Solid Earth

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Supplement of

Eruptive shearing of tube pumice: pure and simple

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Neutron tomography image analysis

To extract a bubble for further analysis, the resulting dataset was then segmented using a watershed algorithm acting on the attenuation gradient (Banhart, 2008). This method begins by allocating a unique label to all local minima in the gradient. The remaining voxels are inserted into a priority queue. The priority of each voxel is inversely proportional to its gradient, *i.e.* low gradient voxels are processed first. Each un-labelled voxel in the queue is tested to see if any of its neighbours are labelled. If any of the neighbours of this voxel have already been labelled, and all of those labels are the same, then the voxel is allocated this label. If two or more of the neighbourhood labels are different then this voxel will be labelled as an "edge". This edge definition is very rigorous as it always defines the edge at the position of maximum gradient between two objects. The edge also forms a perfectly closed shell around each object and this can be viewed by discriminating individual bubbles (Fig. 7).

Watershed segmentation is sensitive to image noise, as small perturbations in the image intensity can generate local minima and lead to over-segmentation. This was counteracted using de-speckling, or "median" filtering in a 3x3x3 voxel neighbourhood to remove high amplitude noise (e.g., Banhart, 2008). Low-amplitude noise in the attenuation gradient was removed using an H-minima transformation (e.g., Banhart, 2008). This suppresses all minima whose depth is less than a specified cut-off level.

References

Banhart, J.: Advanced tomographic methods in materials research and engineering, Oxford University Press, New York, 2008.