Mount Pleasant Ore System: The Result of Topaz-rhyolite or A-type Magmatism

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GEOL 393

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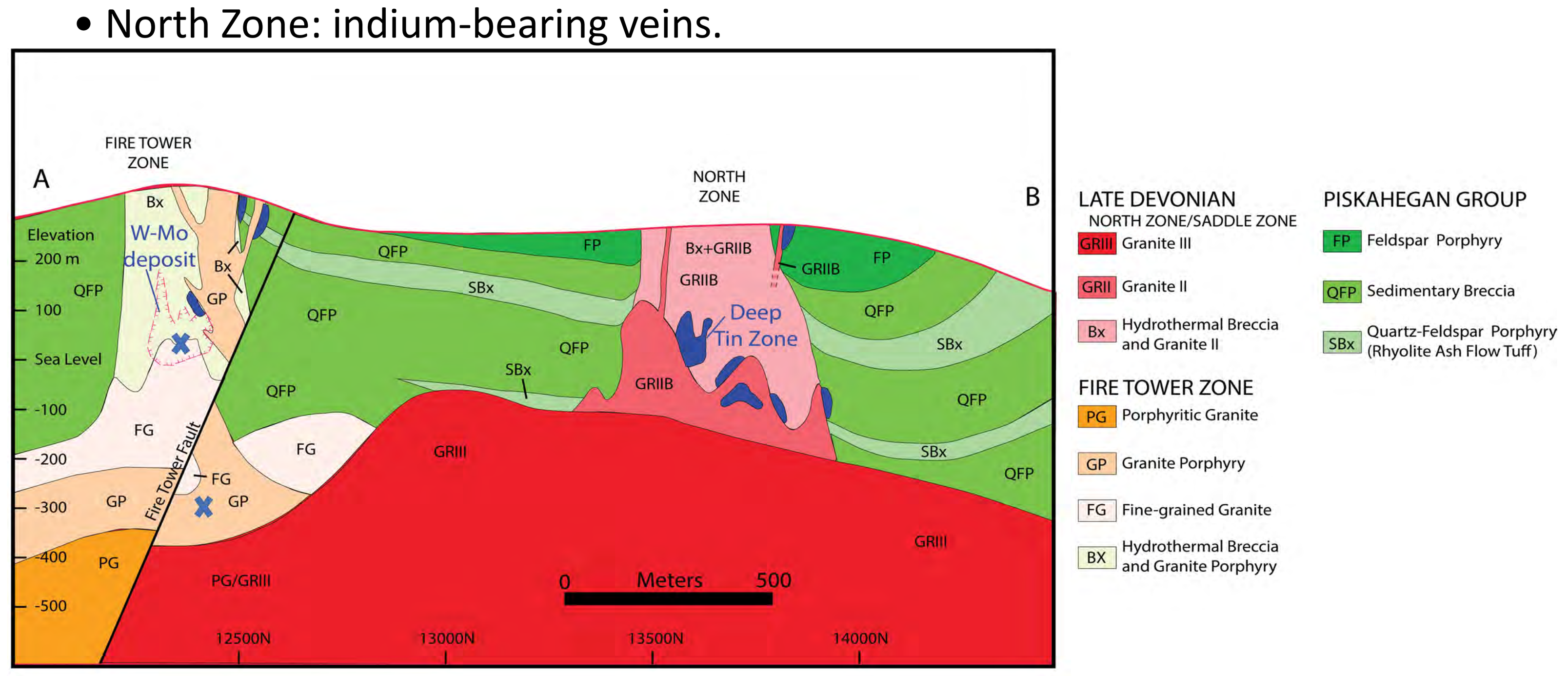
Introduction

