Comparing Paleoproterozoic Felsic Volcanic Centers Across Wisconsin

Implications for Tectonic History and sulfide mineralization

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Regional geology

The rocks containing the Crandon deposit are part of the Pembine-Wausau Terrain and formed ~1.85 billion years ago. These formed in a bark-arc setting as part of the Penokean Orogeny. Arc-derived sediments eventually covered the ocean vent systems. The accretion of the Marshfield Terrain resulted in low grade metamorphism and small intrusions to the Crandon deposit (Schulz and Cannon, 2007). This is true for the rocks from the Eisenbery suite as well. The Lobo deposit is a part of the Wisconsin Magmatic Terranes (DeMatties, 1994) composed of plutonic, volcanic, and sedimentary rocks that were accreted during the collision of the Pembine-Wausau terrane and Superior craton during the Paleoproterozoic Penokean orogeny (May and Dinkowitz, 1996). The host rocks of the Lobo deposit are primarily sericite-altered lapilli tuff. The wolf river deposit is like the lobo deposit in that the Wolf river is a composite deposit and the lobo deposit is one of its clusters. The Flambeau Cu-Zn Deposit in Northwestern Wisconsin is only 4 miles from the Eisenbery Deposit but is geochemically distinct indicating a distinct and different environment that it formed in.

VMS Deposits

Tectonic Setting and Importance

Volcanogenic Massive Sulfide (VMS) deposits form in marine environments where high temperature hydrothermal fluids combine with cold sea water causing the precipitation of sulfide minerals. The ore zones typically occur as polymetallic lenses with immediate host rocks being either volcanic or sedimentary producing major sources of Zn, Cu, Pb, Ag, and Au(Galley et al, 2007). Hydrothermal vent systems seep metals from volcanic strata though hot seawater rock interactions and re-precipitate them when the fluid cools at the surface. Types of precipitated metals are determined based on the composition of the surrounding rock and on the temperature of the water moving through the system. Therefore, rock compositions of these systems requires careful trace element analysis.

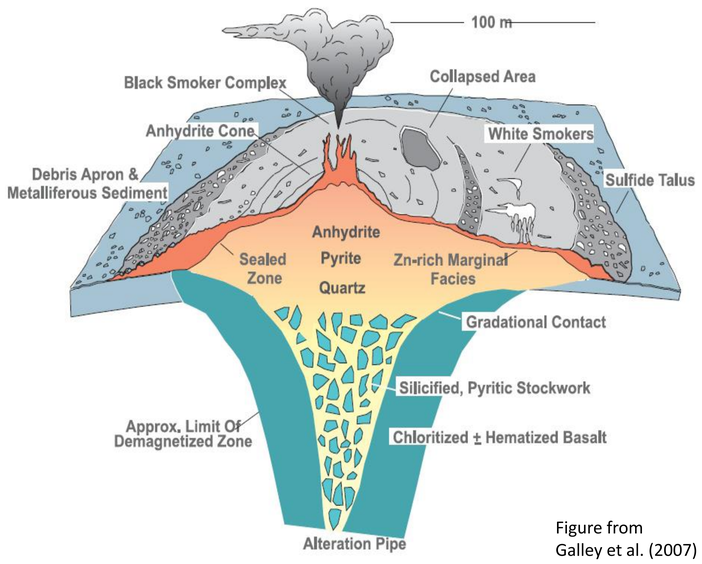
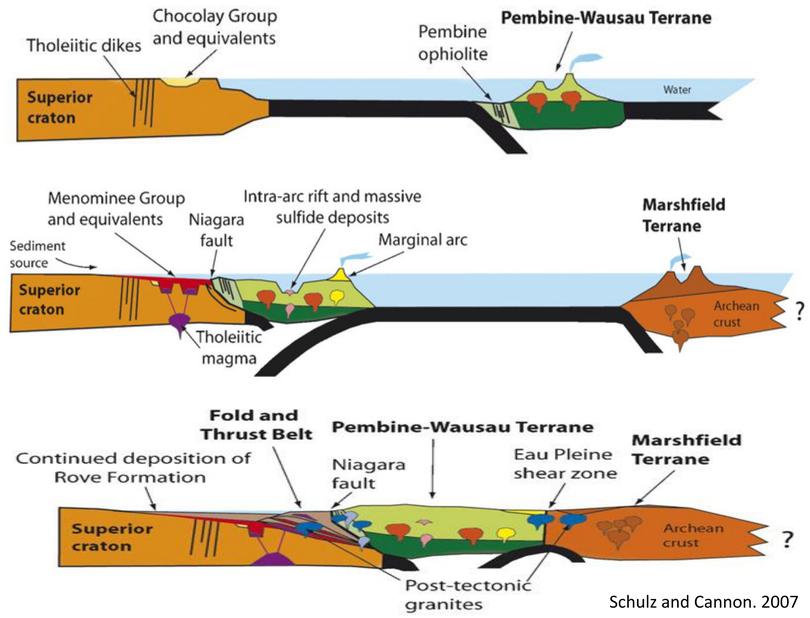
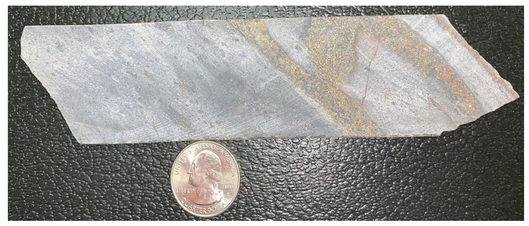


Figure from Galley et al. (2007)

