RATIO OF FIRST AND SECOND GENERATION FOLD WAVELENGTHS ON LAVAS MAY INDICATE FLOW COMPOSITION; Tracy K.P. Gregg and Jonathan H. Fink, Department of Geology, Box 871404, Arizona State University, Tempe, AZ 85287-1404

The surface crust of an advancing lava flow will buckle transverse to the flow direction under sufficiently strong compression. Compression may be caused by an obstacle in the flow path, shear along flow margins, or by differential velocities in the downstream direction. Fold wavelength depends primarily upon the thickness and viscosity of the crust, and the viscosity of the flow interior [1]. Previous attempts to relate fold wavelength to lava composition have met with limited success [2, 3]. We have taken a different approach, focusing on the ratio of first-generation to second-generation fold wavelengths. We conclude that this ratio depends on the unique physical properties of the lava flow and surface crust, such as crystallinity, vesicularity, composition, and crustal strength and thickness.

By extruding polyethylene glycol wax (PEG) into a tank filled with cold sucrose solution, we can carefully observe the folding process. The distance from the vent at which first-generation folds appear depends primarily on eruption temperature, effusion rate, and underlying slope: the greater these parameters, the further from the vent folding takes place. Under certain conditions of sustained compression, multiple generations of folds may form. As the folded crust moves away from the vent, it cools and thickens. At some critical distance from the vent (which depends on cooling rate and flow velocity) the crust becomes too thick to accommodate additional compression by deforming into small, first-generation folds. Instead, a second generation of folds with longer wavelengths develops, superposed on the first-generation folds, appears. If compression continues as the crust thickens, a third generation may form. Alternatively, the crust may become too thick and brittle to deform in a ductile manner, and may break into a series of overriding plates.

We have examined fold wavelengths on flows of three compositions: rhyolite, basalt, and polyethylene glycol. (PEG is a commercially available wax, used in previous laboratory experiments to simulate lavas [4, 5, 6].) Comparing the wavelengths of the first (λ_1) and second (λ_2) generation folds observed in the laboratory simulations reveals a nearly constant ratio of $\lambda_2 / \lambda_1 \sim 8$. This ratio is independent of flow rate, flow temperature, underlying slope, or cooling rate. Examination of glassy rhyolite flows (e.g., Big Glass Mountain, California) reveals a ratio of fold wavelengths equal to ~3. Hawaiian and Icelandic basalt flows give a ratio of wavelengths equal to ~5 (Figure 1).

This sequence suggests that some innate property of the lava crust--perhaps strength, which can be related to composition--limits the ratio of first- and second-generation fold wavelengths. We are currently examining surface folds on venusian and martian lava flows to determine if ratios are similar to those observed on terrestrial lava flows.

References. [1] Fink, J.H. and R.C. Fletcher (1978) *JVGR 4*, 151. [2] Fink, J.H. (1980) *Geology 8*, 250. [3] Porter, T.K. and P.H. Schultz (1990) *LPSC XXI*, 973. [4] Hallworth et al. (1987) *M. Geol. 11*, 93. [5] Fink, J.H. and R.W. Griffiths (1990) *JFM 221*, 485. [6] Griffiths, R.W. and J.H. Fink (1992) *JGR 97*, 19,739.

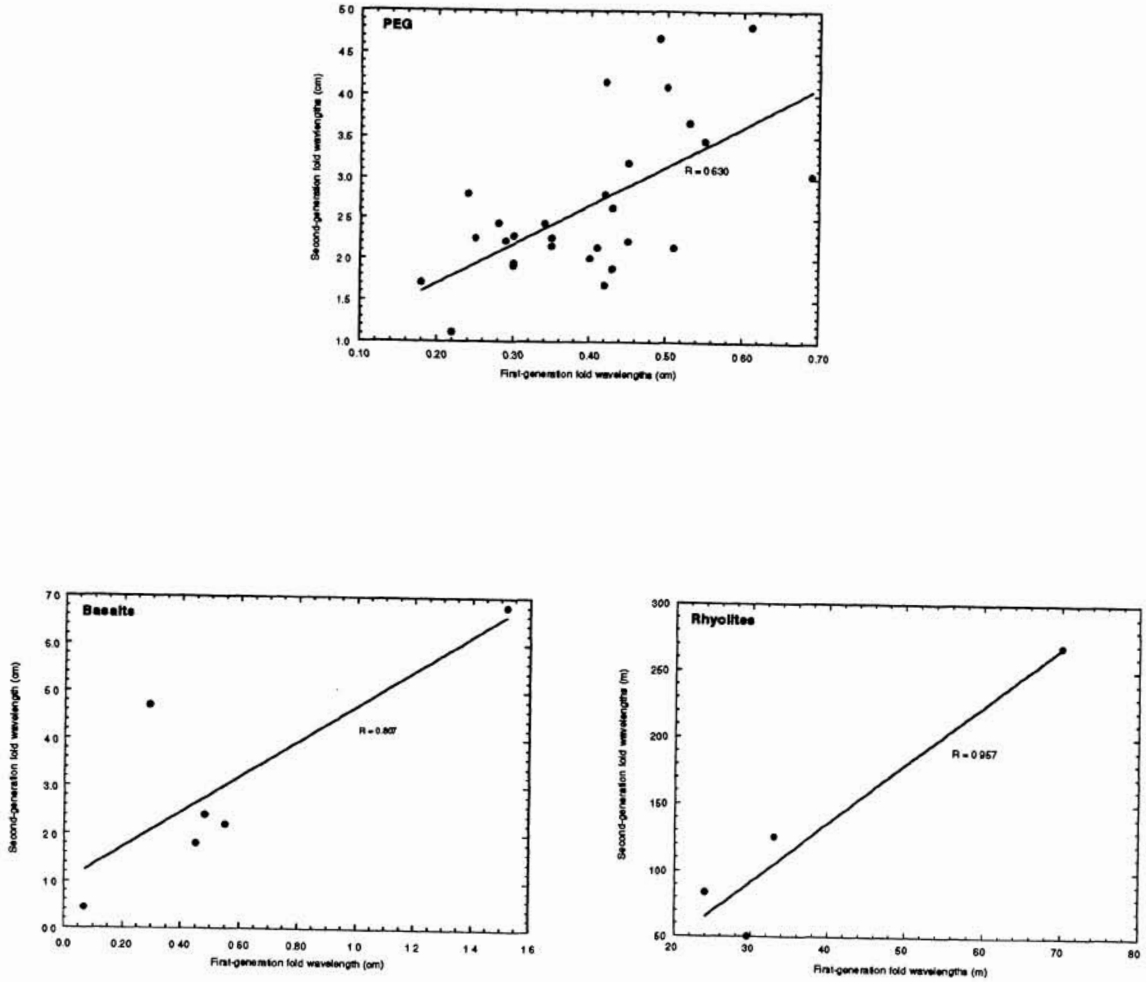

Figure 1. First and second generation fold wavelengths for basalts, rhyolites, and PEG.