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The role of fracture wall cementation on the vein spacing in microporous carbonates in the Lilstock area, UK

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Formation of vein networks is a common process in the upper and middle crust and has significant implications of its strength and permeability. Most such vein networks form by crack-seal or crack-jump mechanisms, where fracturing and fracture sealing is cyclically repeated many times. Whilst the geometries of such vein networks are well documented, the factors that control the distribution of the veins and the dynamic evolution of such networks are still under a debate.

Here we present results from a study of the Lilstock limestones in the UK that contain pervasive sets of subparallel microveins. The veins are filled with calcite and have a width ranging from 10-100 μm. They are arranged in bundles, where the individual veins are regularly spaced at distances of 50–100 μm in between. The lack of crosscutting relationships and the small width of most of the veins suggest that they were rheologically stronger than the host rock during the fracturing cycles and did not tend to reactivate. However, the observed bundle-type arrangement of these veins does not follow the typical pattern that can be expected when a homogenous material undergoes fracturing. We suggest that the observed arrangement of the calcite veins in the Lilstock limestones may be determined by the fluid interaction with the host rock during the vein formation, where it not only seals the fractures, but also cements the pore spaces in the adjacent host rock. The fractures in every next brittle cycle therefore do not form randomly, but rather nucleates and are deflected on the new rheological boundary between the unaltered host rock and the cemented host rock. We employ detailed microstructural and micro-chemical analysis to characterize the porosity structure and connectedness around the veins, determine the distribution of the intergranular cement and its relation to the veins. This study sheds light on the role of wall rock cementation in the development of vein networks.