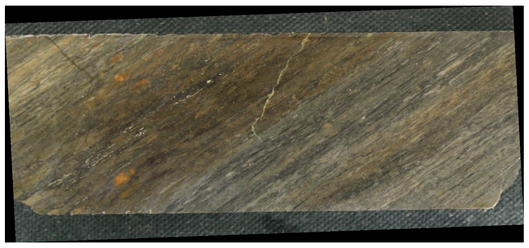


Schulz and Cannon. 2007

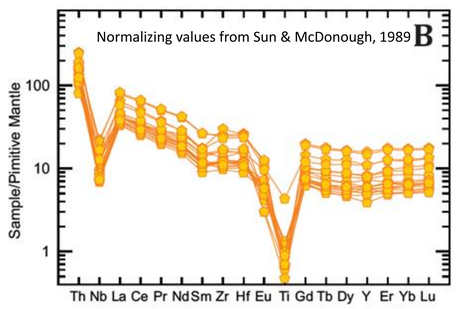
Felsic Rock Images and Analysis



Eisenbery Deposit
17TH-T14-243. Ga-Qrtz-Ser schist. Strongly foliated, disseminated Py+Po



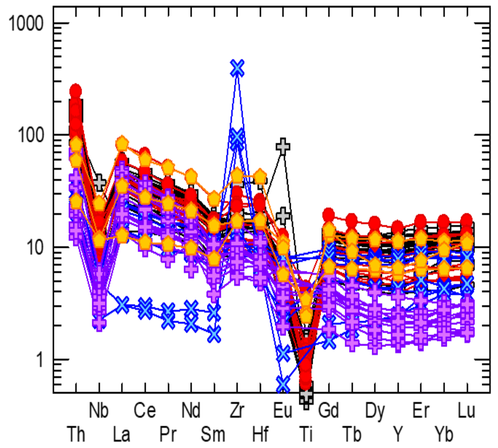
Flambeau Deposit:
Metadacite, Hand Sample: Poor to moderately foliated and are relatively aphanitic showing little to no mineralization. The suite is characterized by a pronounced green color but have no obvious primary texture and are relatively homogeneous.



Wolf River Deposit:
Primitive Mantle Normalized Trace Element
Felsic rocks have Th and LREE enrichment along with
negative Nb, Ti, and Eu anomalies. In addition, they show modern La/Yb ratios and undepleted HREE, suggesting that they are derived at moderate crustal depths consistent with rifting crust.

Crandon Deposit:
Petrographic Image
Andesite intrusion into a dacite tuff

Wolf River Deposit:
Sericite-altered felsic lapilli tuff (core)

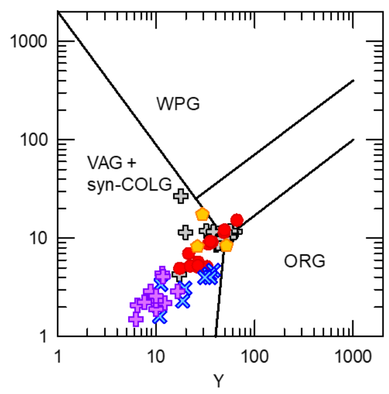


Symbols

Grey "+"=	Lobo
Red Dot=	Wolf River
Blue "X"=	Eisenbrey
Purple "+"=	Flambeau
Yellow Pentagon=	Crandon

Primitive Mantle HSFE

By analyzing the deposits relative to one another, there are some common trends noticed. There is a relative enrichment in Th, and a depletion in Ti, which are both common in magmas derived from moderate crustal melt in a rift setting. This is consistent with the basial history given and suggests it to be true for all the rock suites. However, there is a relative enrichment in Zr in the Eisenbrey deposit, along with lower La and Sm values, suggesting formation in shallower crust, with a different formation process, like an arc setting.



ARC MAGMATISM

The figure to the left shows the same rock suites as above with the same color key. By looking at the relative Nb to Y amounts it further supports that Eisenbery suite was formed in an arc setting in a post tectonic event. Additionally, there appears to be a trend within the location of each deposit. The Eisenbrey and Flambeau deposits which are located on the west end of the study area are depleted in Nb while the Wolf River and Crandon deposit on the east appear to be enriched in NB. This is similar to the Flambeau suite as well.

CONCLUSIONS

The goal of this study was to better understand the volcanic and tectonic setting of Volcanogenic Massive Sulfide (VMS) deposits in Wisconsin by comparing the petrographic and geochemical data(trace elements) from five different felsic volcanic suites across the state. Preliminary data supports the know geology of the region. However, a more through comparison of the different deposits is needed to better understand the interconnectivity of each rock suite.

REFERENCES

DeMatties, T.A., 1994, Early Proterozoic Volanogenic Massive Sulfide Deposits in Wisconsin; An Overviews, Economic Geology, v. 89, p. 1122-1151.

Galley, A., et al., 2007, Volcanogenic massive sulphide deposits in Goodfeelow W.D., ed., Mineral Deposits of Canada, Special Publication 5, p. 141-161.

May,E.R. and Dinkowitz, S.R., 1996, An overview of the Flambeau supergene enriched massive sulfidedeposit: geology and mineralogy, Rusk County, Wisconsin, in LaBerge, G.L., ed.,Volcanogenic Massive Sulfide Deposit of Northern Wisconsin: A Commemorative Volume: Institute on Lake Superior Geology Proceedings, v. 2, part 2 p. 67-93.

Schulz, K.J., Cannon, W.F., 2007, The Penokean orogeny in the Lake Superior region, Precambrian Research, v. 157, p. 4-25

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