- Mount Pleasant is a magmatic-hydrothermal tin-tungsten-molybdenum-indium ore system located in southern New Brunswick, Canada.
- There are conflicting characterizations of the host granite: whether it is the result of A-type or topaz-rhyolite magmatism.
- The mineralogy of accessory phases and major/trace element compositions of accessory phases at Mount Pleasant will be compared to the same accessory phases in rocks from localities of a known type of magmatism. In this study, the known types will be A-type granites from Climax, CO, USA, and topaz-rhyolites from Thomas Range, Utah.
- The accessory phases (biotite, topaz, and fluorite), were chosen because they are common to the three igneous systems of interest, and they reflect the characteristics of the melt they crystallized from.
- Besides answering the geologic question at hand, this research has implications on which granitic systems (A-type granites or topaz-rhyolites) might be associated with indium-bearing molybdenum deposits.

Location of Mount Pleasant.
http://www.adexmining.com/aboutcompany.php

Background

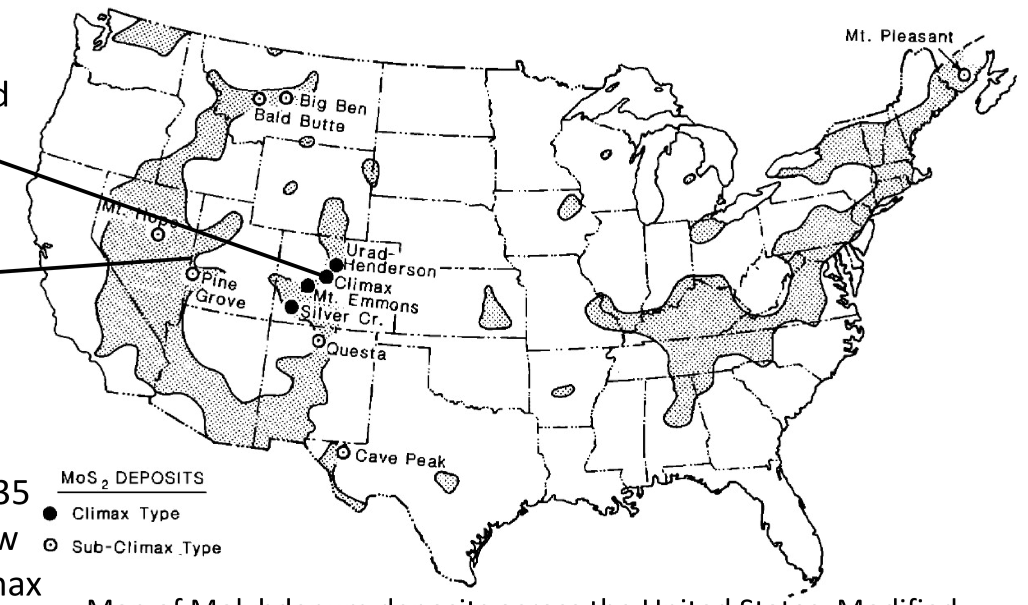
- Mount Pleasant deposits occur within the Late Devonian Piskahegan Group.
- Two distinct ore zones:
  - Fire Tower Zone: porphyry tungsten-molybdenum deposits with negligible indium.
  - North Zone: indium-bearing veins.



Geologic Cross Section of Mount Pleasant. Areas where samples were collected from are marked with an 'X'. Modified from Sinclair et al. (2006).

Additional Background

- The Climax-Henderson complex consists of two molybdenum mines- the Henderson underground mine and the Climax open-pit mine.
- The Thomas Range topaz-rhyolites are located ~200 km NE of Pine Grove, which is of a similar type.
- Climax and Sub-Climax types are classified based on ore grade. Climax-types contain an average of 0.35 to 0.45 wt% MoS_2 and do not go below 0.20 percent (Wallace 1985). Sub-Climax types contain a lower percentage but otherwise have similar characteristics.



