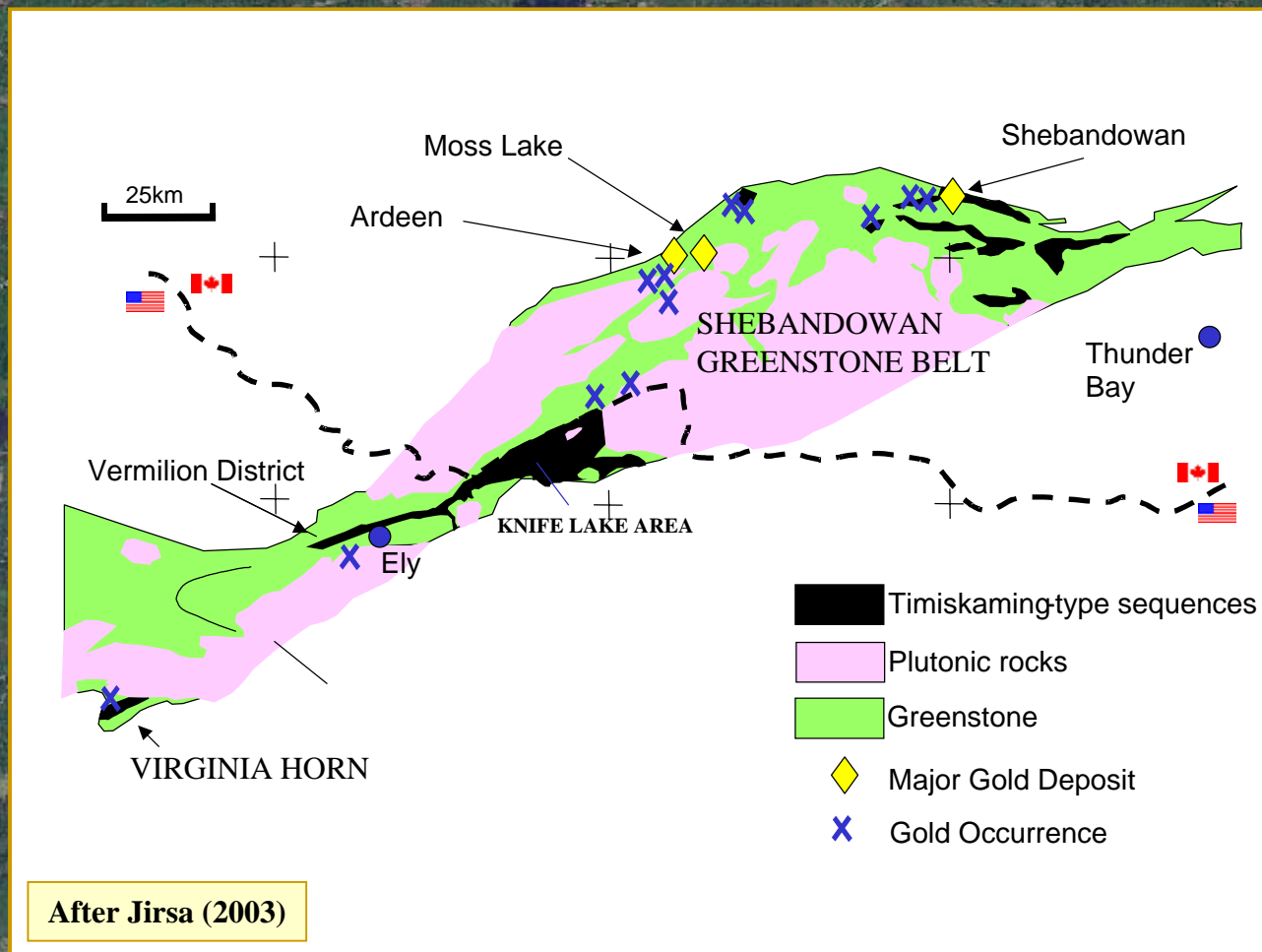


# Superior Province Mineral Deposits





# From Ontario, Canada into Minnesota, USA





A satellite image of a greenstone belt area, showing a complex pattern of green, brown, and dark patches representing different geological units and water bodies. Overlaid on the left side is a dark grey vertical bar containing a list of mineralization models. The title 'Greenstone Belt Gold Mineralization Models' is at the top of this bar in a light yellow font. Below it are five bullet points, each preceded by a yellow diamond icon and followed by the model name in white font. In the top left corner of the slide, outside the grey bar, is a small yellow logo consisting of three concentric circles.

# Greenstone Belt Gold Mineralization Models

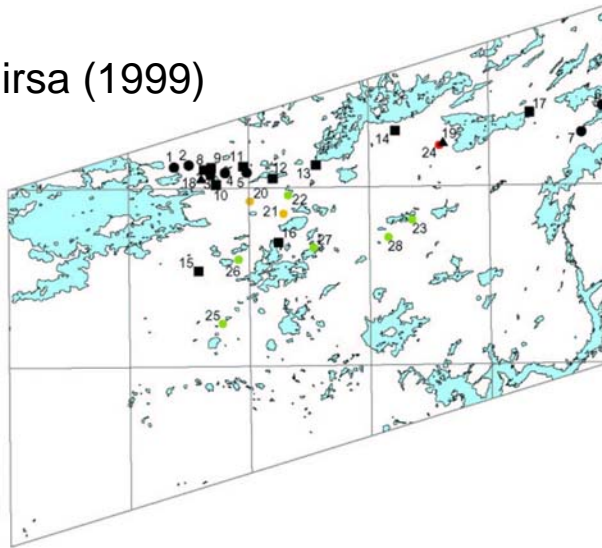
- ❖ Shear-related Lode Gold
- ❖ Intrusion hosted Gold
- ❖ VMS-related Gold Deposits
- ❖ Banded Iron Formation (BIF)
- ❖ Timiskiming-Type Sediments



# Vermilion District Gold

Peterson and Jirsa (1999)

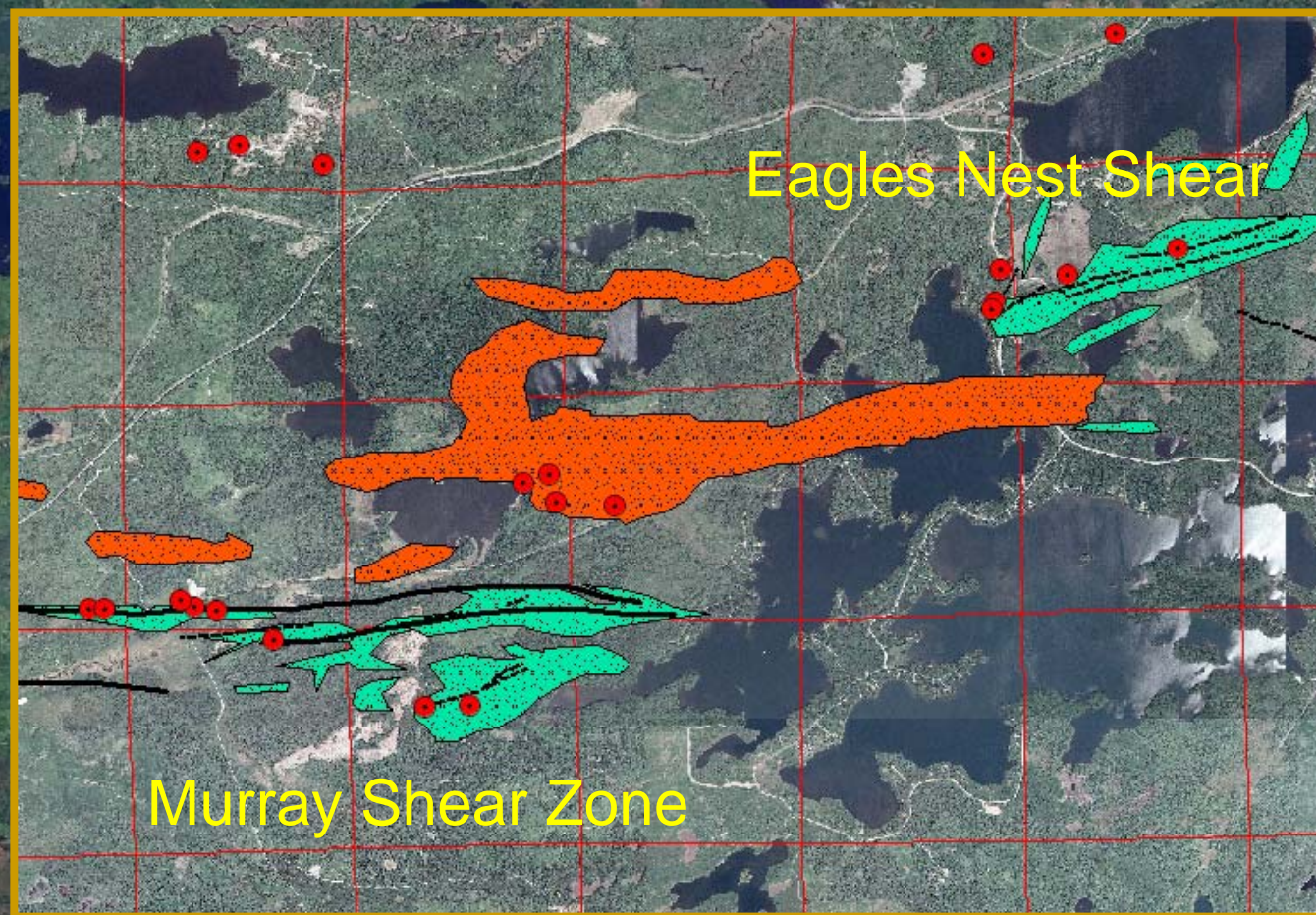
- PROSPECTS AND SHOWINGS**
- **Iron-formation-hosted lode gold**
    - 1. Dead Canary West
    - 2. Dead Canary
    - 3. Pac Man Pond
    - 4. Section 5
    - 5. Walsh Shaft
    - 6. Garden Lake
    - 7. Section 30
  - **Shear zone-hosted gold**
    - 8. Clear Cut
    - 9. Kerr McGee Show
    - 10. Section 6 Southeast
    - 11. Railroad Zone
    - 12. Mud Lake
    - 13. Foss Lake
    - 14. Burnside River
    - 15. Murray Shear
    - 16. Eagles Nest Shear
    - 17. Spaulding Bay
  - ▲ **Intrusion-hosted gold**
    - 18. Section 6
    - 19. Raspberry Prospect
  - **Volcanogenic massive sulfide Felsic dominated**
    - 20. Gafvert Lake
    - 21. McComber
  - **Volcanogenic massive sulfide Mafic dominated**
    - 22. Clear Lake
    - 23. Twin Lakes
    - 25. Skeleton Lake
    - 26. Fivemile Lake
    - 27. Eagles Nest No. 4
    - 28. Purvis Road
  - **Volcanogenic massive sulfide and lode gold**
    - 24. Quartz Hill



Gold prospects and showings in the Vermilion District have been interpreted using a range of mineralization models for greenstone terranes.



# Shear-Related Lode Gold



Exploratory  
Bore Hole

## Faults and Shears

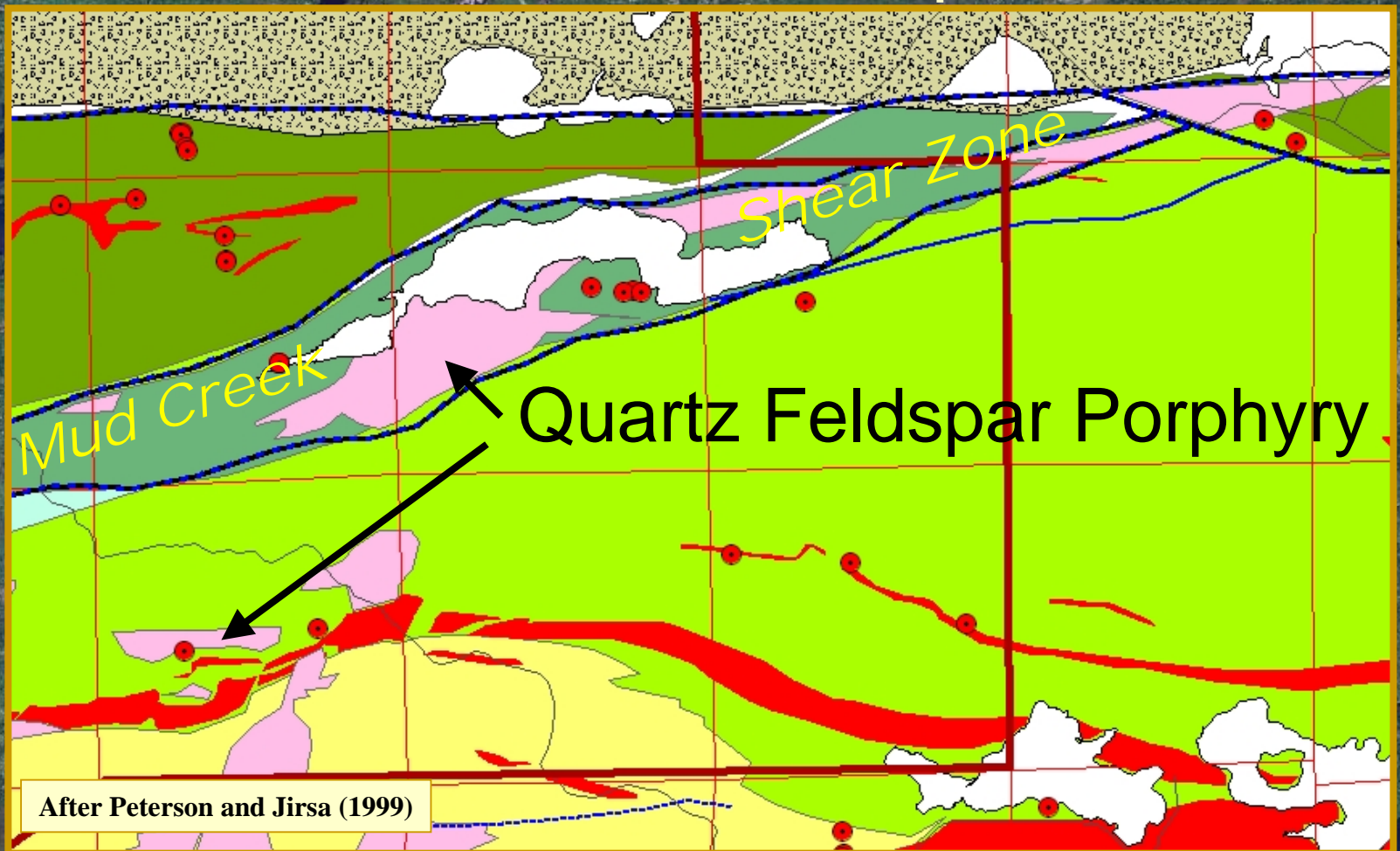
- First Order
- Second Order
- Third Order

