THE FOLD ILLUSION: LARGE ARCUATE LAVA-SURFACE FEATURES ARE FORMED BY TENSILE FRACTURING. G. D. M. Andrews[1], S. M. Kenderes[2,3], S. L. Isom[1], S. R. Brown[1], and A. G. Whittington[3], [1]West Virginia University [2]University of Missouri [3]University of Texas at San Antonio.

Sets of arcuate ridges and troughs, commonly termed ogives or pressure ridges, are characteristic of silicic lavas on Earth. They are also characteristic of many Alpine glaciers and salt-glaciers. Because ogives are readily identified and characterized in remotely sensed images, they are first-order geomorphic criteria for inferring the presence of silicic lavas or glaciers on other planetary bodies. Hitherto ogives on silicic lavas have been interpreted as folds of the upper surface, e.g., [1], [2]. If correct, the waveform characteristics of the ogives can be analyzed and interpreted in terms of lava viscosity [2], [3]; therefore, a useful tool in planetary surface reconnaissance. However, if incorrect, this application is invalid.

Re-examination of classic silicic lavas in the western US and Sardinia, coupled with thermo-rheological and stress modeling, leads to a contradictory interpretation [4]. Rather than being folds of the upper surface, Ogive troughs are interpreted as splaying tensile fractures separating 'horsts' as ridges. Brittle-tensile mode-I fractures are ubiquitous on the upper surfaces, at all scales from $10^{-2} – 10^{1}$ meters. Where folds are identified they are recumbent, similar-style folds associated with shear-folding of the flow-banding: not buckle-folding of the upper surface. Moreover, the rheological properties of the pumiceous carapace make ductile deformation incredibly unlikely in the timescales predicted between eruption and cooling to ambient temperature. Instead, the low tensile strength of pumice encourages repeated fracturing, including during continued vesiculation at atmospheric pressure. The recurrence of fracturing and the presence of older fractures combine to prevent accumulation of enough stress to induce ductile flow.

In short, it is impossible to sustain ductile shortening of the upper surface of a silicic lava at the Earth's surface [4]. Whether or not this limitation applies at submarine eruptions or on other planetary bodies is unresolved; however, ductile flow is only likely under conditions where the ambient pressure is high and cooling rates are very slow (e.g., very high ambient temperature). Regardless, like other gravity currents, silicic lavas spread, and therefore are in extension for most of their emplacement, so even if ductile deformation can be sustained at the upper surface, shear -thinning is expected and not folding. The waveform characteristics of ogives are more likely to reflect the tensile strength of the upper surface and the depth to the brittle-ductile transition.

[1] Fink, J. H. (1980) *Geology, 8,* 250-254. [2] Gregg T. K. P. et al. (1998) *JVGR, 80,* 281-292. [3] Byrnes J. M. (1997) *LPS XXVIII,* Abstract #1250. [4] Andrews G. D. M. et al. (2021) *EPSL, 553,* 116643.