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Synchrotron quantification of fracturing during maturation of shales

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To understand both the hydrocarbon migration within and from shale rocks, and during hydraulic fracturing, is needed to evaluate and predict its environmental footprint. As a consequence, the time characterization of fracture networks in shale is particularly important.
Time resolved synchrotron X-ray tomography was used to quantify the initiation and propagation of fractures during the simulated maturation of an organic-rich Kimmeridge Clay shale from the μm to mm scales. Scanning electron microscopy (SEM) observations were performed before and after maturation in order to compare the microstructure evolution and better understand the fracture location.
Fracture and strain development during heating was quantified in 3D by Digital Volume Correlation (DVC) (Bay et al., 1999). The combination of DVC, X-Ray tomography and SEM obtained direct 4D strain measurements of the anisotropic mechanical behaviour of Kimmeridge shale with the temperature during an accelerated thermal maturation (Figueroa Pilz et al.). Such a combination has rarely been investigated in 4D at these scales in the past. In the study conditions, the results demonstrated the anisotropy in thermal expansion and the aperture fracture pathways through organic matter and clay matrix.