



HAL
open science

Quartz amorphization to produce porosity in crustal shear zones

Jacques Précigout, Cécile Prigent, Gina McGill, Laurent Arbaret, Laura Airaghi, David Wallis

► To cite this version:

Jacques Précigout, Cécile Prigent, Gina McGill, Laurent Arbaret, Laura Airaghi, et al.. Quartz amorphization to produce porosity in crustal shear zones. European Geosciences Union General Assembly 2024 (EGU24), 0000, à renseigner, Unknown Region. 372, pp. 1-12, 10.5194/egusphere-egu24-9882 . insu-04647678

HAL Id: insu-04647678

<https://insu.hal.science/insu-04647678>

Submitted on 15 Jul 2024

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



Distributed under a Creative Commons Attribution 4.0 International License

EGU24-9882, updated on 15 Jul 2024

<https://doi.org/10.5194/egusphere-egu24-9882>

EGU General Assembly 2024

© Author(s) 2024. This work is distributed under the Creative Commons Attribution 4.0 License.



Quartz amorphization to produce porosity in crustal shear zones

Jacques Précigout¹, Cécile Prigent², Gina McGill¹, Laurent Arbaret¹, Laura Airaghi¹, and David Wallis³

¹Institut des Sciences de la Terre d'Orléans (ISTO), Université d'Orléans, CNRS, BRGM, UMR7327, Orléans, France (jacques.precigout@univ-orleans.fr)

²Institut de Physique du Globe de Paris (IPGP), Université Paris Cité, CNRS, UMR7154, Paris, France

³Department of Earth Sciences, University of Cambridge, Cambridge, United Kingdom

Micropores are commonly observed in quartz-rich rocks that deformed at depths of the viscous, metamorphic continental crust. Although the presence of such porosity – often occurring with angular, pyramidal shapes – has major implications for fluid circulations and rock strength, whether or not they are produced by deformation remains unclear. Here we provide detailed documentations of pure quartz aggregates decorated by micropores in granitic shear bands from Naxos (Greece). Through estimations of geometrically necessary dislocation densities, we first document very high values ($\gg 10^{15} \text{ m}^{-2}$) along intragranular boundaries, several of them containing micropores. We then performed focused ion beam (FIB) cross-sectioning and transmission electron microscopy to image pore shapes along all types of quartz boundaries. Pores do not necessarily arise with angular shapes, but they are systematically embedded within amorphous SiO_2 , i.e., silica glass, along both grain and intragranular boundaries. FIB volume reconstruction also revealed pyramid-like pits occurring with round-shape faceted pores, the shape of which challenges long-lasting hypotheses for pores to originate. Together with recent studies^[1,2], our findings support deformation to produce porosity through (1) mechanical amorphization where dislocations accumulate and (2) fluid exsolution from the resulting glass because of a pressure/stress drop, here attributed to grain boundary sliding.

[1] Idrissi, H., Carrez, P. & Cordier, P. On amorphization as a deformation mechanism under high stresses. *Current Opinion in Solid State and Materials Science* 26: 100976 (2022)

[2] Li, B. Y., Li, A. C., Zhao, S. & Meyers, M. A. Amorphization by mechanical deformation. *Materials Science & Engineering R* 149: 100673 (2022)