## Alteration

- Lode gold  
Style
- VMS Style

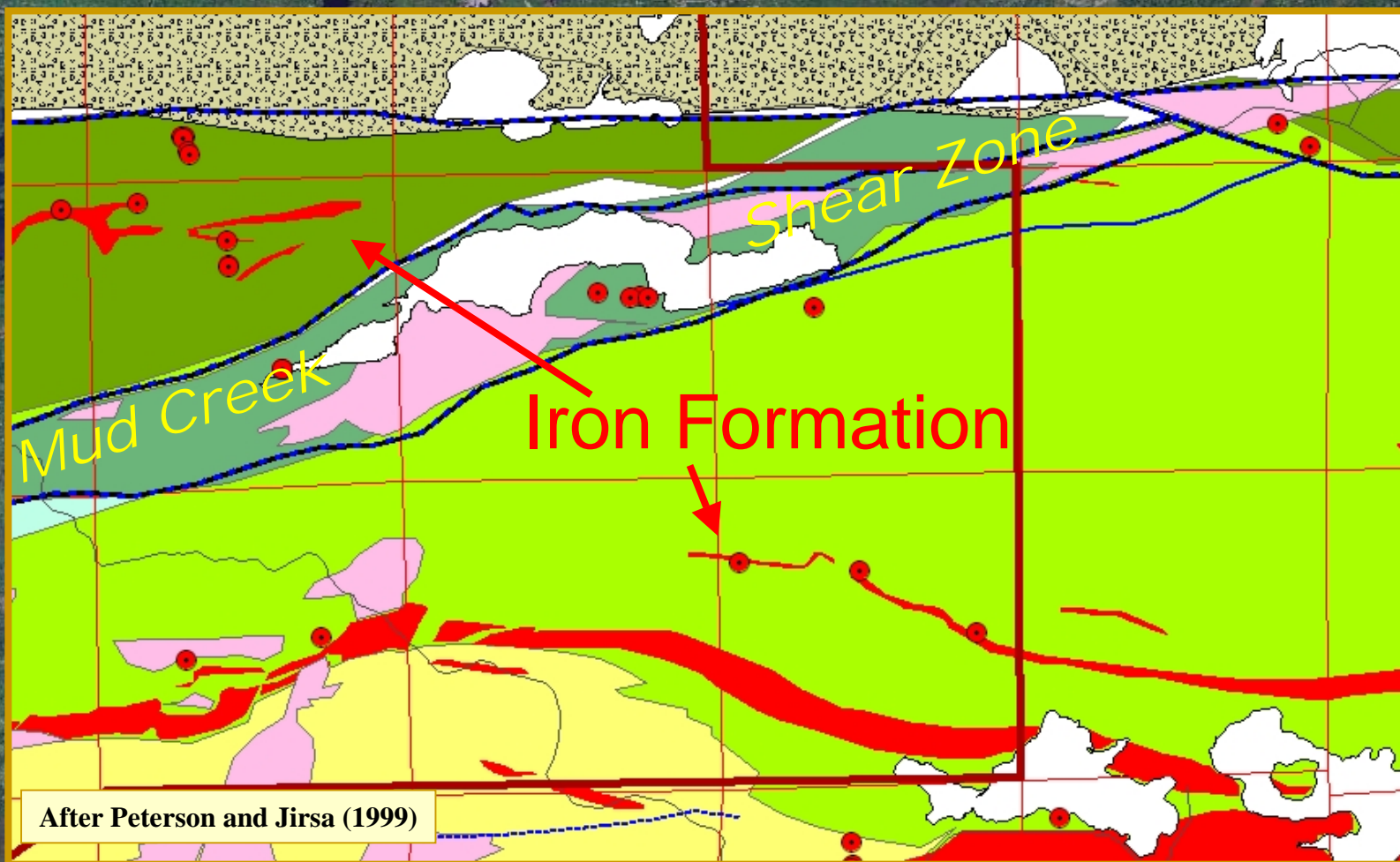


# Intrusion Hosted Gold Deposits



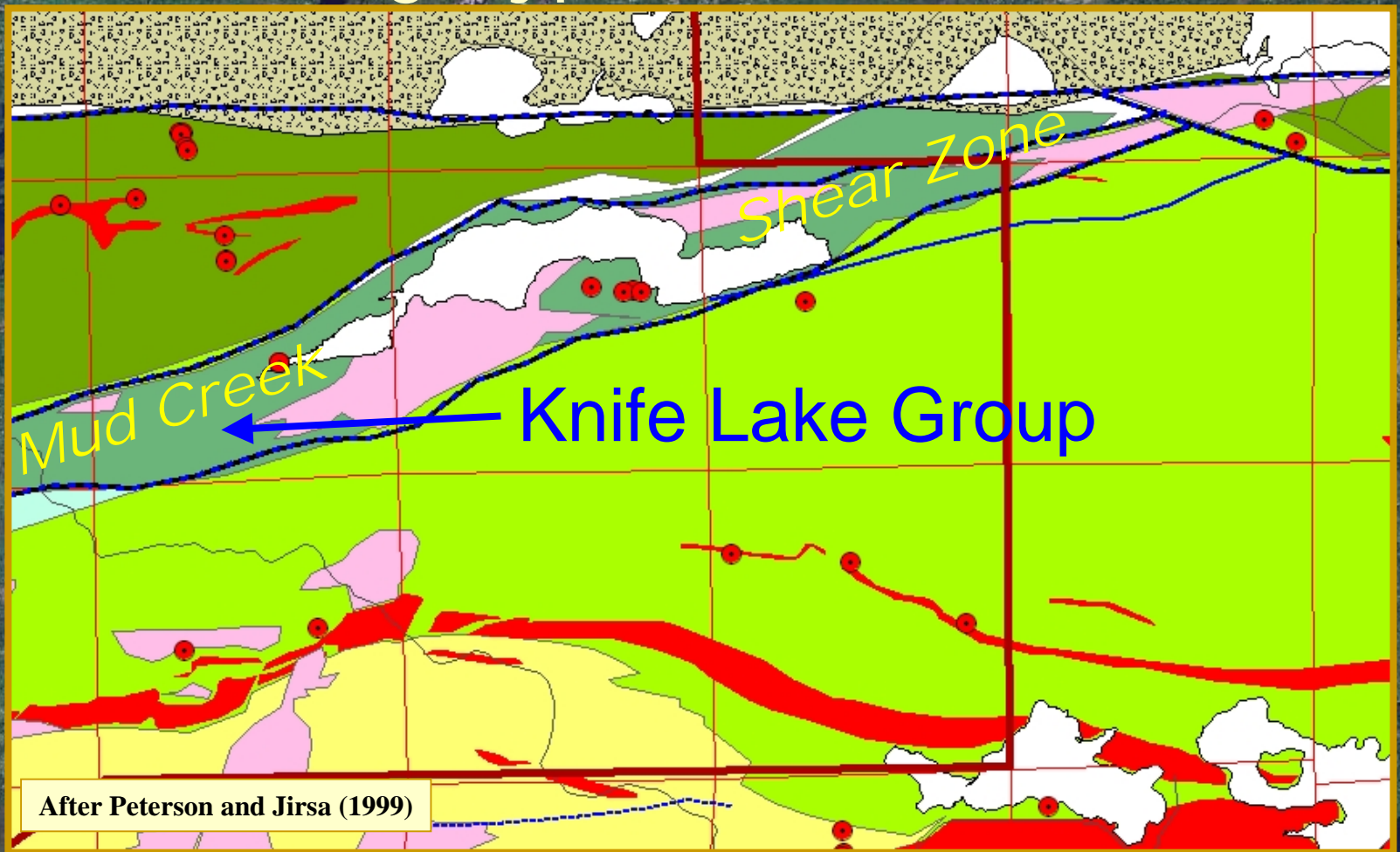


# Banded Iron Formation-Hosted Gold



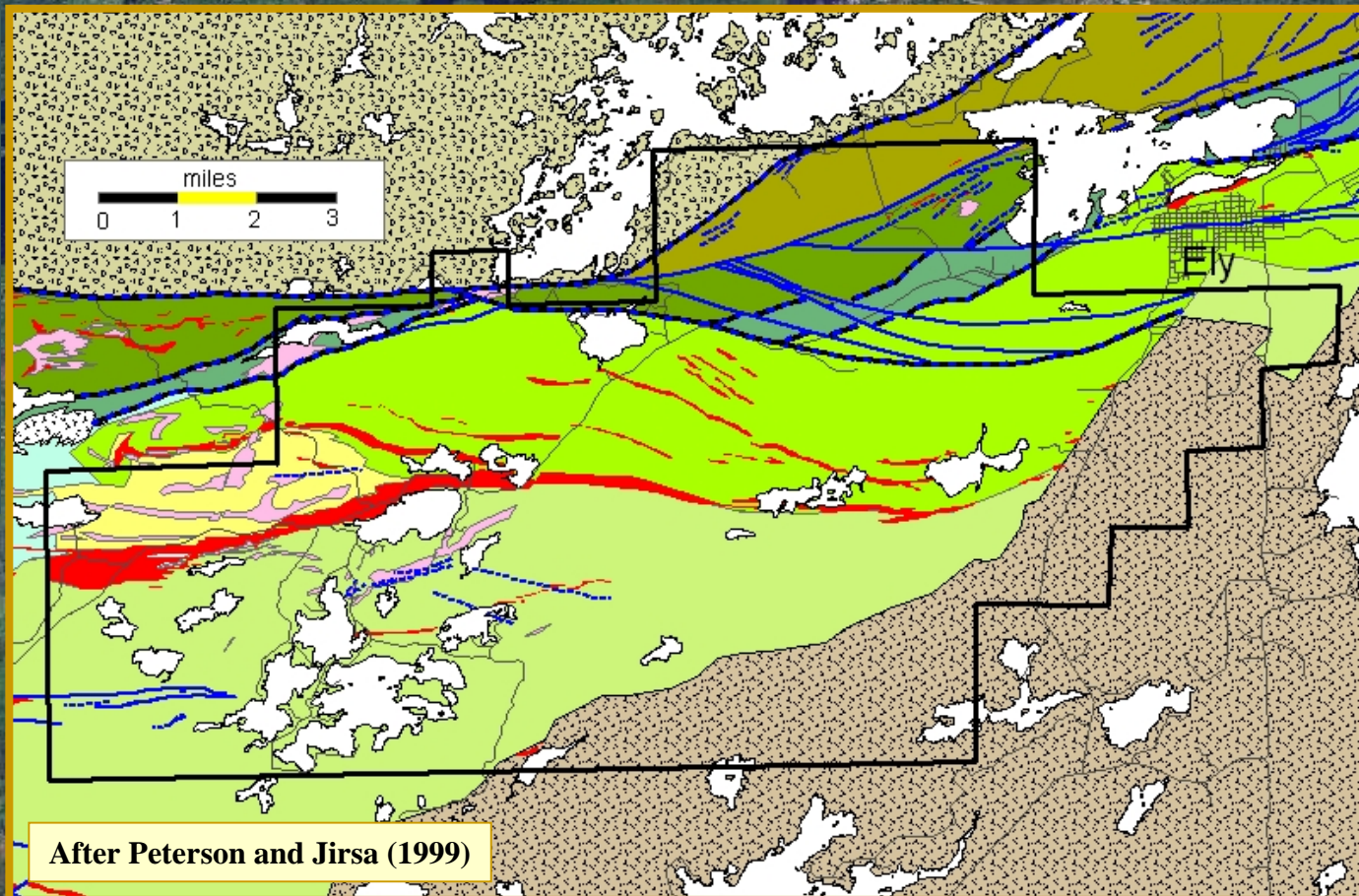


# Timiskiming-Type Metasediments





# Vermilion District Bedrock Geology



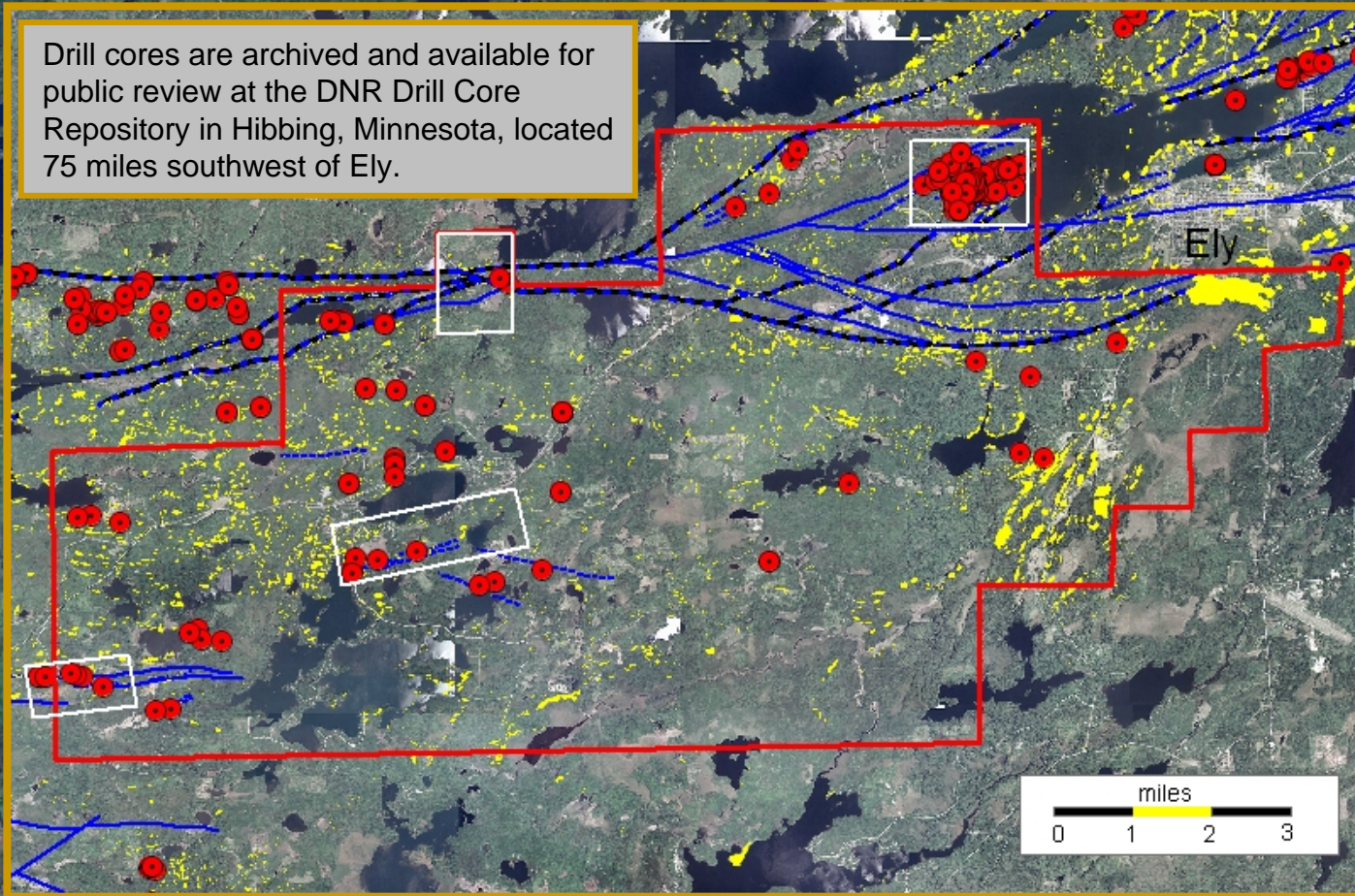
## Late Archean Rocks

- Quartz Feldspar Porphyry
- Giants Range Batholith
- Vermilion Granitic Complex
- Newton Lake Formation
- Bass Lake sequence
- Knife Lake Group
- Lake Vermilion Formation
- Galvert Lake Felsic Complex
- Upper Ely Greenstone
- Soudan Iron Formation
- Lower Ely Greenstone



# Outcrops and Drill Holes

Drill cores are archived and available for public review at the DNR Drill Core Repository in Hibbing, Minnesota, located 75 miles southwest of Ely.



