Supplementary Figure DR1
A. Simple shear deformation of an emulsion at high volume fractions produces drop shape asymmetries as shown (from Li et al., 1995).
B-C. SEM BSE images of Cerro Galan pumice. Vesicle asymmetries in Cerro Galan pumice are similar to those in experimental deformation of emulsions, but with pointed tips. Scale bar is applicable for both image B and C.
Supplementary Figure DR2

Supplementary Figure DR3
SEM BSE images of Cerro Galan pumice showing A. asymmetry of bubbles, and B. localization of strain into high shear bands.

Supplementary Video DR1
Scan through 3-dimensional X-Ray tomographic volume of Monte Pilato pumice sample; 1 pixel = 4.45 μm; width of movie frame is 3.18175 mm. Grayscale pixels are glass walls.

Supplementary Video DR2
Reconstructed 3-dimensional X-Ray tomographic volume of Monte Pilato pumice sample; volume dimensions are 445 x 445 x 445 μm. Red blobs are individual vesicles, distinguished and selected through the interactive program blob3D and the vol_tools reconstruction code (Ketcham, 2005; Rivers and Gualda, 2009).

References Cited