Strain drop measurements of porous silica, charcoal and shale for probing crackling noise

Viktor Soprunyuk[1], Wilfried Schranz[1], Andreas Tröster[2], Eduard Vives[3] and Ekhard Karl Hermann Salje[4]

[1] University of Vienna, Faculty of Physics , Boltzmanngasse 5, A -1090 Wien, Austria

[2] Vienna University of Technology , Institute of Material Chemistry , Getreidemarkt 9, A -1060 Wien, Austria

[3] Departament d'Estructura i Constituents de la Matéria, Facultat de Física, Universitat de Barcelona, Martí i Franqués 1, E-08028 Barcelona, Catalonia, Spain

[4]University of Cambridge , Department of Earth Sciences , Downing Street CB2 3EQ, Cambridge , United Kingdom

Abstract

SiO_2-based porous materials (Vycor, Gelsil), charcoal and shale have been measured under slow uniaxial compression at low constant force rates using a Diamond DMA (Dynamical Mechanical Analyzer , Perkin Elmer). The jerky evolution of the sample's height with time was analyzed in order to determine the corresponding power-law exponents for the maximum velocity distribution ($\mu \approx 2$), the energy (squared velocity) distribution ($\varepsilon' \approx 1.5$) as well as the modified Omori's law ($p \approx 0.7$) of events. These power-law exponents are in good agreement with mean-field values.

For charcoal and shale we generally find significant lower values for the exponents μ and ε'. For charcoal a clear decay of aftershock activity was found with $p \approx 0.6$, whereas preliminary measurements for shale do now allow to draw a definite conclusion about the aftershock dynamics.

The results show that the failure dynamics of materials can be well studied by measuring strain drops under slow compression, giving reasons for hope that in near future it will be possible to study earthquake dynamics in the laboratory also at non-ambient conditions, i.e. at elevated temperature or with different pore fillings.

Acknowledgements: The present work was supported by the Austrian Science Fund (FWF , project Nr . P 28672 – N36).