Exploratory  
Bore Hole

Outcrop

2009  
Lease Sale

Prospect  
Boundary

## Faults and Shears

First Order

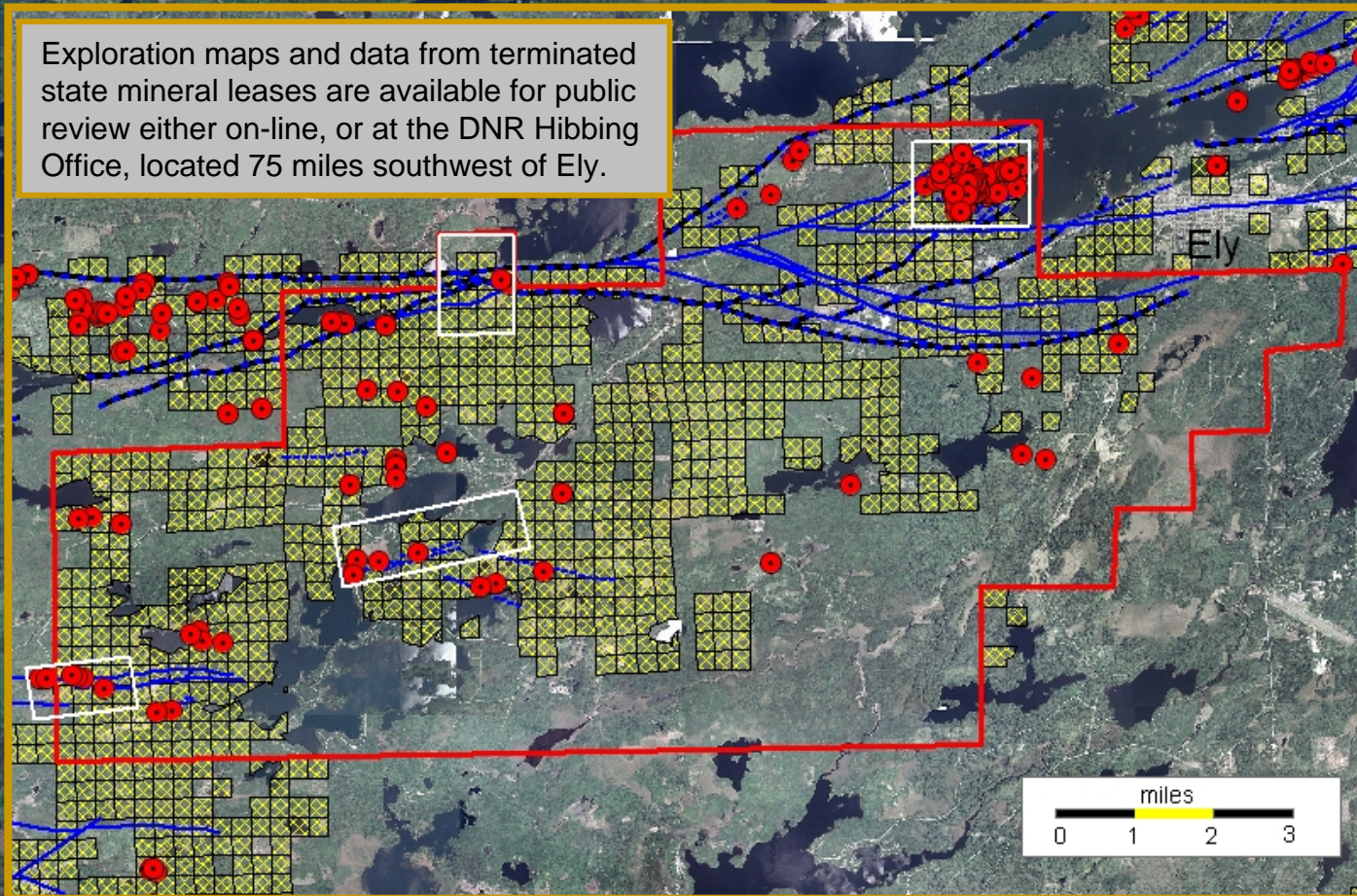
Second Order

Third Order



# Terminated State Mineral Leases

Exploration maps and data from terminated state mineral leases are available for public review either on-line, or at the DNR Hibbing Office, located 75 miles southwest of Ely.



Exploratory  
Bore Hole

Terminated  
Lease

2009  
Lease Sale

Prospect  
Boundary

## Faults and Shears

First Order

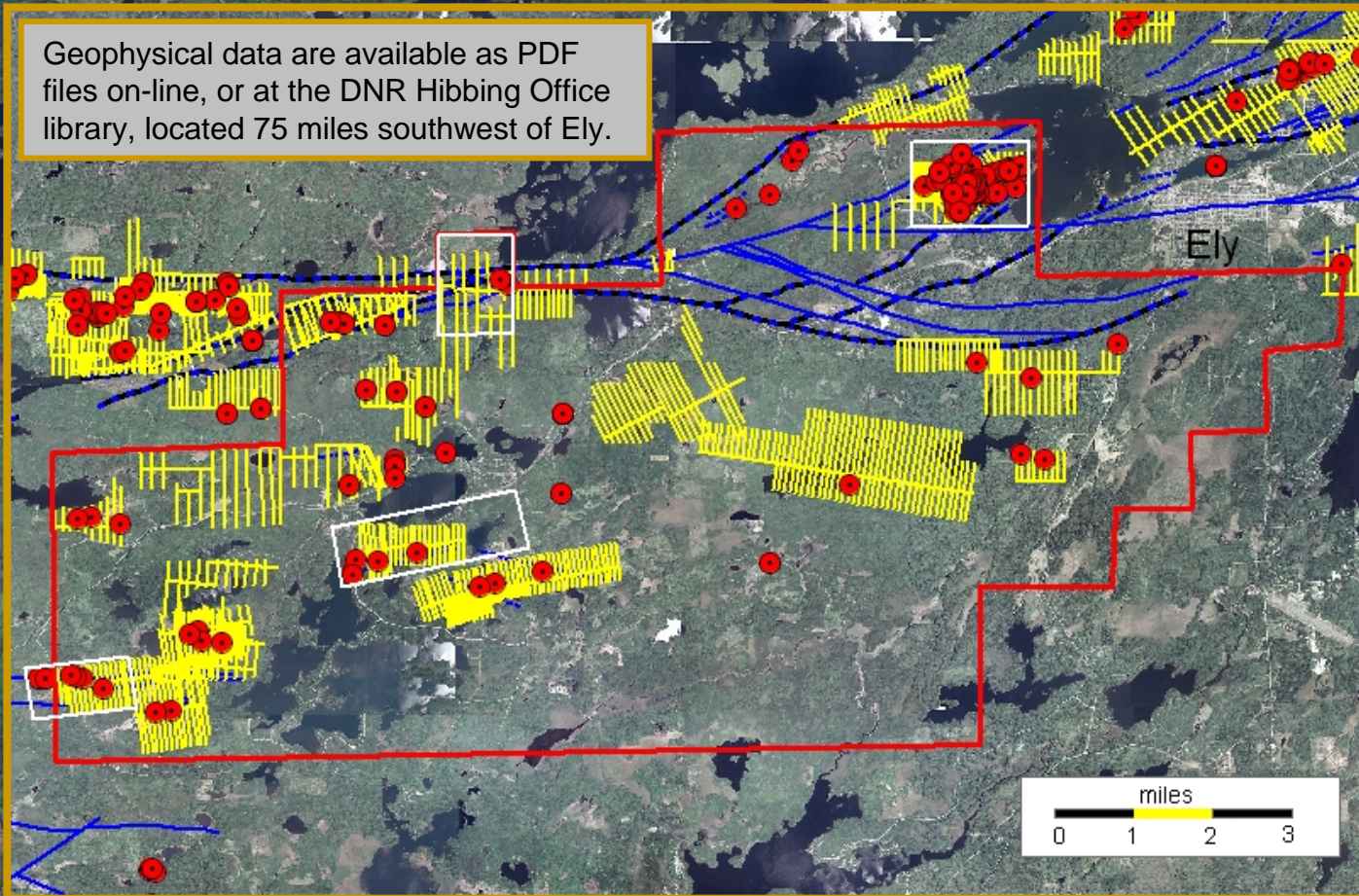
Second Order

Third Order



# Geophysical Grids

Geophysical data are available as PDF files on-line, or at the DNR Hibbing Office library, located 75 miles southwest of Ely.



