ED SMAER

Thesis subject 2013

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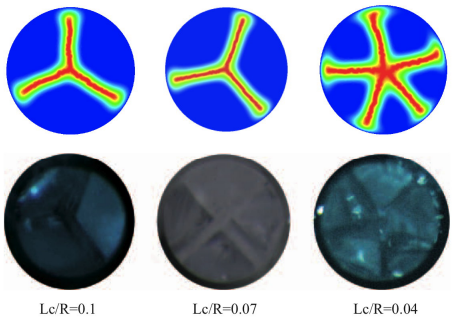
Title of the thesis : **Fracture energy minimisation principle applied to several crack patterns observed in the nature**

Collaboration within the thesis : C. Maurini (IJLRDA), B. Bourdin (Luisiana State University)
This subject can be published on the doctoral school's website : Yes

Thesis's summary (Abstract)

Giant's Causeway, septarias, shrinkage (drying or cooling) mud-patterns, bark cracking, impact spider network cracks are some more or less known examples of self-organized crack patterns that are still poorly understand.
The variational approach of fracture mechanics is a generalisation of Griffith type energy minimisation principle. Recently, we have demonstrate the ability of this approach to retrieve qualitatively, but also quantitatively the crack patterns appearing in directional drying experiments of colloidal suspensions in capillary tubes (see figure and references below).
The aim of this proposal is to apply the same approach to crack patterns observed in the nature. For instance, in geosciences, basalt columns, septarias, permafrost cracks, martian crack networks may be studied in collaboration with geophysicists. In biology, brack cracking is still purely understand and may be studied in collaboration with wood specialists and observers. In engineering, a better understanding of thin films cracking or impact patterns is crucial and may also be studied in collaboration with experimentalists.
The approach is both analytical and numerical. A constant care will be taken to compare the predictions with experimental and natural measurements. Depending of the student interests, the subject is modular and can also be extended to an experimental study.



References:

1. https://www.math.lsu.edu/_bourdin/Drying/Drying.html
2. Shrinkage star-shaped cracks: Explaining the transition from 90 degrees to 120 degrees. Gauthier, G. , Lazarus, V. , Pauchard, L. EPL, 89, 26002 (2010)