

Title: Mechanical behavior and localized failure modes in a porous basalt from the Azores

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Abstract: Basaltic rocks are the main component of the oceanic upper crust, thus of potential interest for water and geothermal resources, storage of CO₂ and volcanic edifice stability. In this work, we investigated experimentally the mechanical behavior and the failure modes of a porous basalt, with an initial connected porosity of 18%. Results were acquired under triaxial compression experiments at confining pressure in the range of 25-200 MPa on water saturated samples. In addition, a purely hydrostatic test was also performed to reach the pore collapse critical pressure P*. During hydrostatic loading, our results show that the permeability is highly pressure dependent, which suggests that the permeability is mainly controlled by pre-existing cracks. When the sample is deformed at pressure higher than the pore collapse pressure P*, some very small dilatancy develops due to microcracking, and an increase in permeability is observed. Under triaxial loading, two modes of deformation can be highlighted. At low confining pressure (P_c < 50 MPa), the samples are brittle and shear localization occurs. For confining pressure > 50 MPa, the stress-strain curves are characterized by strain hardening and volumetric compaction. Stress drops are also observed, suggesting that compaction may be localized. The presence of compaction bands is confirmed by our microstructure analysis. In addition, the mechanical data allows us to plot the full yield surface for this porous basalt, which follows an elliptic cap as previously observed in high porosity sandstones and limestones. Citation: Loaiza, S., J. Fortin, A. Schubnel, Y. Gueguen, S. Vinciguerra, and M. Moreira (2012), Mechanical behavior and localized failure modes in a porous basalt from the Azores, *Geophys. Res. Lett.*, 39, L19304, doi: 10.1029/2012GL053218.

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