Exploratory  
Bore Hole

Geophysical  
Grid

2009  
Lease Sale

Prospect  
Boundary

## Faults and Shears

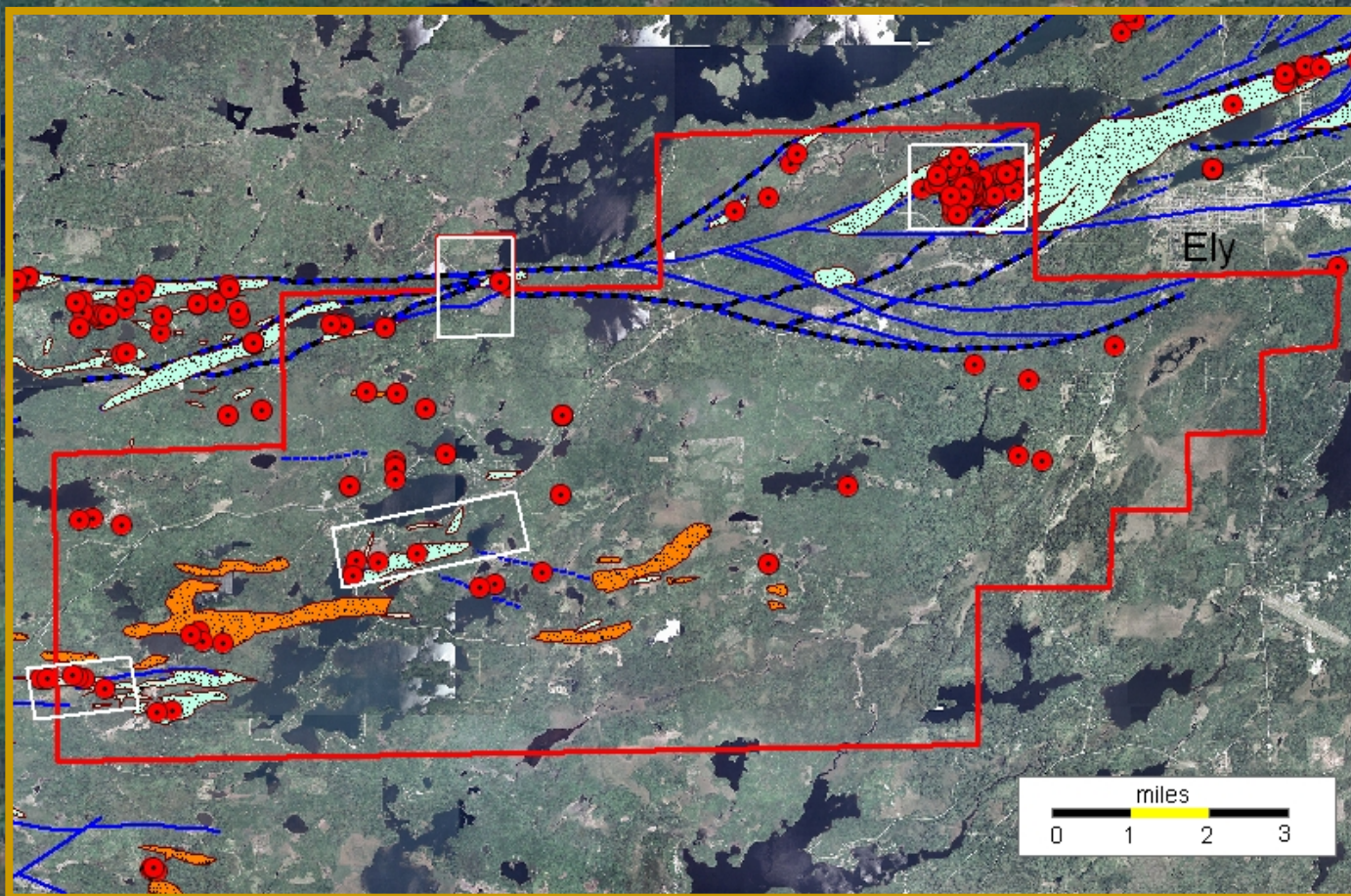
First Order

Second Order

Third Order



# Alteration Zones



Exploratory  
Bore Hole

Geophysical  
Grid

2009  
Lease Sale

Prospect  
Boundary

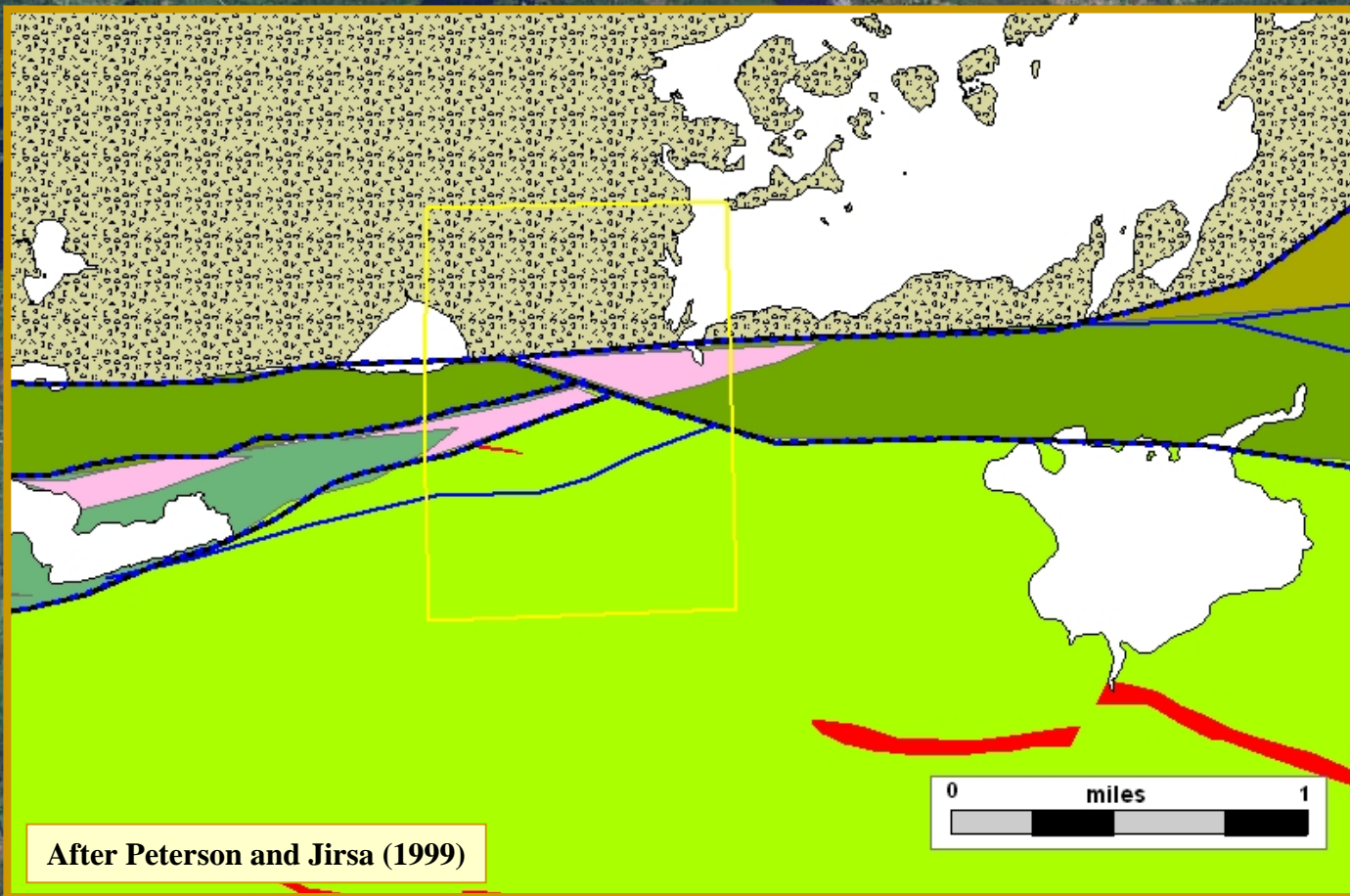
## Alteration

Lode gold  
Style

VMS Style



# Foss Lake Prospect

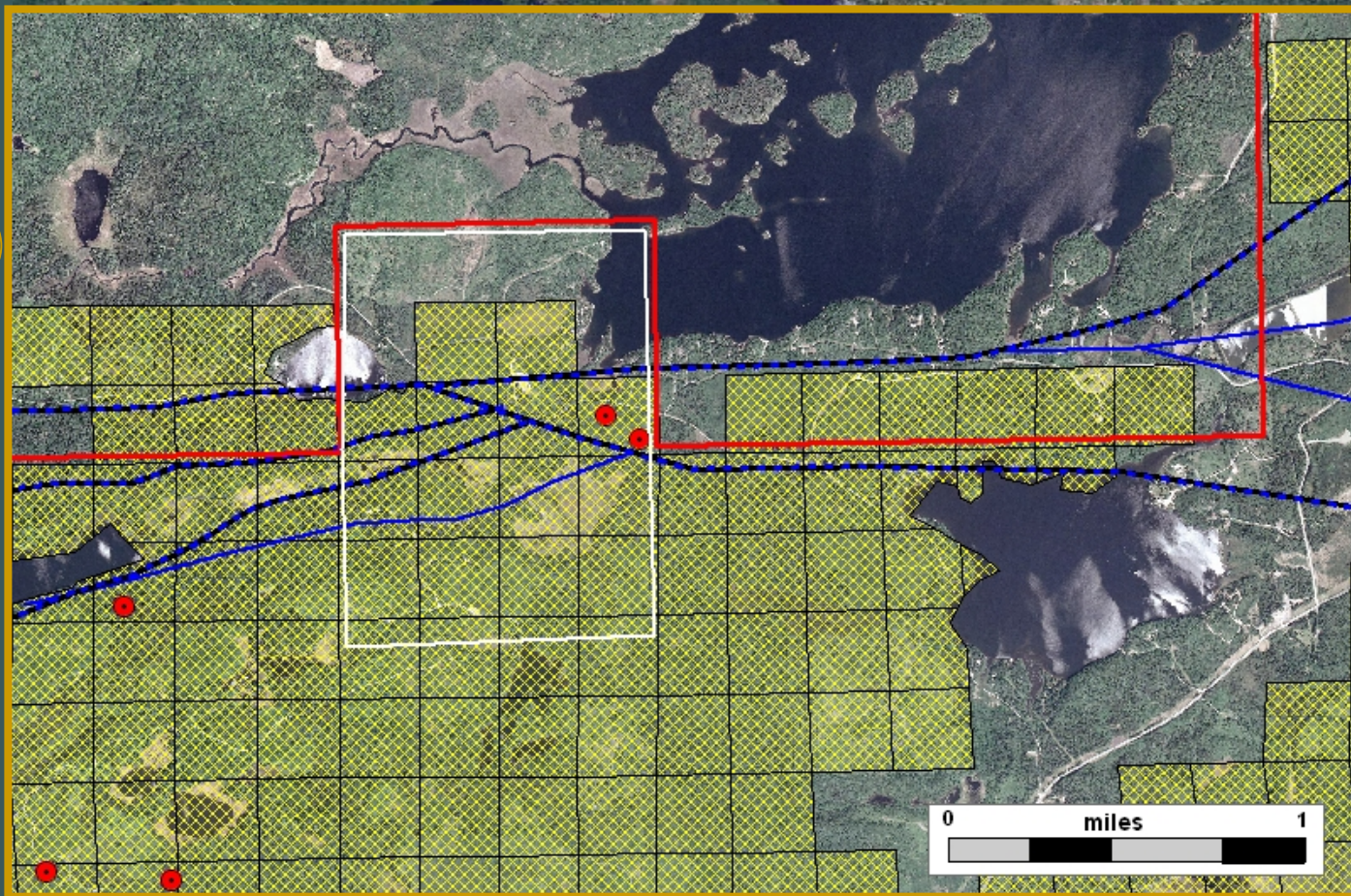


## Late Archean Rocks

- Quartz Feldspar Porphyry
- Giants Range Batholith
- Vermilion Granitic Complex
- Newton Lake Formation
- Bass Lake sequence
- Knife Lake Group
- Lake Vermilion Formation
- Galvert Lake Felsic Complex
- Upper Ely Greenstone
- Soudan Iron Formation
- Lower Ely Greenstone



# Foss Lake Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

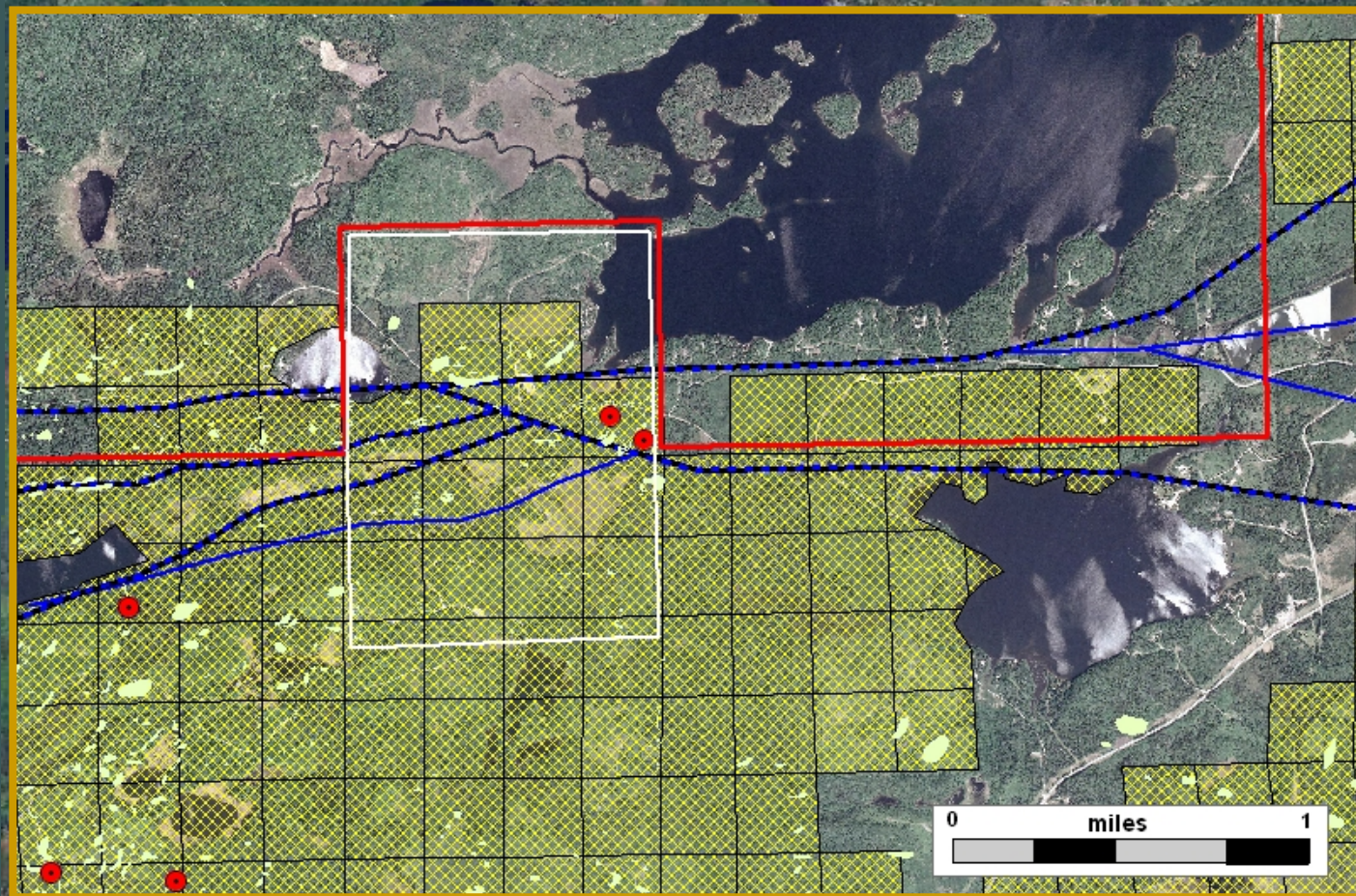
— First Order

— Second Order

... Third Order



# Foss Lake Prospect



● Exploratory  
Bore Hole

Terminated  
Lease

Outcrop

2009  
Lease Sale

Prospect  
Boundary

## Faults and Shears

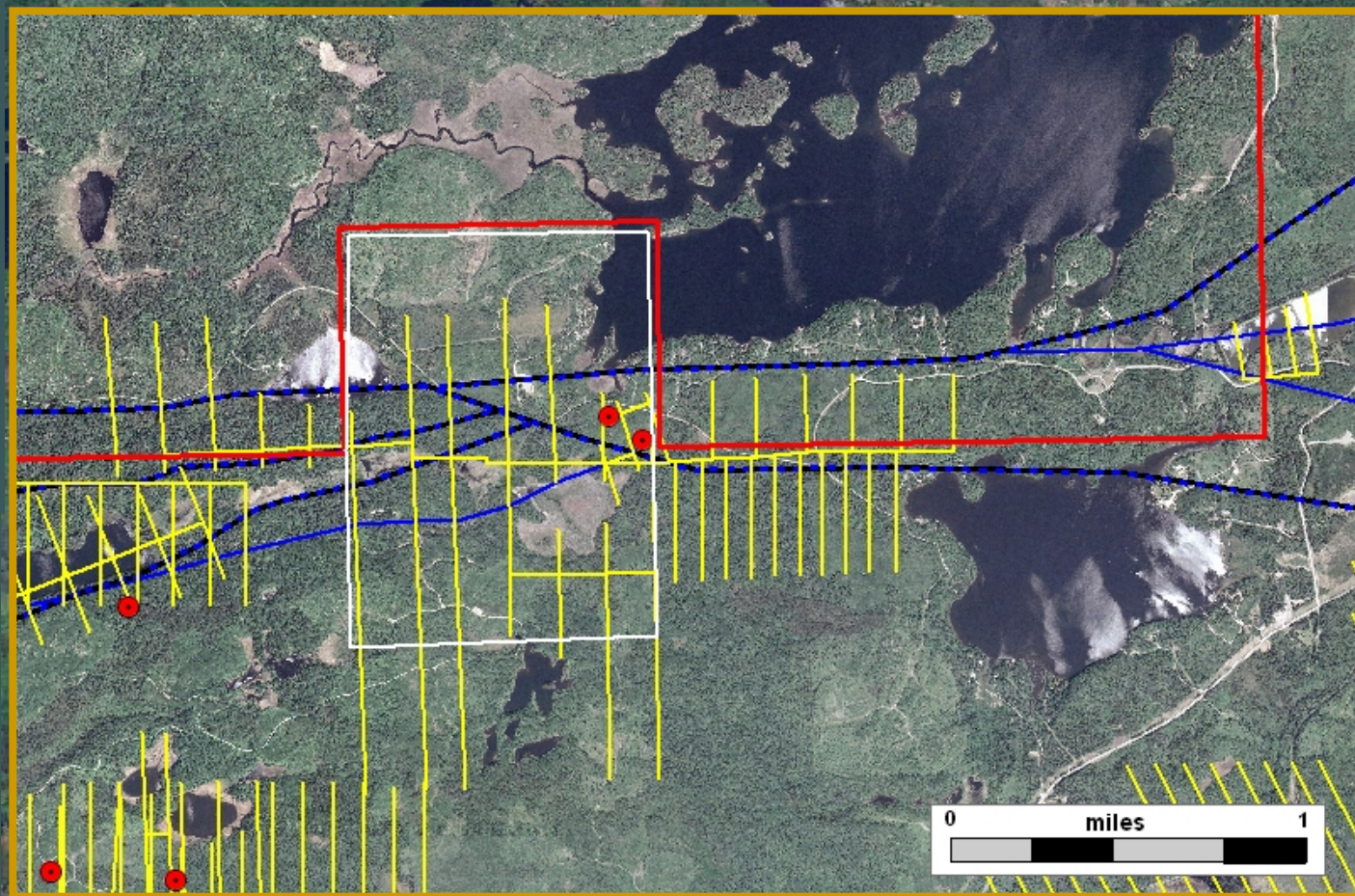
First Order

Second Order

Third Order



# Foss Lake Prospect



● Exploratory  
Bore Hole

||| Geophysical  
Grid

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

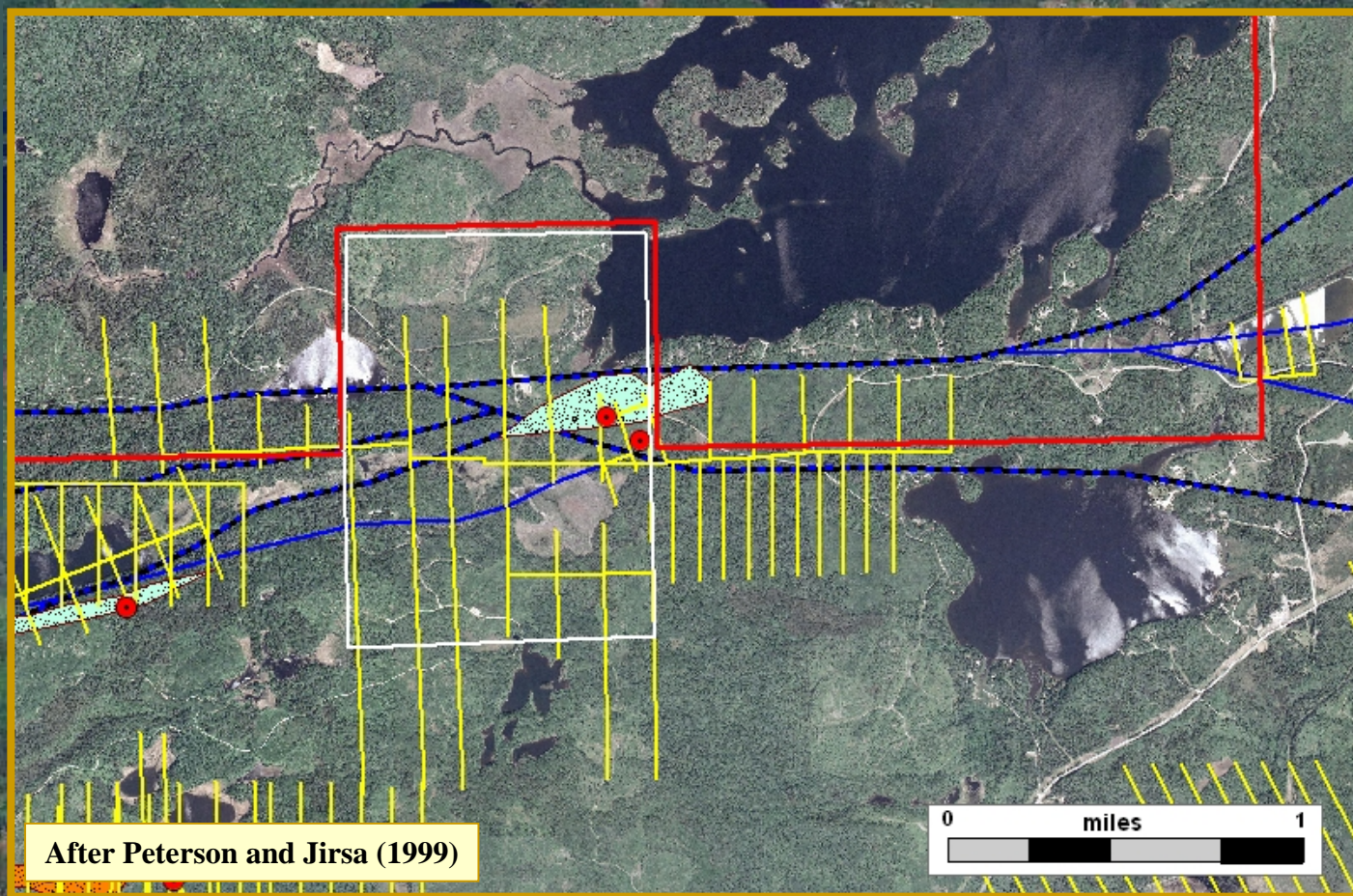
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# Foss Lake Prospect