Map of Molybdenum deposits across the United States. Modified from Wallace (1985)

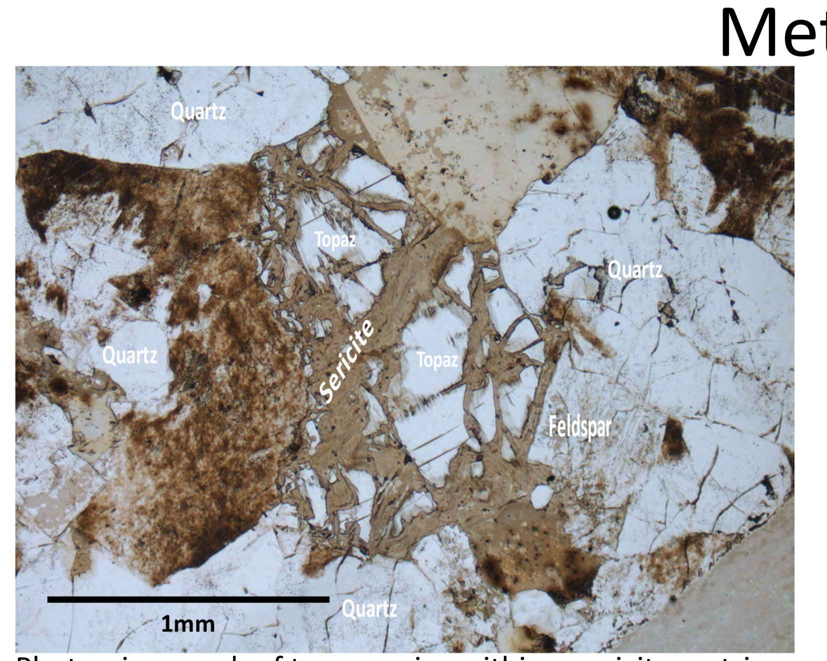
Feature	A-type	Topaz-rhyolite
T	**High**	**Low to Moderate** (600-800°C)
REEs	**High**, except Eu	**Moderate LREE**, high HREE, Low Eu
Enriched	**Zr**, Y, Nb, Sn, Ta, F, Cl	**Ga, Li, U, Th, Rb**, Y, Nb, Sn, Ta, F, Cl
Depleted	Co, Sc, Cr, Ni, Ba, Sr, Eu	**Zr**, Co, Sc, Cr, Ba, Sr, Eu
Mineralogy	**Sodic-amphiboles, olivine**	

Characteristics of A-types and topaz-rhyolites. Modified from Christiansen et al. (1983)

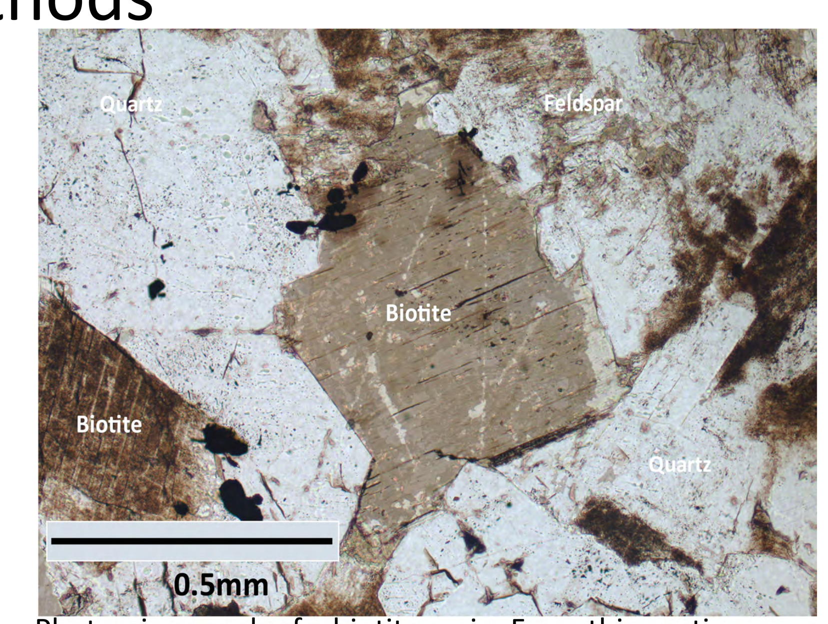
Hypotheses

My null hypothesis is there is **no** difference in the major and trace element signatures in the accessory phases (biotite, fluorite, and topaz) in the causative plutons of Mount Pleasant, Climax, and the topaz-rhyolites of central Utah. My alternative hypothesis is there **is** a difference in the major and trace element signatures in the accessory phases in the causative plutons of Mount Pleasant, Climax, and the topaz-rhyolites of central Utah.

