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Tube pumice kinematics using neutron tomography

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Volume imaging using neutron computed tomography (NCT) offers a new window into rheological processes and their kinematic consequences. In the past, the penetration power of neutron scanning has been offset by its relatively poor resolution (order 1 mm). However, the recent development of new scintillators has improved this resolution by almost an order of magnitude to a voxel size of 20 μm (a range which is now useful for the geosciences). This resolution, coupled with the penetration depth and good contrast of NCT imaging, makes this an attractive method for large (order 1 to 10 cm) geomaterial samples. Here we quantitately analysed the properties of bubbles in a tube pumice. The bubbles were isolated and characterised by a purpose built software package. The resulting object database was then tested against models of pure and simple shear. An analysis of the azimuthal variation in maximum axis length perpendicular to the tube elongation reveals that simple shear is the primary deformation. From the distribution of bubble shapes and sizes we were able to infer the shear rate of the flow immediately prior to fragmentation, and the cooling rate / internal heat transport of the pumice after fragmentation. The method also provides an estimate of the post-fragmentational relaxation time. Further, the 3-D imaging reveals that the curvature of the lineation provided by the tubes is significant. The extraction of neutron tomographic data on these witnesses of extreme volcanic fragmentation processes promises to provide new and uniques insights into the conditions of explosive volcanic processes in the years to come.