● Exploratory  
Bore Hole

⌘ Geophysical  
Grid

— 2009  
Lease Sale

— Prospect  
Boundary

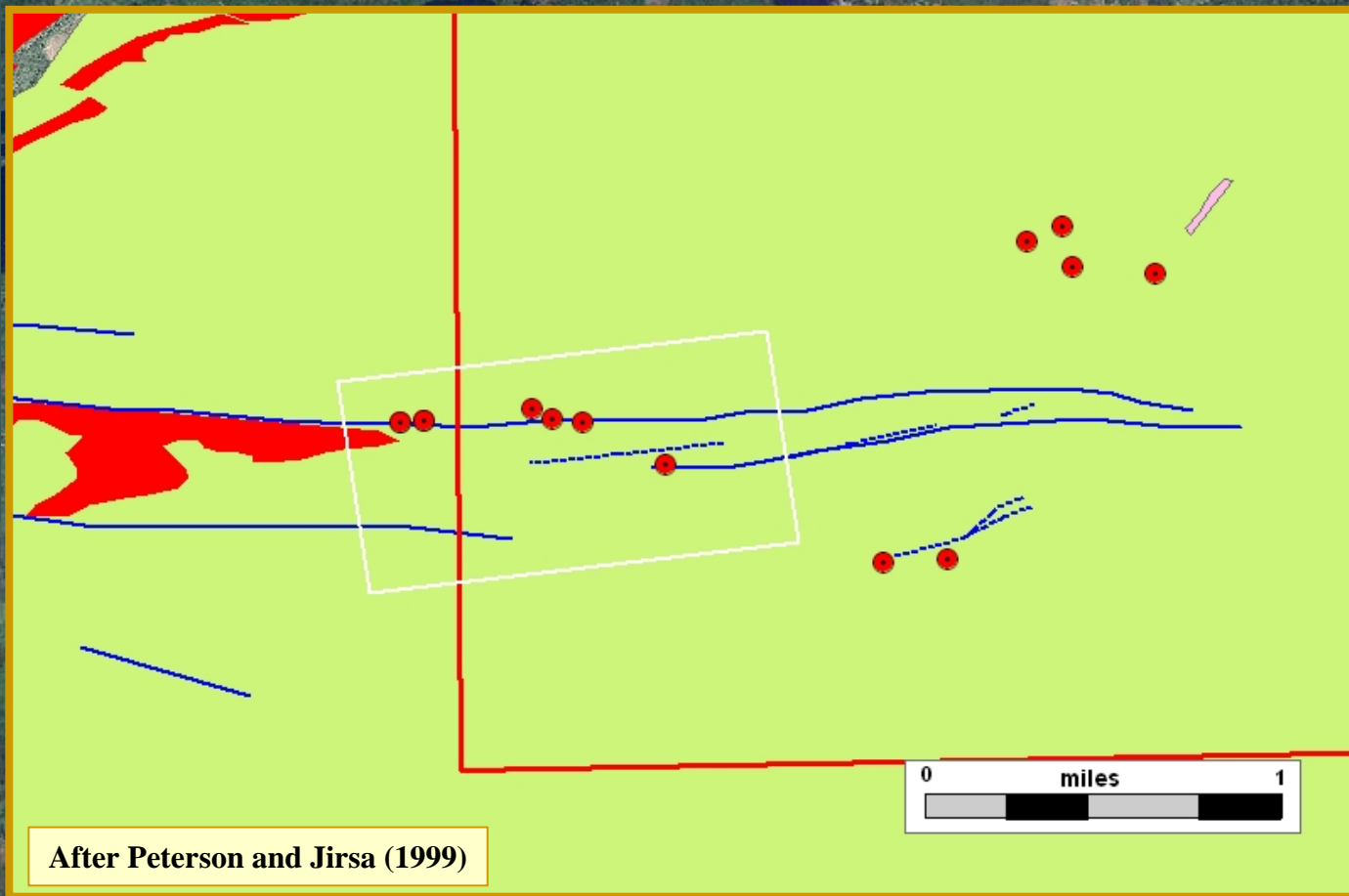
## Alteration

● Lode gold  
Style

● VMS Style



# Murray Shear Prospect

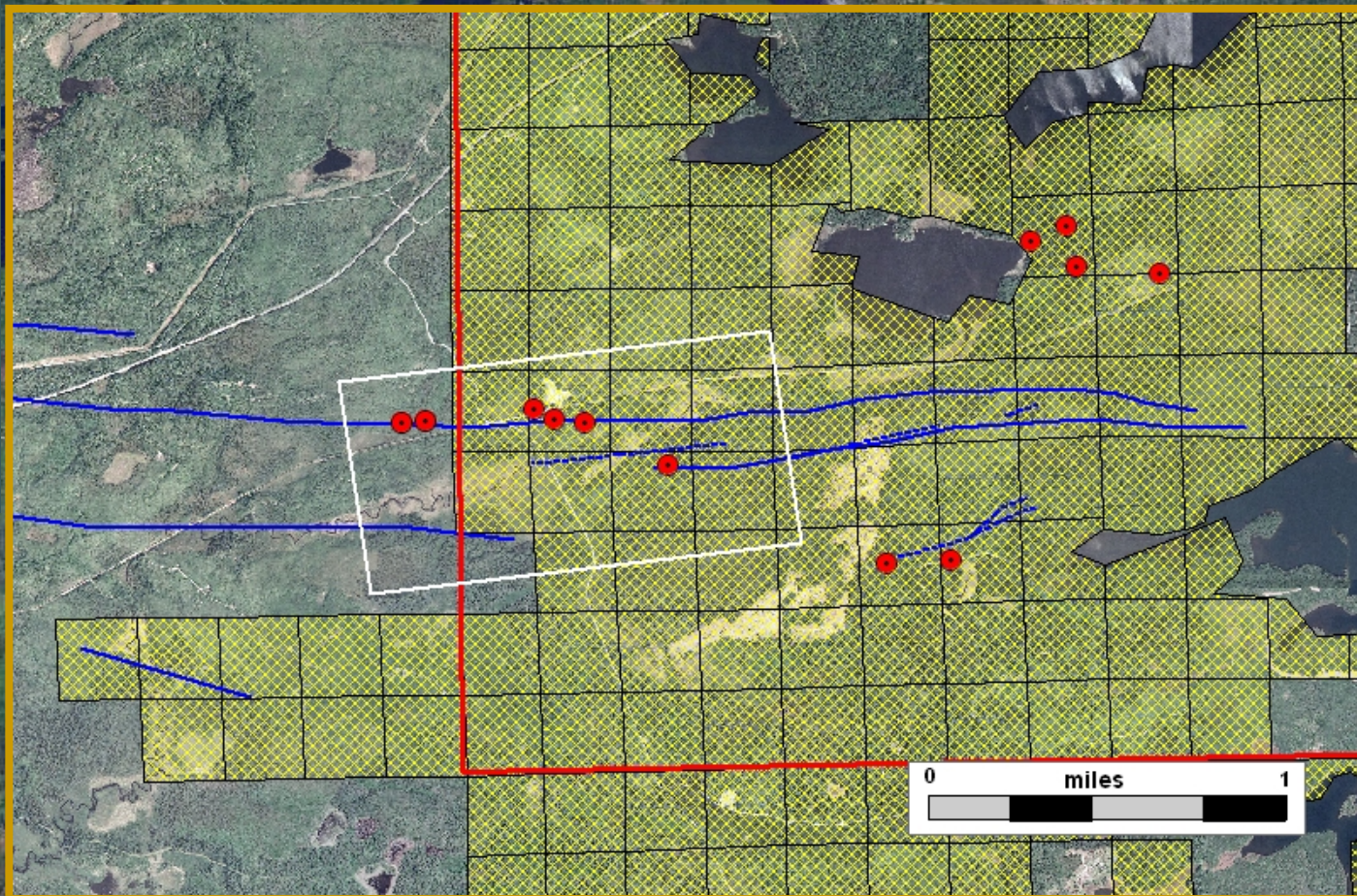


## Late Archean Rocks

- Quartz Feldspar Porphyry
- Giants Range Batholith
- Vermilion Granitic Complex
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- Bass Lake sequence
- Knife Lake Group
- Lake Vermilion Formation
- Galvert Lake Felsic Complex
- Upper Ely Greenstone
- Soudan Iron Formation
- Lower Ely Greenstone