Methods



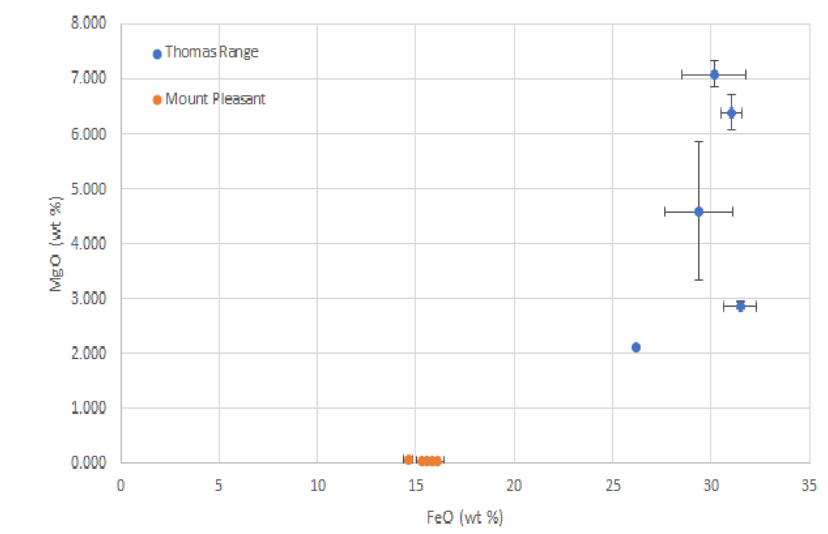
Photomicrograph of topaz grains within a sericite matrix. From thin section MP-91-1.36.



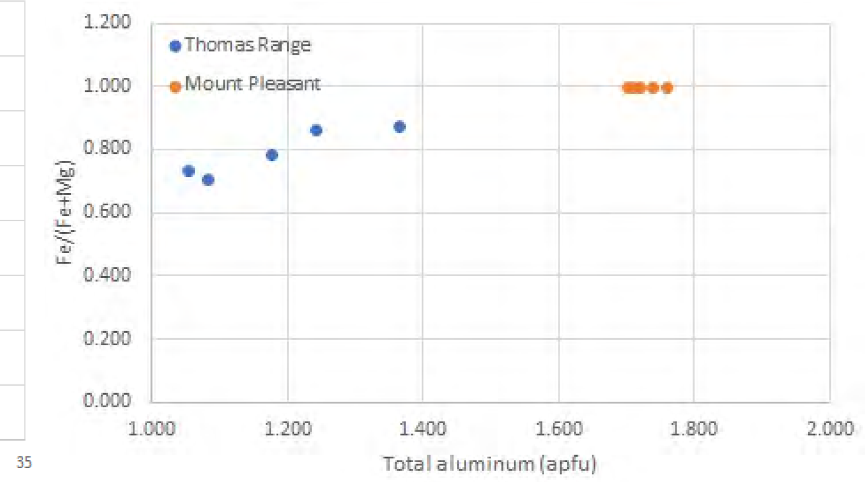
Photomicrograph of a biotite grain. From thin section MP-91.1.36.

