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Changes of petrophysical properties in deformation bands (Leithakalk, Eastern Austria).

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In contrast to frictional faults and cataclasites in well consolidated and cemented sediments, lithologies with little or no diagenetic consolidation and high porosity develop deformation band type faults. Generally, deformation bands often form in well sorted fine to medium-grained sandstones before major porosity loss during diagenesis.
These deformation structures were studied at the Eastern border of the Eisenstadt Basin where deformation bands were found in Neogene calcarenites of the Leithakalk formation in a quarry near St. Margarethen (Eastern Austria). The Badenian Leithakalk in the quarry mainly comprises bioclasts dominated by corallinacean debris and foraminifera.
The orientation of the deformation bands indicates E-W directed extensional kinematics which can be correlated to large scale horst-and-graben structures within the underlying basement and lower Miocene sedimentary rocks. Generally, the Leithakalk shows a primary porosity of around 25%, but within the deformation bands the porosity is reduced to Ĩ%, showing no observable cataclastic grain size reduction.
A 3x3.5cm sized drill core containing a deformation band was analyzed using X-ray micro-tomography with a spatial resolution of 70 microns. The pores outside the deformation band are 500-2000 microns in diameter, and show a well connected pore space. In contrast, the size of pores is strongly reduced within the deformation band to a maximum of 100 microns; the pores are clearly isolated and fill < 1 % of the volume. Furthermore, the permeability across selected deformation bands was measured with a minipermeameter. The deformation bands itself has almost zero permeability due to the decreased porosity. The permeability is 50-100 times reduced in contrast to the undeformed rock fabric.
Thin section analysis of the same samples revealed a significantly lower amount of carbonatic cement within the deformation bands than in the undeformed limestone. However, no fracturing of bioclastic particles or cement grains could be observed. Therefore we conclude that the deformation bands formed before the cementation of the Leithakalk.

Using detailed X-Ray tomographic data of porosity and connected pore space within and outside the deformation bands, in combination with microstructural investigations, we are able to constrain the deformation mechanisms and relative timing of deformation with respect to the cementation of the limestone.