

# Miriam Galenas, Geology

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**Funding Source:** Arts and Sciences Undergraduate Research Mentorship Program

## Viscosity of mid-ocean ridge basalts

*Miriam Galenas and Alan Whittington*

Over seventy percent of the Earth's surface is covered by basalts erupted from mid-ocean ridges. The rate, style, and morphology of these underwater volcanic eruptions is controlled by the magma viscosity, yet almost no data has been collected on the viscosity of these flows. During a sea-floor eruption, magma at about 1200 °C meets with seawater at about 1 °C. This extreme difference in temperature causes the magma to cool rapidly and quench to a glass. Our aim for this project is to measure the density of these quenched lavas, and their viscosity as a function of temperature and water content. The results will allow for better understanding of seafloor formation and submarine volcanic hazards. We have measured the viscosity and density of samples from two locations on the East Pacific Rise. Density measurements were obtained using the Archimedean method, and average  $2.85 \pm 0.04$  g/cm<sup>3</sup>. Viscosity was measured in the glass transition range using a parallel plate viscometer. Viscosity decreases with increasing temperature, from  $\sim 5 \times 10^2$  Pa.s at 634 °C to  $\sim 1 \times 10^9$  Pa.s at 710 °C, with a significant spread between different samples. Differences in viscosity may result from variations in water content or bulk composition. We employed FTIR analysis to determine water contents, which are 0.4-0.6 wt.% in sample D3. The viscosity of a remelted (nominally anhydrous) sample of D3 is about a factor of 10 higher at measurement temperatures of  $\sim 950$  °C. Extrapolating the results for sample D3, containing  $\sim 0.5$  wt.% H<sub>2</sub>O, suggests a viscosity of  $\sim 25$  Pa.s at the eruption temperature of 1200 °C. This is much lower than the value of 400 Pa.s assumed in modeling studies, which is a better estimate for anhydrous lavas.