Temperature links to compositional variations at Mutnovsky Volcano, Kamchatka, Russia

Lindsey Clark  
*University of Nevada, Las Vegas*

Adam Simon  
*University of Nevada, Las Vegas, simonac@umich.edu*

Kelly L. Robertson  
*University of Nevada, Las Vegas*

Sean Mulcahy  
*University of Nevada, Las Vegas*

---

**Repository Citation**

Clark, Lindsey; Simon, Adam; Robertson, Kelly L.; and Mulcahy, Sean, "Temperature links to compositional variations at Mutnovsky Volcano, Kamchatka, Russia" (2009). Undergraduate Research Opportunities Program (UROP). 9.  

---

This Event is brought to you for free and open access by the Undergraduate Research at Digital Scholarship@UNLV. It has been accepted for inclusion in Undergraduate Research Opportunities Program (UROP) by an authorized administrator of Digital Scholarship@UNLV. For more information, please contact digitalscholarship@unlv.edu.
Full petrographic descriptions of fifty-two rock samples collected from one hundred thousand year old Mutnovsky Volcano, Kamchatka, Russia are being studied to determine the magma compositions of the volcano through time. I expect that the composition will change with time owing to variation in input at the base of the volcano pluming system, above the subducting Pacific Ocean crust. This variation in composition, including the abundance of important atmospheric gases, water, and carbon dioxide, may play a key role in the abundance and type of greenhouse gases being emitted. The samples will also be analyzed by using electron probe microanalysis (EPMA) to determine the major and minor element abundances in co-existing pyroxene and olivine minerals, and these chemical data will be used to calculate the temperature and pressure of magma crystallization. The temperature of crystallization is a function of the water and carbon dioxide concentration of the magma.
Temperature Links to Compositional Variations at Mutnovsky Volcano, Kamchatka, Russia

Lindsey Clark, Adam Simon, Kelly Robertson, and Sean Mulcahy
University of Nevada Las Vegas, Las Vegas, NV

INTRODUCTION/PURPOSE

Full petrographic descriptions of fifty-two rock samples, collected from one hundred thousand-year old Mutnovsky samples in Kamchatka, Russia, are being studied to determine the nature of compositions of the volcano through time. We expect that these compositions will change with time owing to variations in input at the base of the volcanic plumbing system; above the subducting Pacific plate. This variation in composition, including the abundance of important atmospheric gases, water, and carbon dioxide, may play a key role in the composition of magma forming at the surface. We determined the major and minor elements abundances from analyzing pyroxene minerals, and then chemical data were used to calculate the temperature of magma crystallization. The temperature of crystallization provides a function of the water and carbon dioxide concentration of the magma.

METHODS

1. Each thin section was viewed and described using a petrographic microscope to determine the composition and abundance of phenocrysts and dissolution features. All of the phenocrysts of the four main rock types in MLP are found in this sample.
2. Each thin section was examined for orthopyroxene and clinopyroxene using electron probe microanalyzer (EPMA). The minor and major element abundances were determined using Rietveld Refinement (1988) and methods from Brey and Kohler (1996), and GAFF (Lindley and Anderson, 1985).

RESULTS

The two photos above display pyroxene phenocrysts containing dissolution features. The photo on the left was taken using a petrographic microscope at 25x magnification. The grain was outlined using the electron microscopy. The core of the phenocryst is lighter gray in color, while the black core is pyroxene.

CONCLUSION

The crystalization temperatures display a correlation between the composition of the rock and the temperature at which it was formed. Generally, the more alkali a rock, the lower the temperature of formation. Some rocks were 1000°C for basalt, 1300°C for basaltic andesite, 1600°C for andesite, and 1900°C for dacite. At Mutnovsky, the composition of basaltic and dacitic phenocrysts shows a possibility of a new source of fresh magma input, causing an increase in temperature, which would cause the more melts to form a composition.

FUTURE DIRECTIONS

Barometry: The samples will be evaluated using EPMA to determine major and minor element abundances. This data will be useful to calculate the presence of magma crystallization.

Melting Analyses: Melting analyses are the study of melt that has been trapped within a crystal as it grows, and are important in understanding the chemistry of melts trapped within the mantle. Data from Mutnovsky volcano will constrain the abundance of CO2, SO2, and CO2, and important H2O emissions over the past 500 thousand years. These data can be used to determine the amount of magma that has passed through different magma compositions as well as to infer other volcanic activity.

ACKNOWLEDGEMENTS

I would like to thank my mentor, Kelly Robertson, for giving me the opportunity to work on this project and helping me interpret the data. I would also like to thank Sean Mulcahy for managing the EPMA lab and helping me collect the data.

REFERENCES

[References]

Geologic Map of Mutnovsky Volcano

Courtesy of Alexey Kryuchkov

Institute of Volcanology and Seismology

Kamchatka