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Brittle onset of monodispersed magmatic suspensions: from spheres to spheroid

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This abstract describes one of the last projects engaged by Dr. Luigi Burlini. It highlights his wish to make a close link between experimental and numerical studies, and push even further our understanding of rock mechanics. His students, engaged in this study, wish to credit these results to the legacy left by him owing to his constant involvement in Science and in educating the next generation of rheologists. While he could not see this project to fruition, his constant support and help during the conception of the project made it possible. The brittle-ductile transition remains a central question of modern geology as rock failure is the main parameter in mitigating geological risks, such as, for volcanic eruptions, the transitions from effusive to explosive eruptive style. Although numerical simulations are the only way to fully understanding the physical processes involved, we are in a strong need of an experimental validation of the proposed models. We first recall some experimental results obtained under torsion and uni-axial compression on both pure melts and crystal-bearing magmas. Torsion experiments were performed at high temperature (600 to 900 degC) and high pressure (200 to 300 MPa) using a Paterson-type rock deformation apparatus (ETH Zurich). We characterized the brittle onset of two phases magmas from 0 to 65 vol% crystals. The strain-rates span 5 orders of magnitude, with a change in the behavior of the material from viscous to brittle ($10^{-5} - 10^{0} s^{-1}$). $The material stested are a standard borosilicate glass (NIST717), a natural crystal bearing rhyolitic melt (MtUnzen processing, processing and post-processing are all per formed under MATLAB. For the largest meshes, the computation has Dto3-Dby the use of Crouzeix-Raviart type elements. MILAMIN is a native MATLAB implementation, which takes adva ductile transition.$