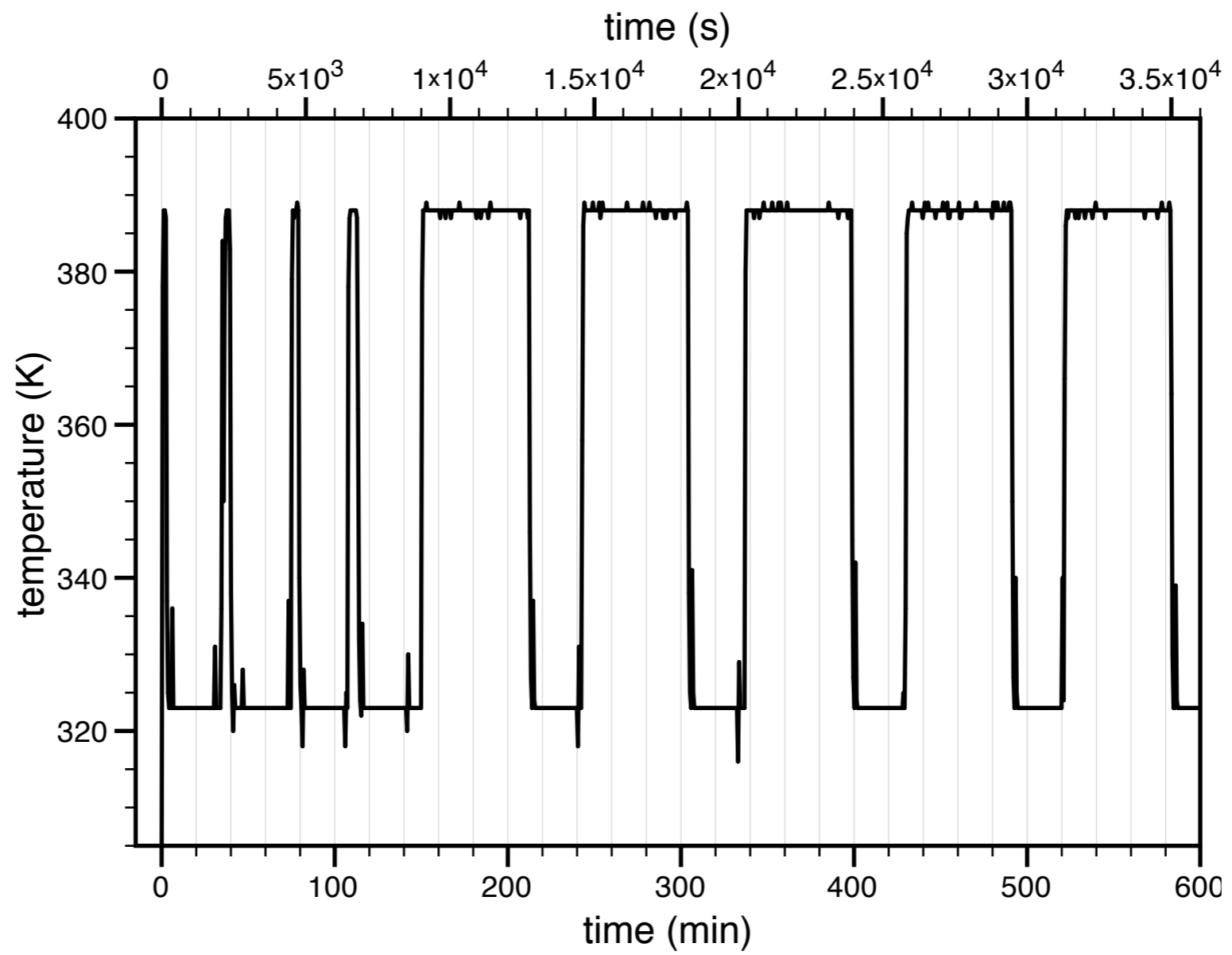
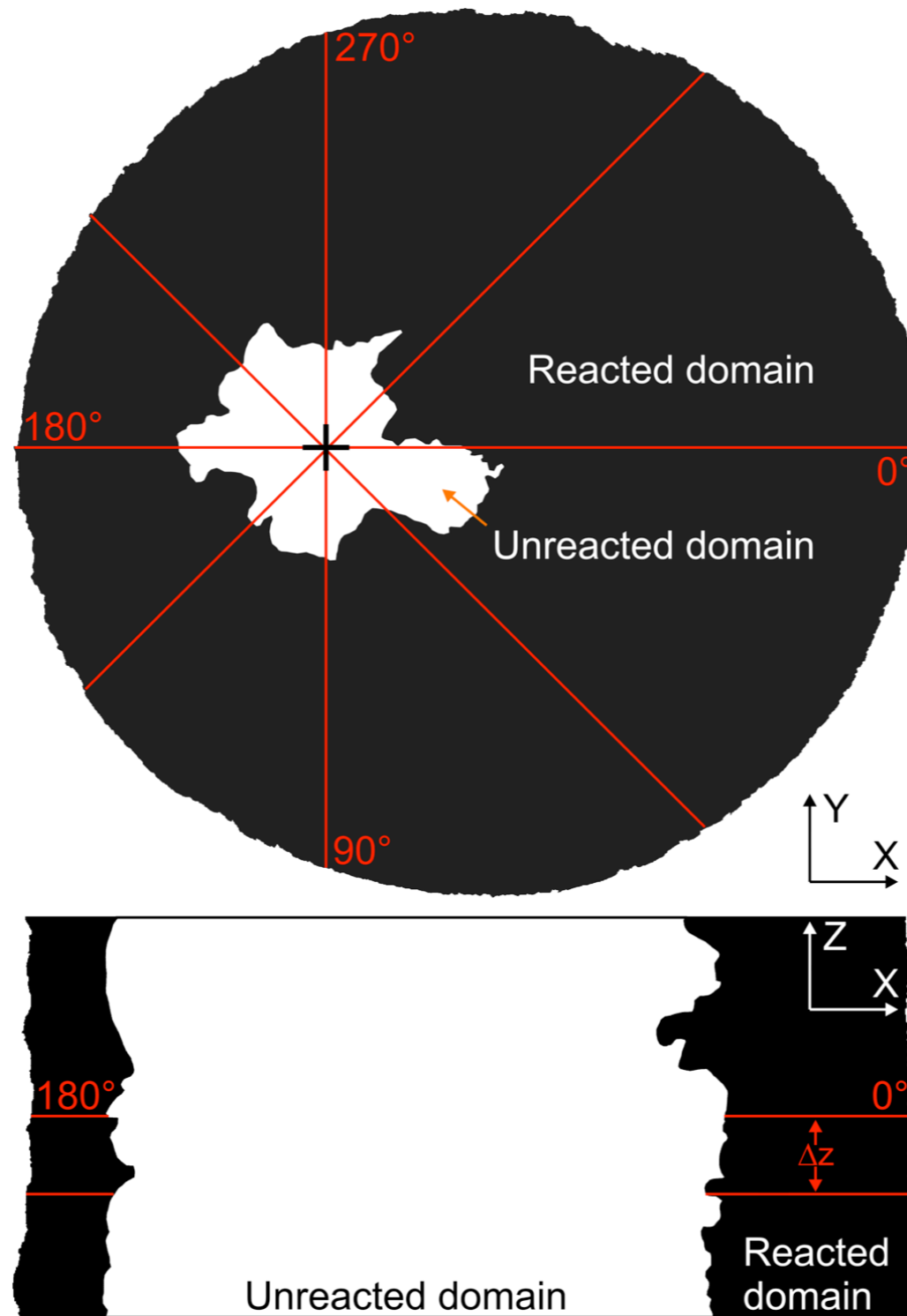