# Murray Shear Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

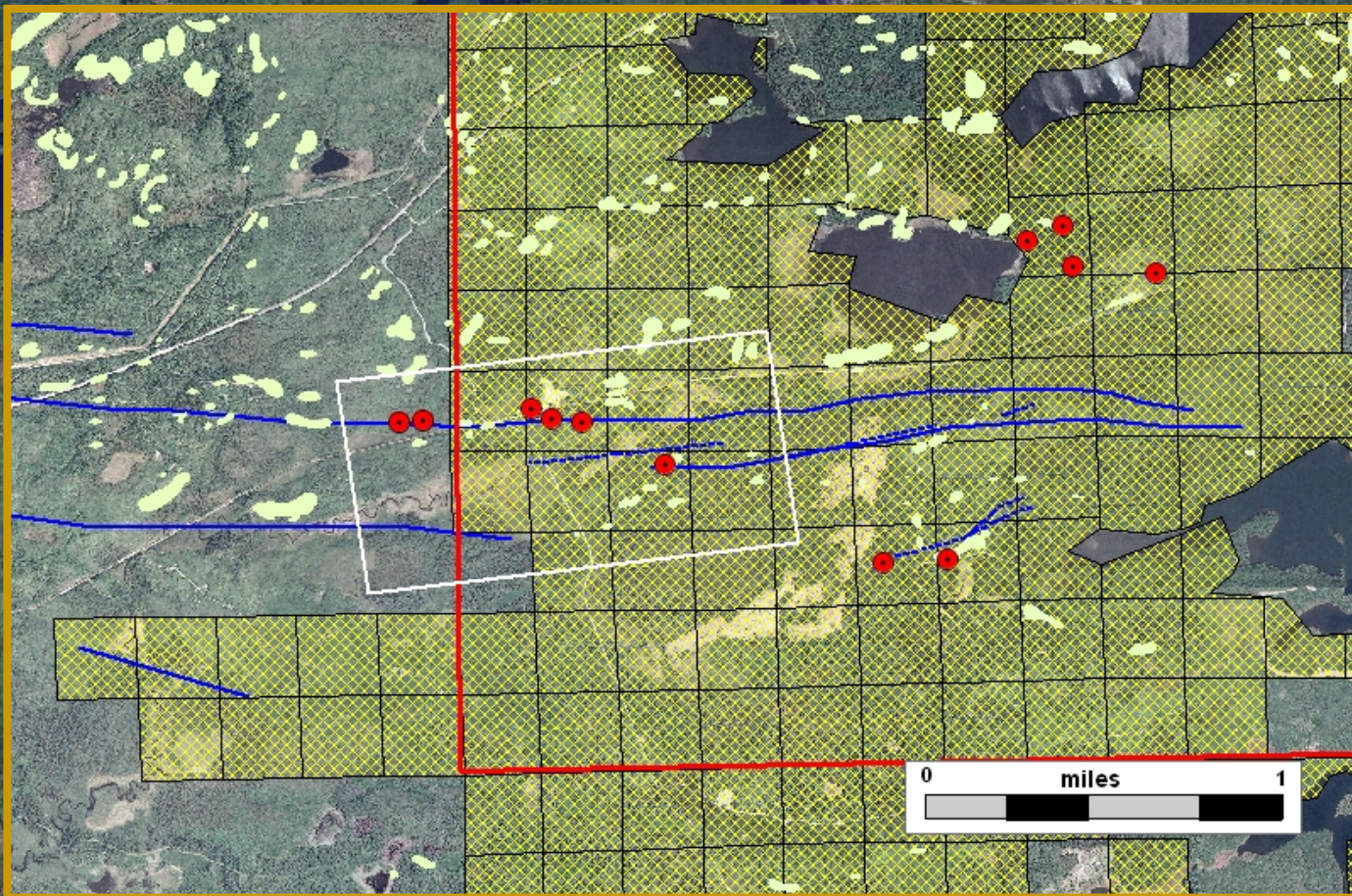
▨ First Order

— Second Order

... Third Order



# Murray Shear Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

■ Outcrop

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

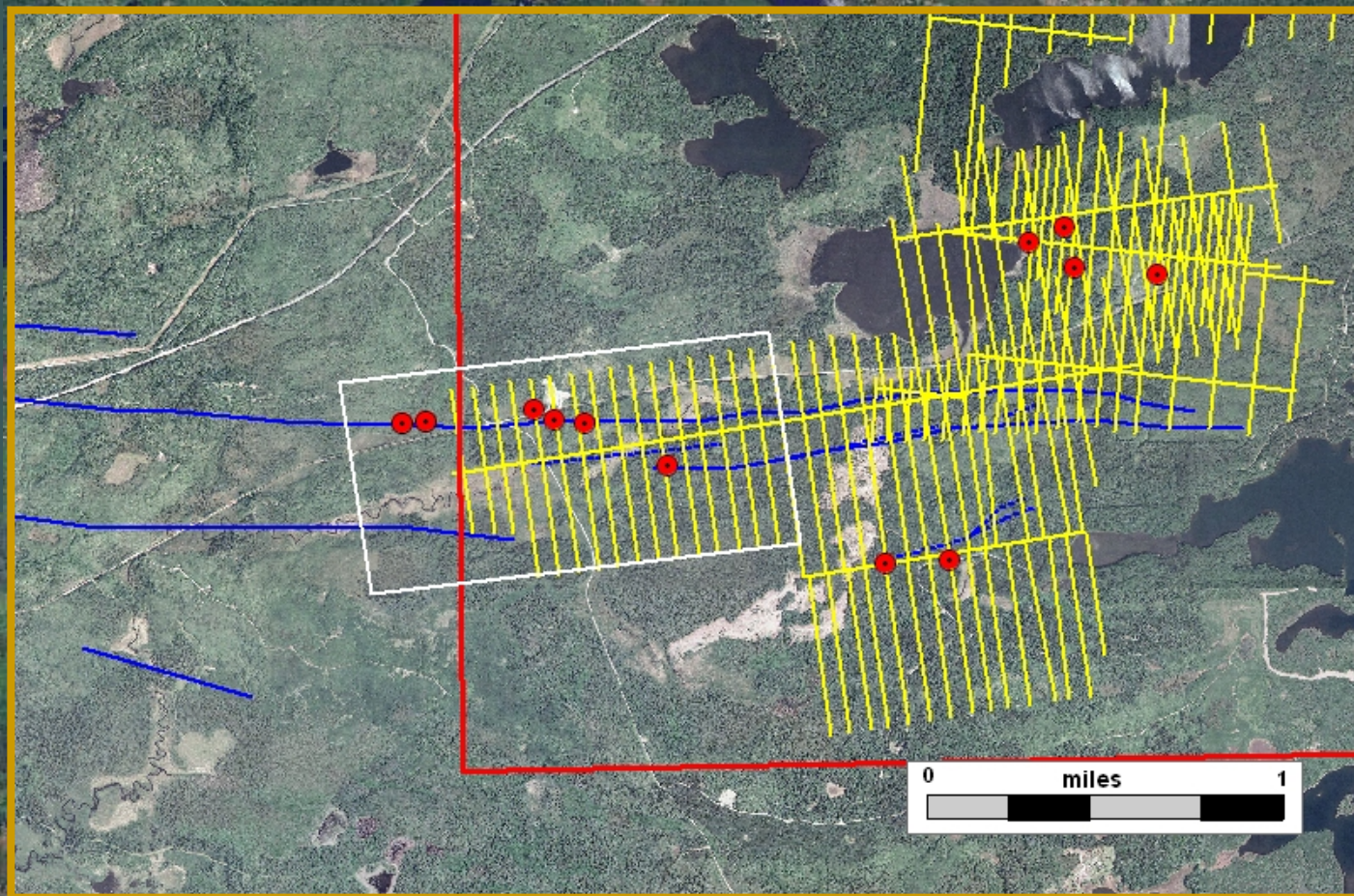
— First Order

— Second Order

... Third Order



# Murray Shear Prospect



● Exploratory  
Bore Hole

⌘ Geophysical  
Grid

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

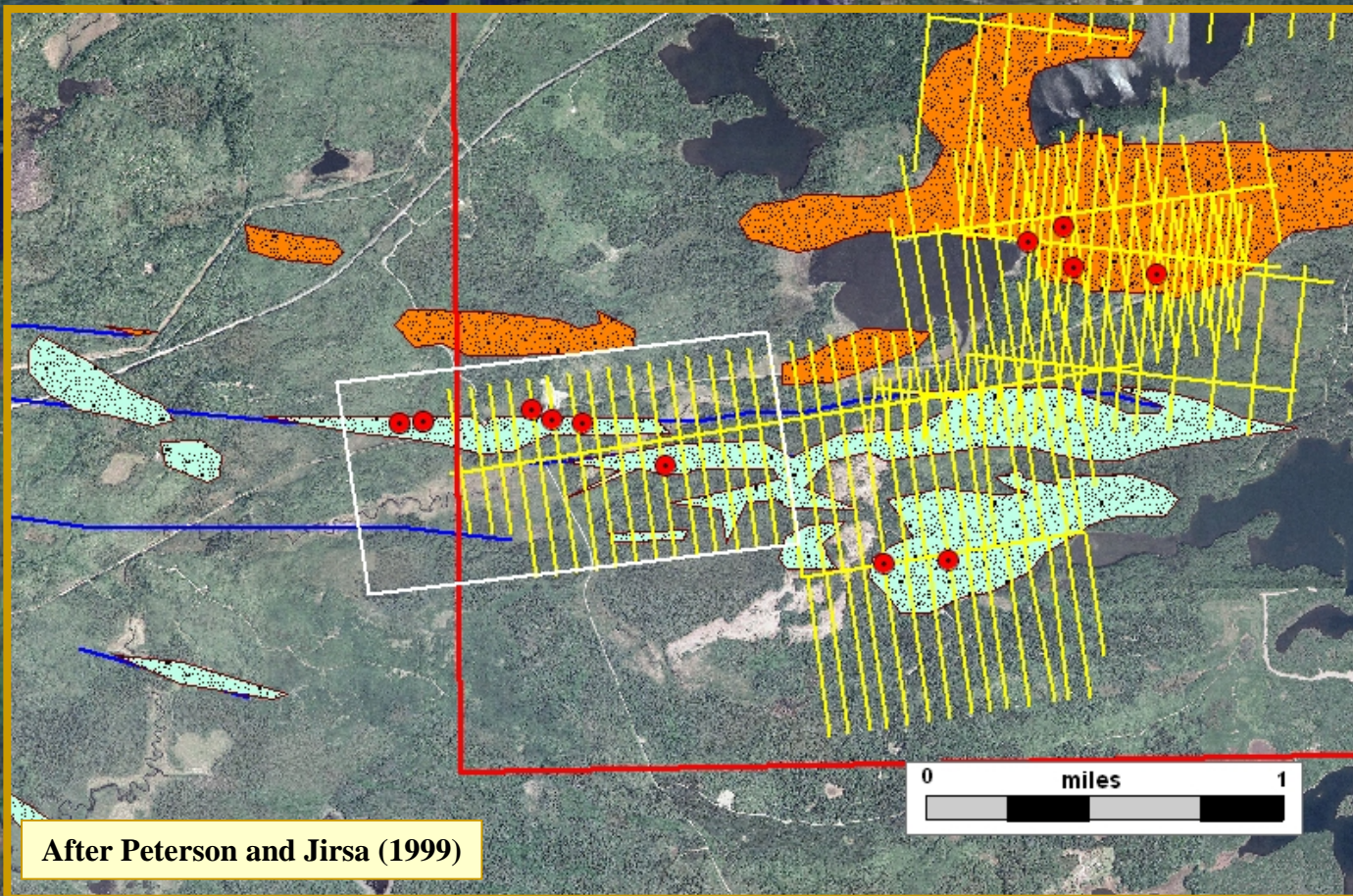
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— Second Order

... Third Order



# Murray Shear Prospect



After Peterson and Jirsa (1999)

