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Power-law rheology of highly filled silicon polymers: can we improve strain localization in analogue experiments?

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The selection of appropriate materials is a central consideration in the design of geologically realistic analogue experiments. Hence, information on the rheology of materials and potential materials is essential to evaluate their suitability as rock analogues. We have been investigating the rheology of highly filled silicon polymers and seeking a power law, strain rate softening viscous fluid that is suitable for modelling rock deformation by dislocation creep. A material composed of PDMS and plasticine is shown to exhibit a power law, strain rate softening behaviour. However, it is also strongly non-linear at low imposed stresses or strain rates. The material has a dynamic yield strength for stresses lower than 70 Pa, resulting in a very high effective viscosity that further increases with strain. For stresses above this threshold, the behavior is quasi-linear (strain independent) and a power law flow law has been derived with an exponent of 2.8, which is close to the natural power law exponent measured for dislocation creep of most rocks and minerals. We investigate the ability of this material to localize deformation with geometrical and rheological heterogeneities in shear zone experiments. The strain localization process is followed in the experiments using Particle Imaging Velocimetry (PIV) that allows high-resolution measurement of geometrical shear zone characteristics (i.e. strain distribution, shear zone width, and strain localization intensity, Iloc).