- Hand samples and thin sections were obtained for Mount Pleasant and Thomas Range.
- Hand samples from Climax are available but the thin section are still in the process of being created.
- Petrographic analysis was performed on the Mount Pleasant thin sections MP-91-1.19 and MP-91-1.36 and phases of interest (biotite, topaz, and fluorite) were identified for further analysis.
- Major element chemistry was analyzed using electron probe microanalysis (EPMA).
- Trace element chemistry was analyzed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

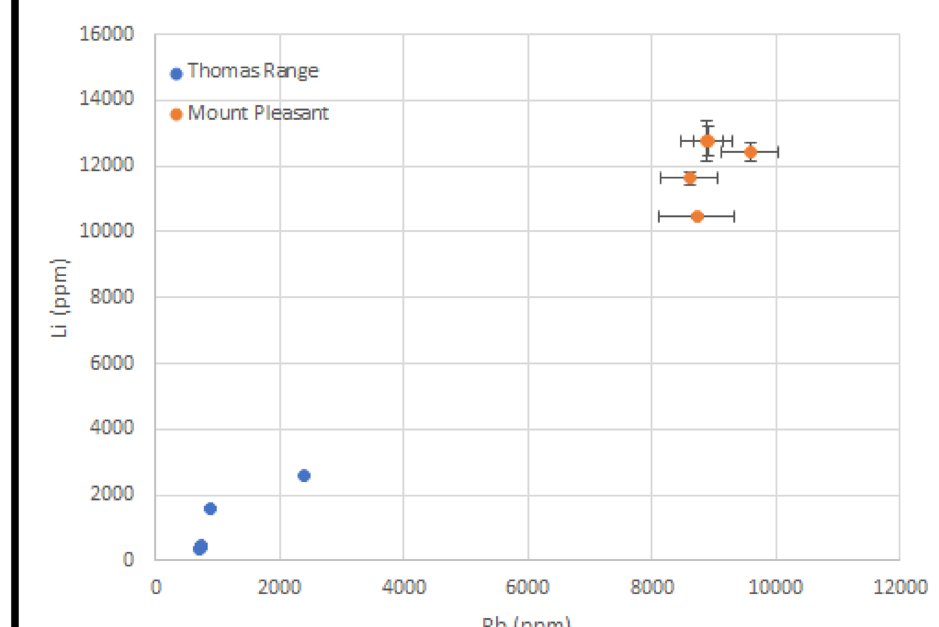
Results



Plot of the MgO versus FeO (in wt%) in biotite from Thomas Range and Mount Pleasant. Error bars plotted are the standard deviation of the mean (SDM) plotted at the 1-sigma level.



Plot of Fe/(Fe+Mg) versus total aluminum in biotites from Thomas Range and Mount Pleasant. Apfu stands for atoms per formula unit.



Plot of Li versus Rb in biotite from Thomas Range and Mount Pleasant. Error bars plotted are the standard deviation of the mean (SDM) plotted at the 1-sigma level.

- There is an exchange of iron, magnesium, and lithium which may result in the biotite end members of annite, phlogopite, and polylithionite, respectively. The Mount Pleasant biotite are between siderophyllite (aluminum) and polylithionite. The Thomas Range biotite are between annite and phlogopite.
- The major element concentrations in the Thomas Range biotite have a much larger spread than at Mount Pleasant.
- The Thomas Range biotite trend towards the Mount Pleasant biotite in terms of aluminum content.

Conclusions and Future Work

- The major and trace element concentrations of the Mount Pleasant biotites are statistically different from the Thomas Range biotites at the one-sigma level.
- Major and trace element patterns were identified that can be used to represent and interpret the different sites.
- Future work will include the analysis of biotite in Climax thin sections and possibly additional Mount Pleasant and Thomas Range sections to further constrain the type of magmatism at Mount Pleasant.

Acknowledgments

This work is supported by the NSF grant #1348010. Thanks to the American Museum of Natural History, and curator Jim Webster, for providing some of the samples in this study. Additional thanks to Leslie Hale from the Smithsonian Institution and Andreas Audetat from the Bayerisches Geoinstitut Universität Bayreuth, Germany, for loaning other samples.

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