Exploratory  
Bore Hole

Geophysical  
Grid

2009  
Lease Sale

Prospect  
Boundary

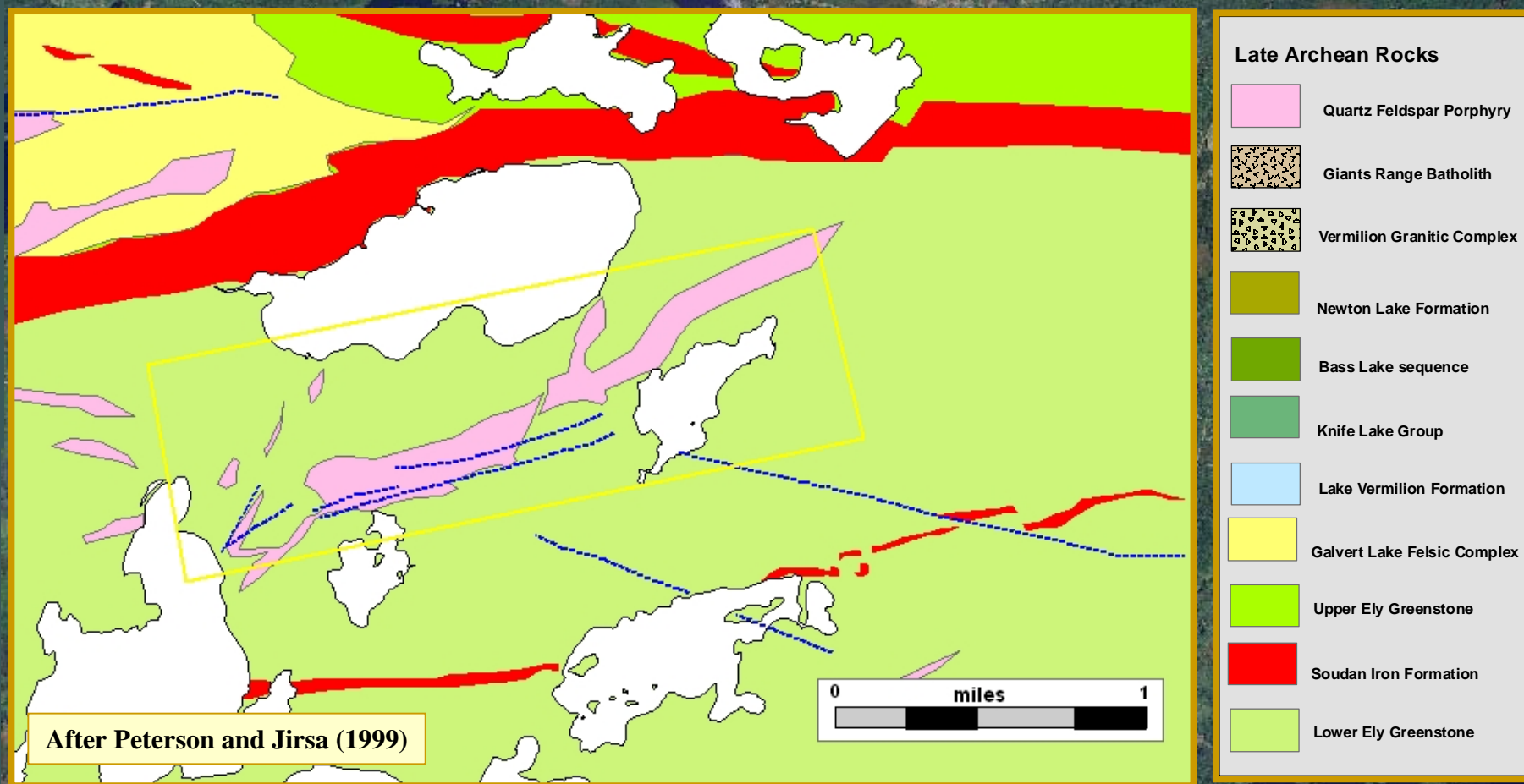
## Alteration

Lode gold  
Style

VMS Style

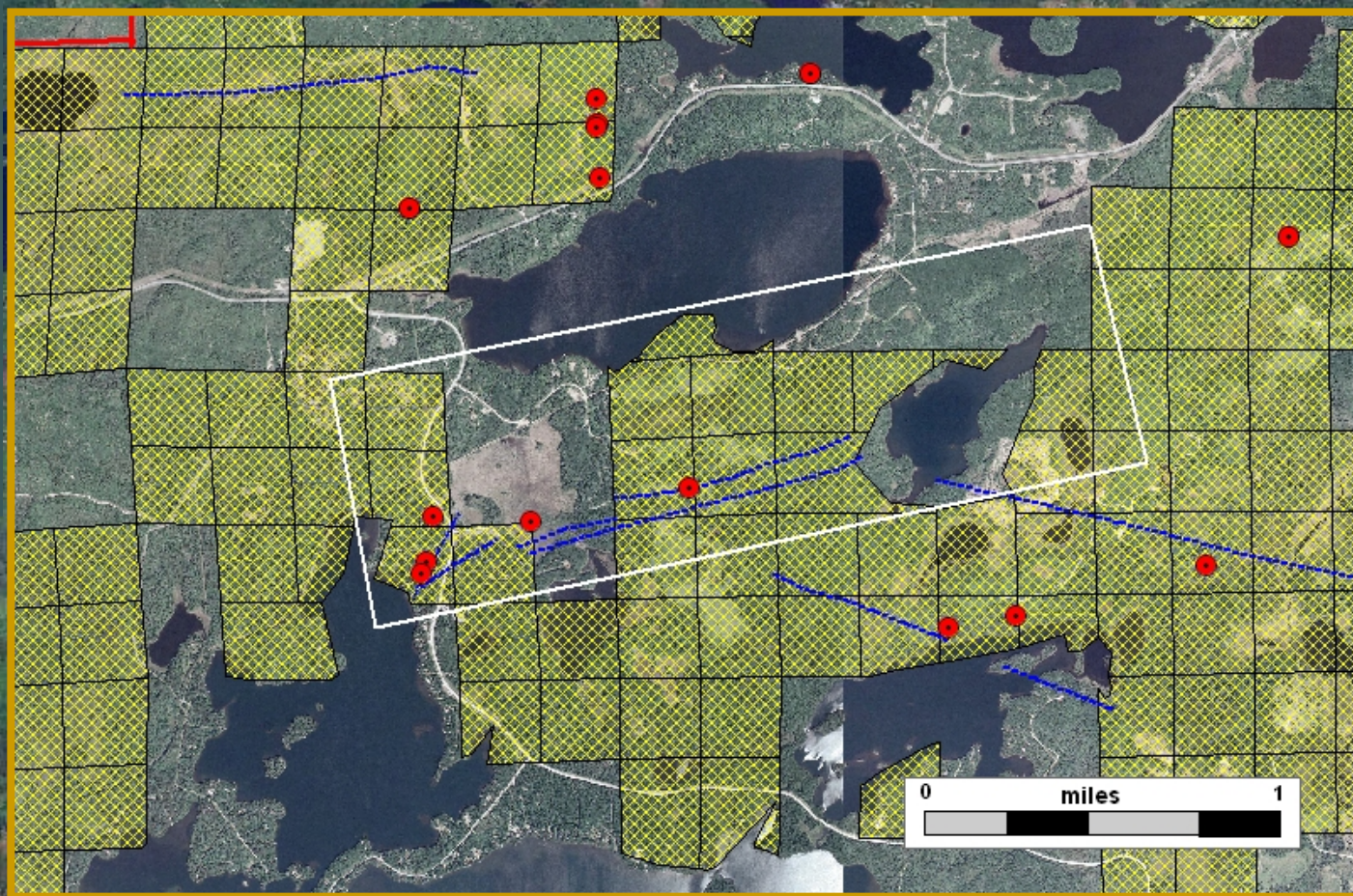


# Eagles Nest Shear Prospect





# Eagles Nest Shear Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

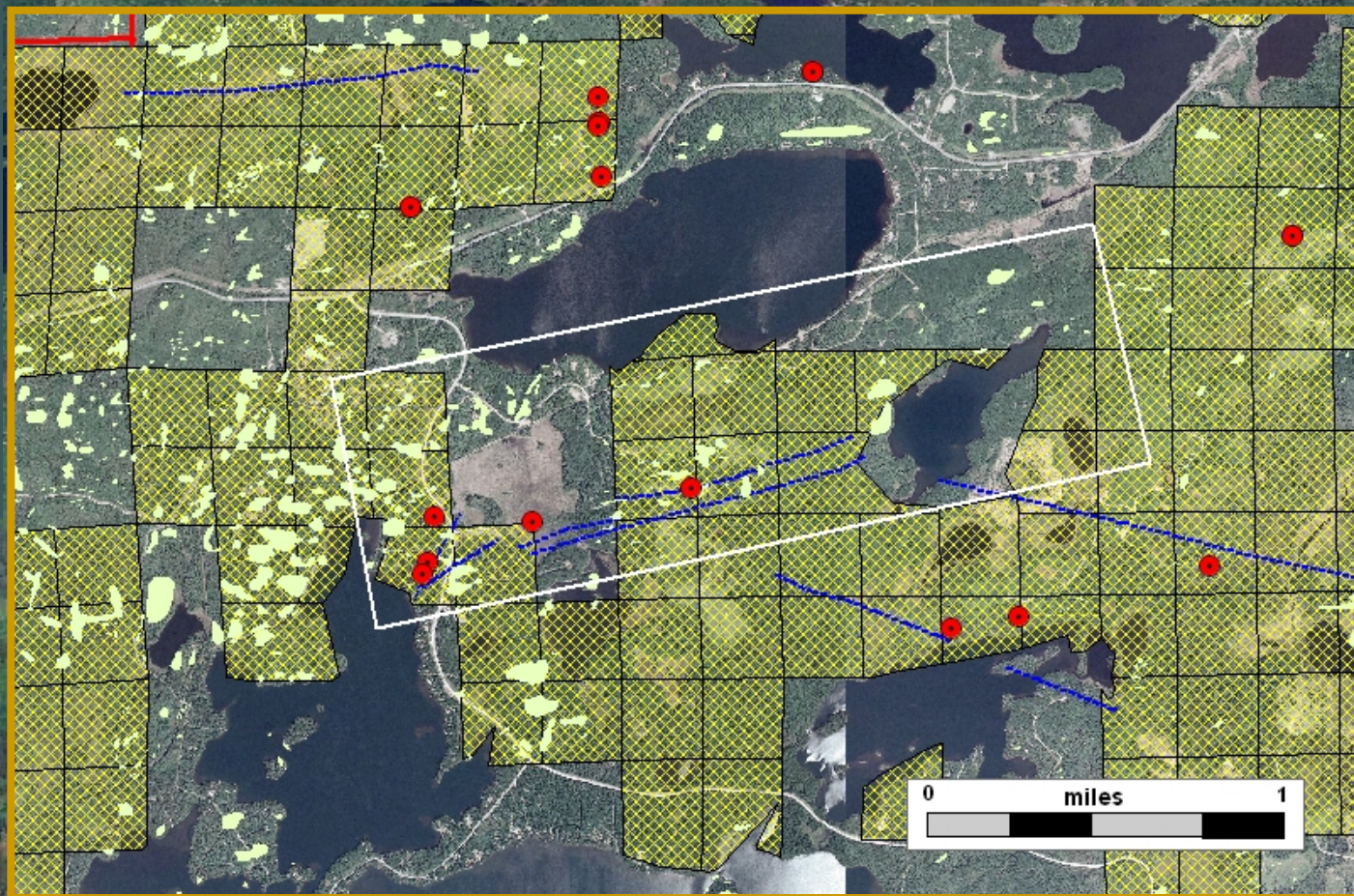
— First Order

— Second Order

... Third Order



# Eagles Nest Shear Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

◀ Outcrop

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

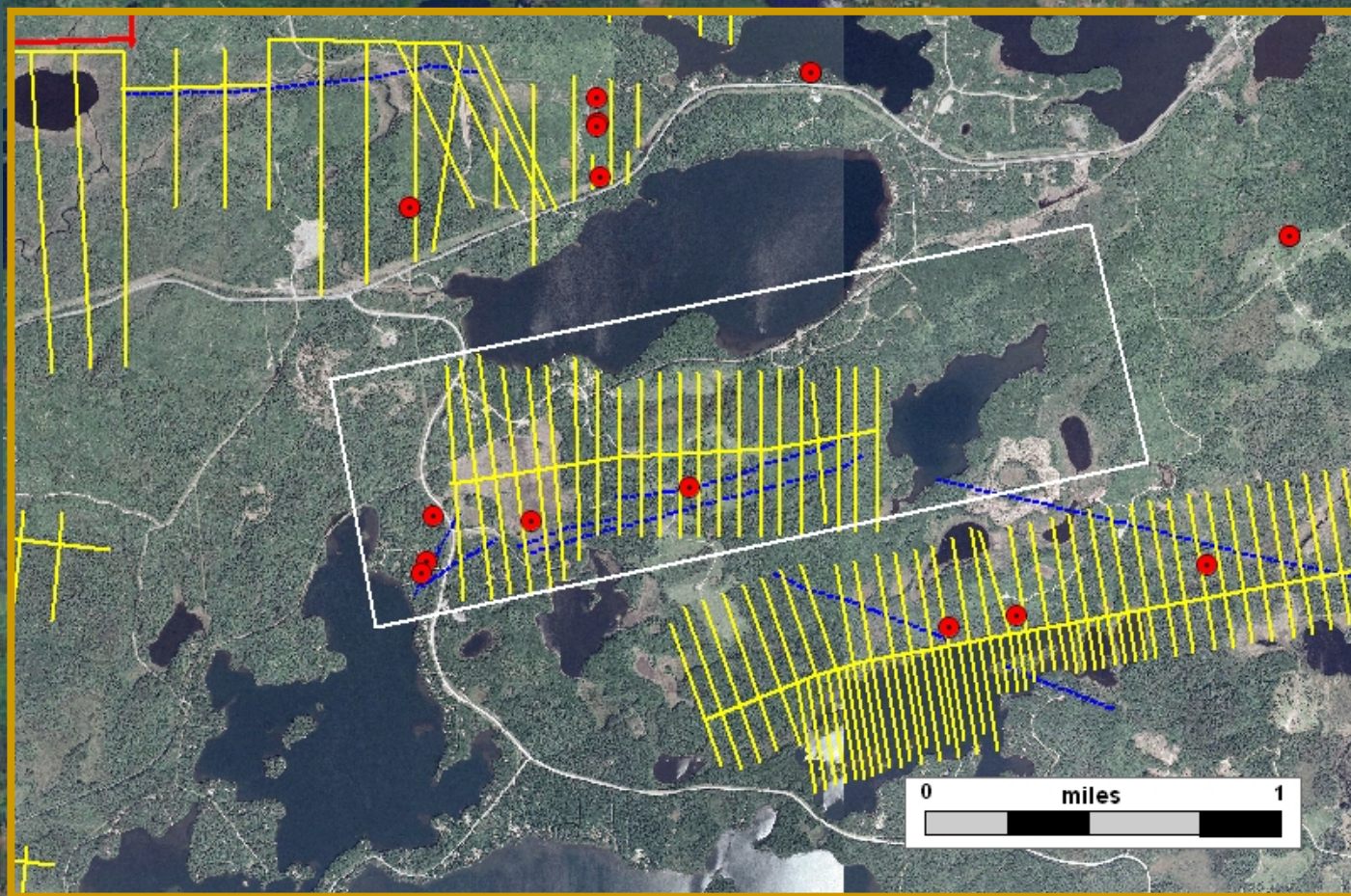
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# Eagles Nest Shear Prospect



● Exploratory  
Bore Hole

||| Geophysical  
Grid

2009  
Lease Sale

Prospect  
Boundary

## Faults and Shears

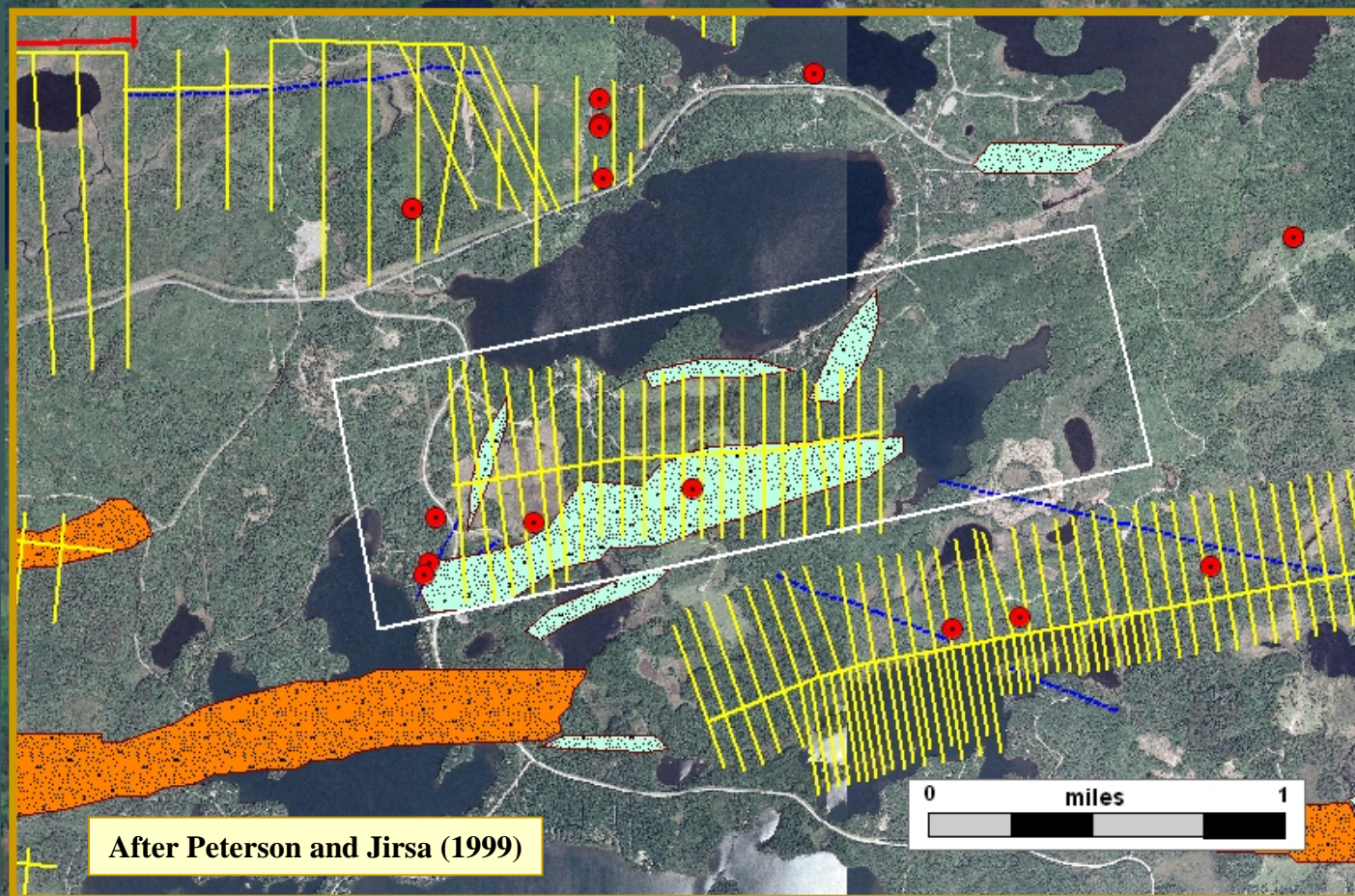
First Order

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# Eagles Nest Shear Prospect



Exploratory  
Bore Hole

Geophysical  
Grid

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Lease Sale

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Boundary

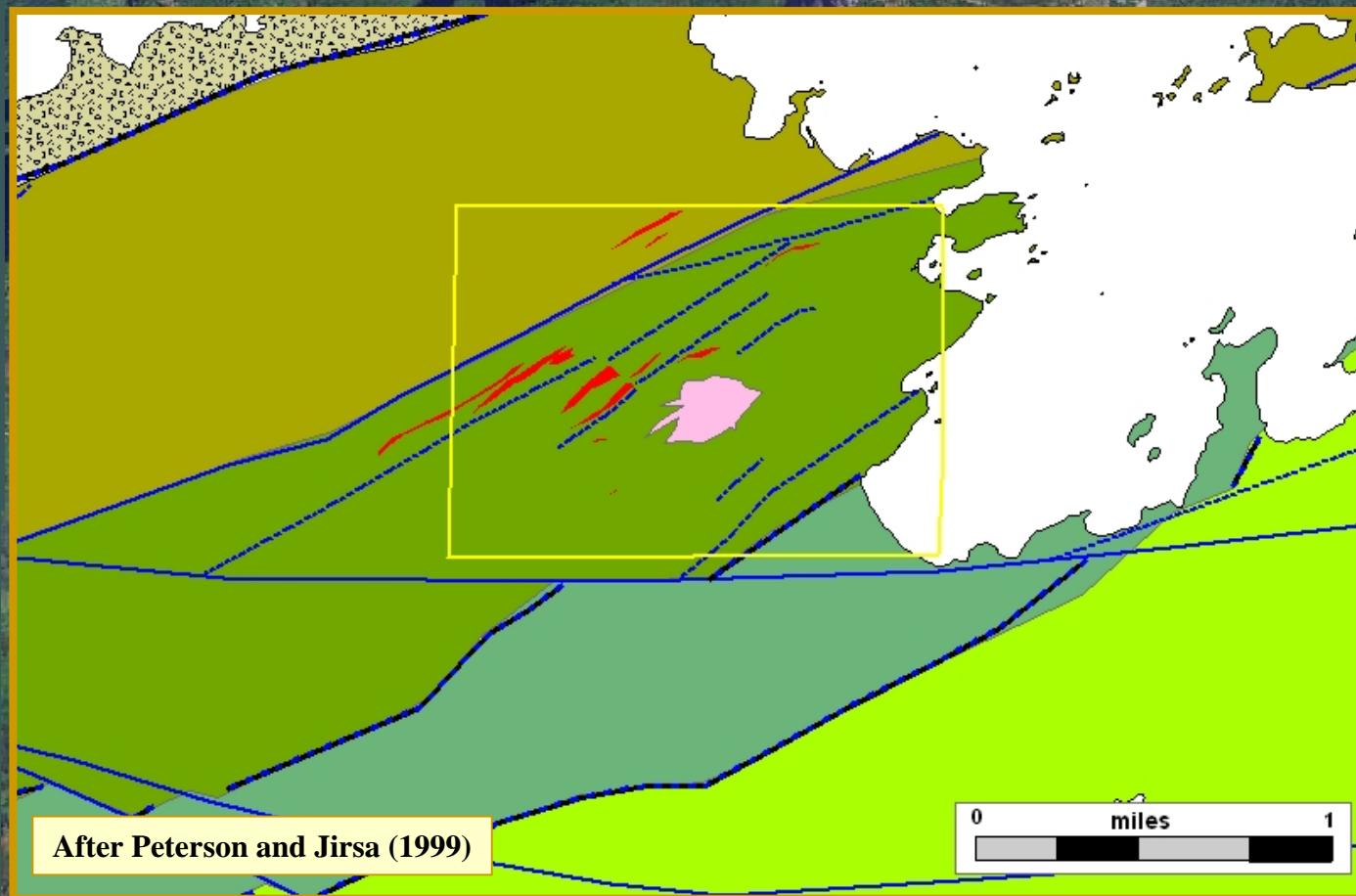
## Alteration

Lode gold  
Style

VMS Style



# Raspberry Prospect

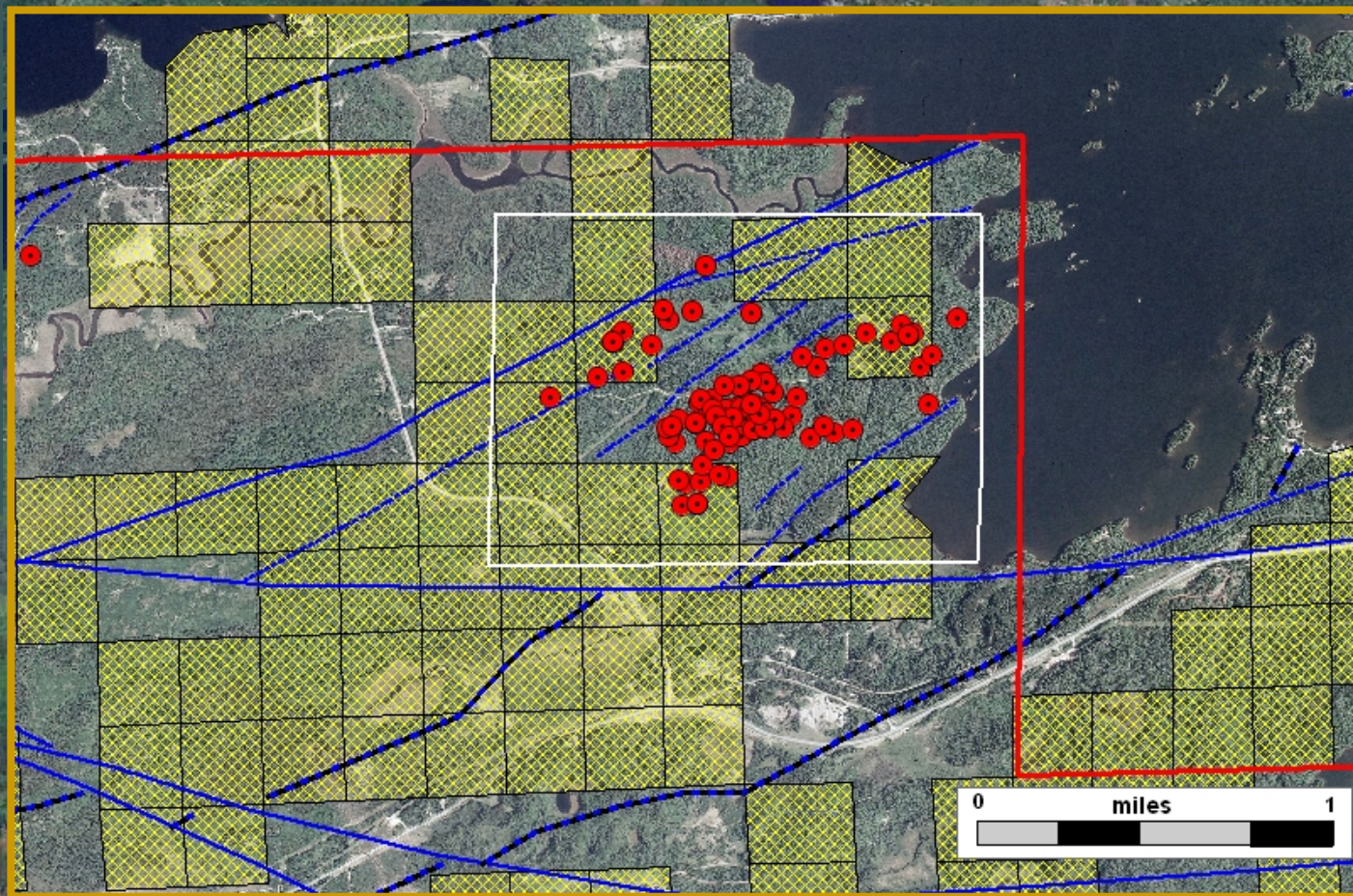


## Late Archean Rocks

- Quartz Feldspar Porphyry
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# Raspberry Prospect



