

**Deep Ocean Exploration Institute
Questionnaire for Final Project Report**

**Volatile Fluxes through the Northern Kamchatkan Volcanic Arc
Alison Shaw**

What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

The main goals of this study were: 1) to develop a technique for measuring volatiles on volcanic glass samples using WHOI's 1280 ion microprobe, and 2) to use this technique to evaluate the role that volatiles such as water, carbon dioxide and sulfur, play in generating melts from Kamchatkan volcanoes (Fig. 1). Volcanoes in Kamchatka produce significantly more magma as compared to other volcanoes – one theory for this enhanced productivity is that higher water contents result in increased mantle melting and thus larger volumes of magma erupting at the surface. An alternative hypothesis is that this exceptional productivity is related to a tear in the subducting Pacific plate which allows for influx of fertile mantle material to a region characterized by a high degree of melting due to fluid inputs from the subducting Pacific plate.

What have you discovered or learned that you didn't know before you started this work?

Based on preliminary results, I find that the volatile contents of melts are similar to those found in other subduction zone volcanic settings so I would conclude that the enhanced magmatic activity could be the result of a tear in the down-going Pacific plate, allowing fertile mantle to melt to a higher degree than is typical for subduction zone volcanoes.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

The development of a technique for measuring volatiles in glasses and melt inclusions on WHOI's 1280 instrument has opened up a whole new capability to the scientific community. A number of internal WHOI instrument users, along with dozens of external users have taken advantage of this capability since I developed it.

What is the significance of this research for society?

Understanding the volatile content of magmas is of great importance since volatiles control the explosivity of volcanic eruptions. The greater the volatile content of a magma, the greater the potential for a large highly explosive volcanic eruptions. Understanding the relationship between magma productivity, volcanic activity and volatile contents is fundamental to volcanic research.

What were the greatest challenges and difficulties?

Apart from the analytical challenge of setting up a new technique on the ion probe, the greatest challenge with this work was actually acquiring the samples – these volcanoes are located in very remote regions of the Kamchatkan Peninsula the Russian Far East, accessible only by helicopter or by all terrain military vehicles (Fig. 2), and requiring special government permits for not only visiting the various localities, but also for shipping samples back to the U.S.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

I conducted field work, collecting rock and gas samples (Fig. 3) from 4 major volcanic centers: Mutnovsky, Avachinsky, Tolbachik and Klyuchevsky.

What were the key tools or instruments you used to conduct this research?

The instruments used to collect this data included WHOI's 1280 ion microprobe, MIT's electron microprobe and Carnegie's 6f ion probe.

Is this research part of a larger project or program?

This research was a collaborative project with biologists from NASA and the University of Moscow who were conducting field work in Kamchatka to explore the limits of life. Prior studies in the region found viable thermophilic bacteria trapped within the permafrost layers of Tolbachik volcano. The harsh acidic environment of Kamchatka provides an ideal site for astrobiological experiments.

What are your next steps?

The next steps with the work will be to compare the melt inclusion data to the gas data. The gas data processing will occur once the extraction line that I have built has been fully calibrated.

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

This work formed the basis of a winter undergraduate research project, but has not yet been published.

Please provide photographs, illustrations, tables/charts, and web links that can help illustrate your research.

Please see photographs below



Figure 1: A converted military vehicle was used to reach the field site



Figure 2: Mount Tolbachik, one of the northern most volcanoes in the Kamchatka Peninsula. Base camp where we stayed in the foreground.



Figure 3: Sampling hot spring gases on Mutnovsky Volcano