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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Multifractal analysis of mercury inclusions in quartz by X-ray computed tomography" *by* T. Shibata et al.

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General Comments The authors have done an interesting multifractal characterisation of samples from two mines from widely different geographical locations, on mercury inclusions in quartz, and found qualitatively similar results. However I have serious doubts regarding their interpretation of the results and conclusion that the inclusions are DLA-like, or sheet-like in shape. Considering the capacity dimension, i.e. the fractal dimension of the support, the value obtained is around 1.7, which the authors consider DLA-like. As far as I understand the authors have used closely spaced CT images to construct a 3-dimensional system, and analysed this 3-dimensional system. A fractal dimension of 1.7 in 3-d cannot be interpreted as a connected structure like DLA of size comparable to the sample size, unless it is a DLA generated in a plane and

simply placed in a 3-dimensional space. As the authors have cited, Muthukumar, PRL 1983, has shown that in 3-d DLA have fractal dimension 2.5, from mean field theory. A dimension less than 2.0 in 3-d generally implies disjoint points i.e. a dust. The dimension reported by the authors is closer to the 3-d Cantor dust with dimension 1.89, rather than 3-d DLA. The figure 1-c does not show evidence of connected structures of any significant size either. One may of course argue that a 2-d section does not necessarily reveal connections in the 3rd dimension, but the fractal dimension in this case does not suggest connectedness on large length scale, at least for scales near about sample size ($\sim$ 90 mm). Specific Comments 1. In view of the problems of interpreting multi-fractal analysis results, I would suggest that the authors construct a 3-d image (using e.g. imageJ), as supplementary evidence for the appearance of the Hg inclusions. 2. Pg. 1369 – lines 1,2, the introduction to multifractal analysis seems obscure. N(r) is the number of 'objects', what do you mean by objects? Line 16 is not clear, 'probability' of what? 3. Pg. 1371 – it is not clear how authors infer the sequence of formation of quartz crystals and Hg droplets. 4. Pg. 1372 – Dq is not a fractal dimension, so can one interpret values of 2.3-2.7 as surfaces and 1.0-1.3 as linear structures? 5. From Fig.3 – the following inference can be made. For both the samples f(alpha) vs. alpha curves are asymmetric. The portion left of the peak at D, which represents the regions with higher density of Hg is narrower than the right side representing regions where Hg is sparse. This means that the regions of large Hg density are more heterogeneously distributed. In addition, the range of ïĄą variation, that is variation of local fractal dimensions is wider for the regions of large Hg density. Typographical and grammatical corrections: Referee Robert Ewing has pointed these out already.

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