● Exploratory  
Bore Hole

■ Terminated  
Lease

— 2009  
Lease Sale

— Prospect  
Boundary

## Faults and Shears

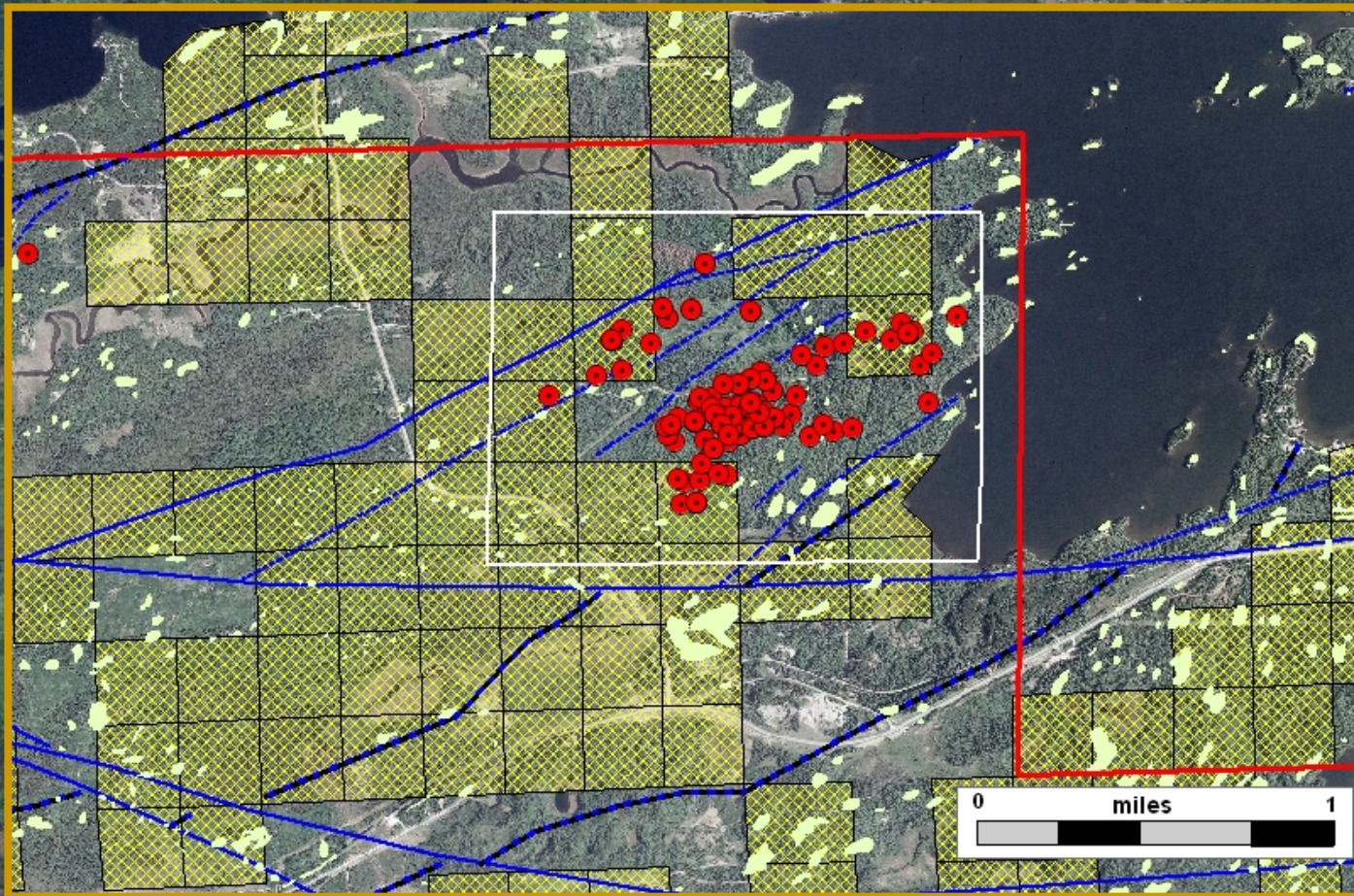
— First Order

— Second Order

... Third Order



# Raspberry Prospect



● Exploratory  
Bore Hole

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Lease

■ Outcrop

— 2009  
Lease Sale

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Boundary

## Faults and Shears

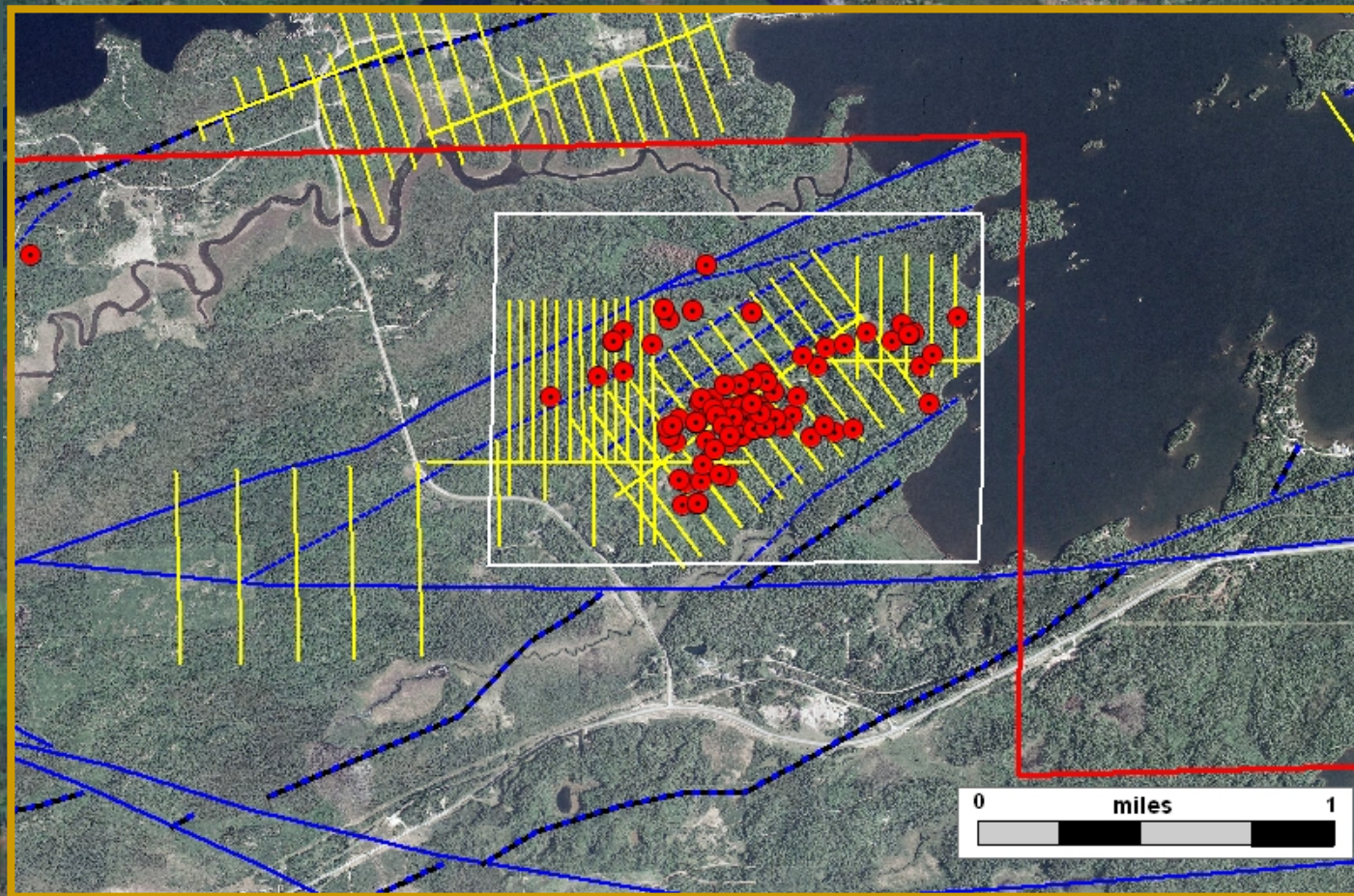
— First Order

— Second Order

... Third Order



# Raspberry Prospect



● Exploratory  
Bore Hole

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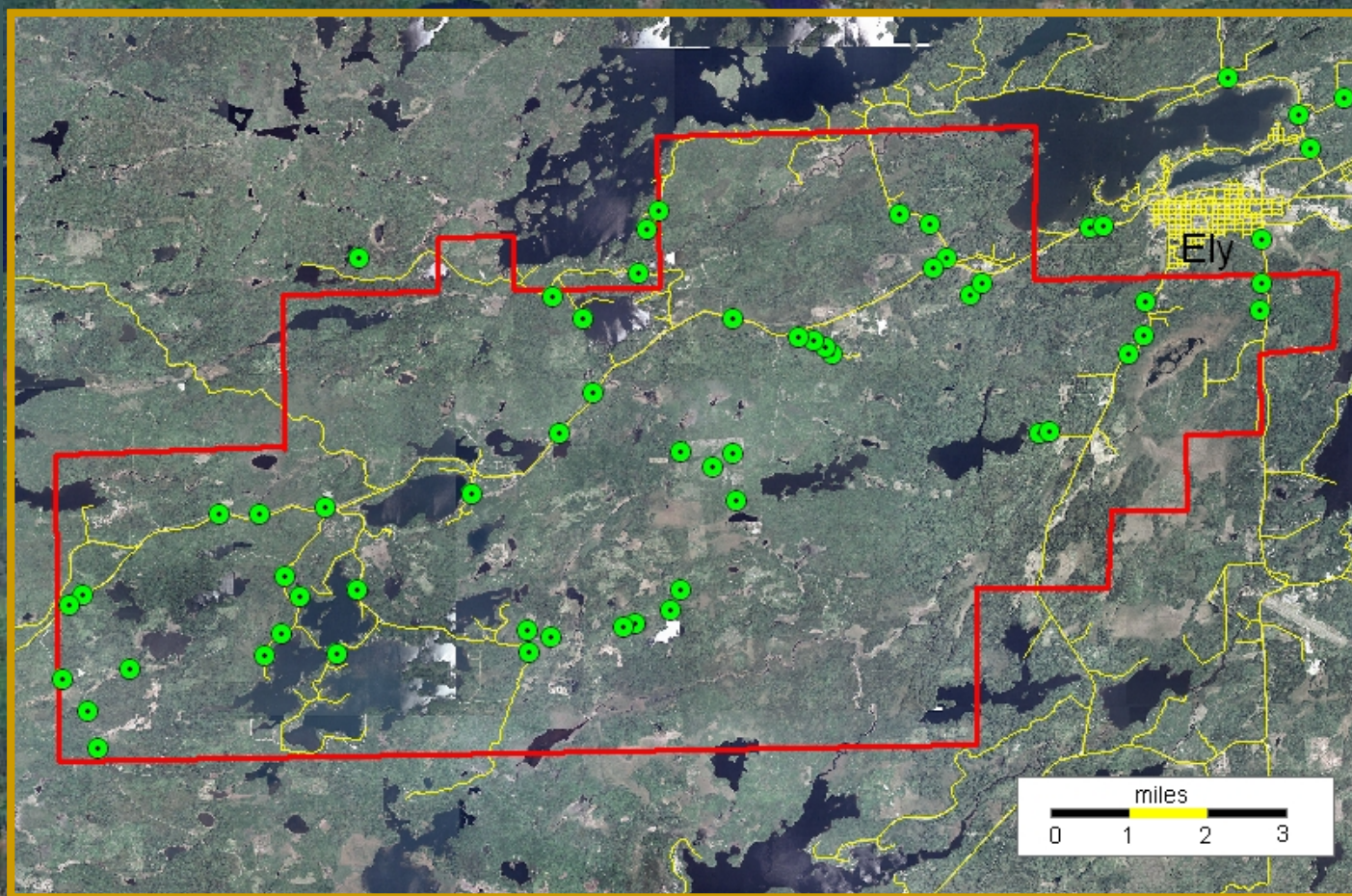
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# Raspberry Prospect



● Exploratory  
Bore Hole

⌘ Geophysical  
Grid

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## Alteration

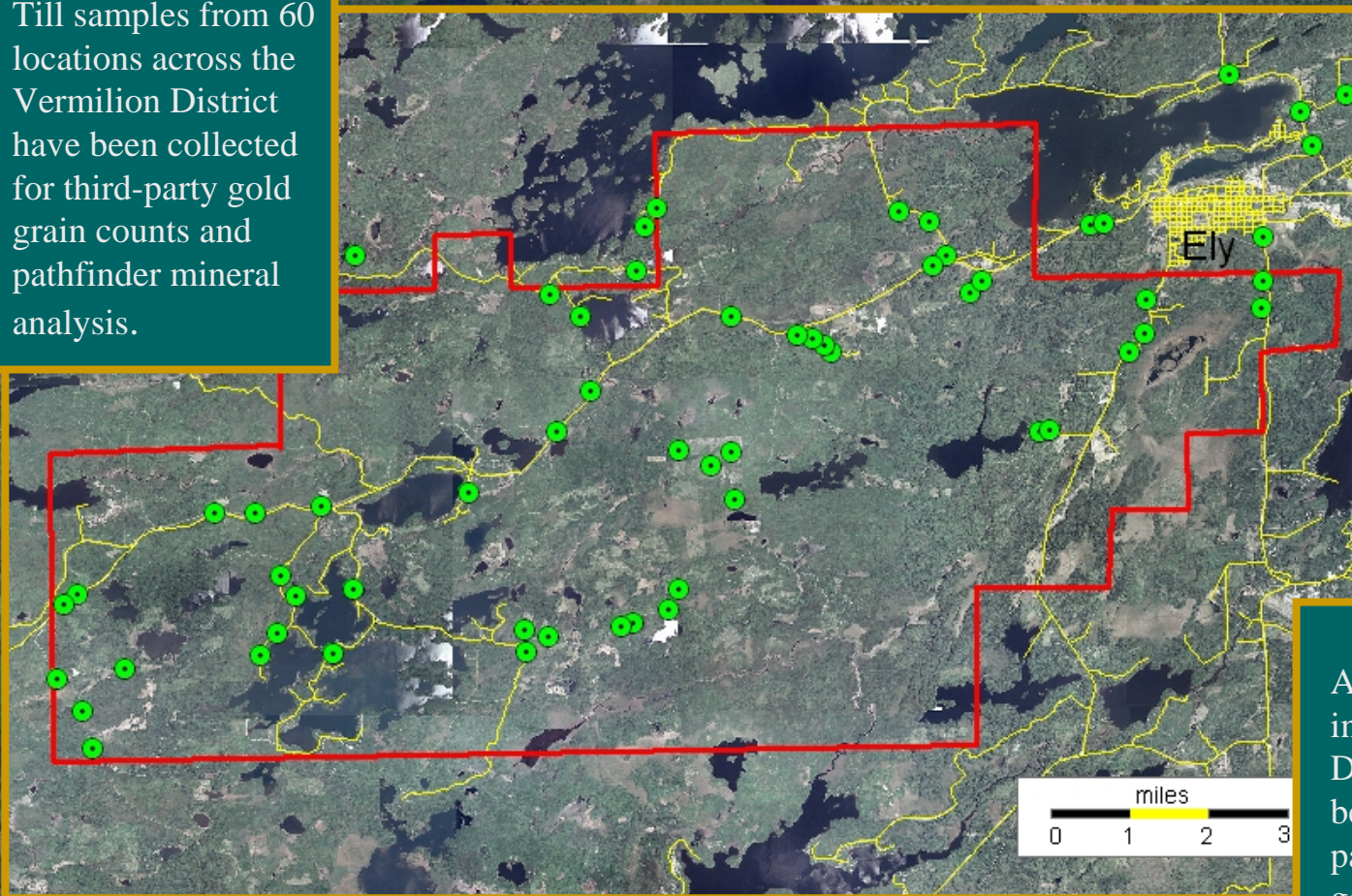
● Lode gold  
Style

● VMS Style



# Work In Progress

Till samples from 60 locations across the Vermilion District have been collected for third-party gold grain counts and pathfinder mineral analysis.



An additional 270 sample intervals of Vermilion District drill core have been submitted for third-party quantitative geochemical analysis.





# For more information:

## Vermilion District Geology

Don Elsenheimer, Minnesota DNR  
[donald.elsenheimer@dnr.state.mn.us](mailto:donald.elsenheimer@dnr.state.mn.us)  
(651) 259-5939

Barry Frey, Minnesota DNR  
[barry.frey@dnr.state.mn.us](mailto:barry.frey@dnr.state.mn.us)  
(218) 231-8484

[Vermilion District Gold : New Results from Drill Holes](#)

[100 Years of Non-ferrous Mineral Information in Minnesota](#)

## State of Minnesota Metallic Mineral Leases

Kathy A. Lewis, Minnesota DNR  
[kathy.lewis@dnr.state.mn.us](mailto:kathy.lewis@dnr.state.mn.us)  
(651) 259-5404

[Notice of Intent to Hold Metallic Mineral Lease Sale](#)

[Minnesota's Mining Laws](#)

PDF