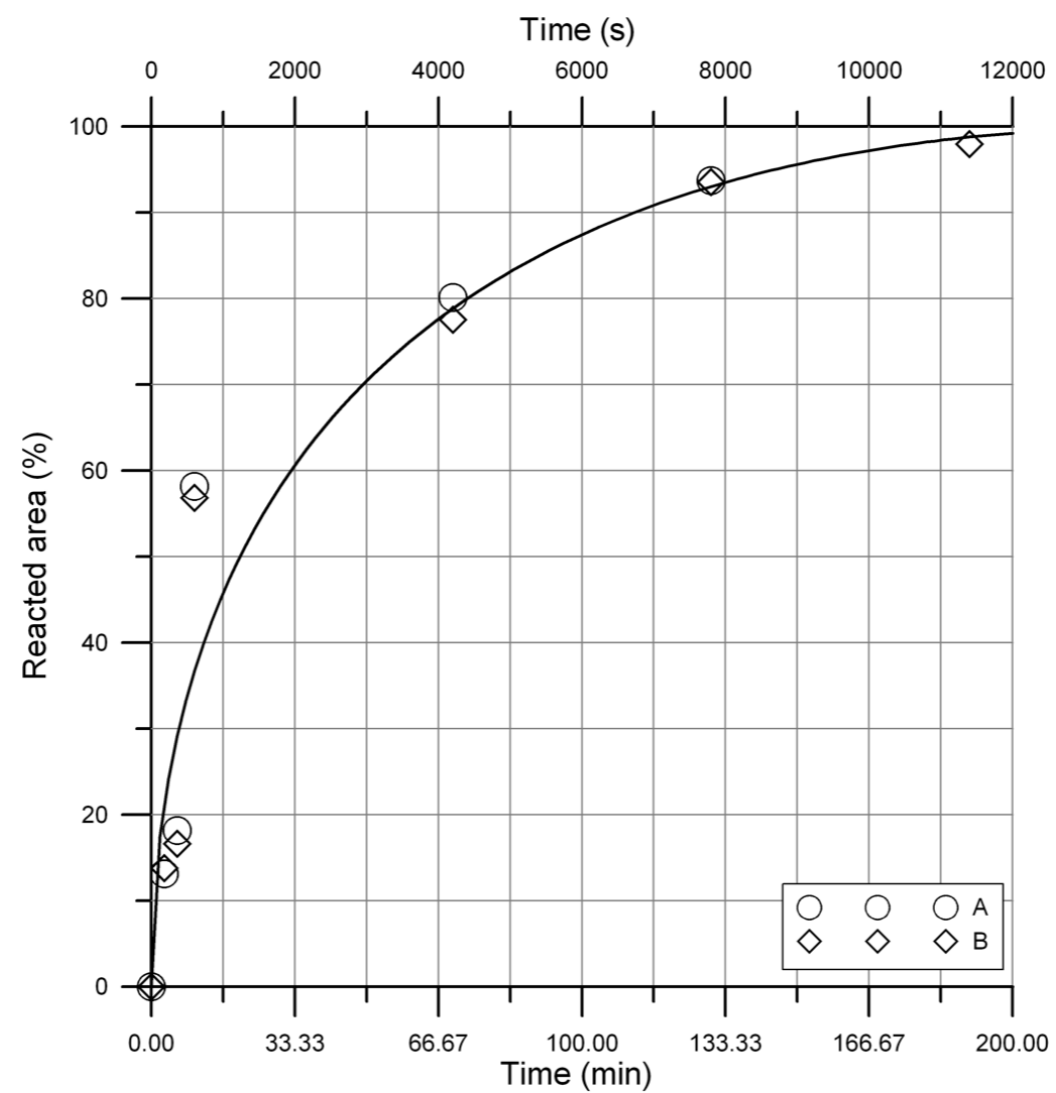
**Suppl. Figure 1** – Left: Photographs of thin sections of Volterra alabaster in polarized light with crossed polarizers. Right: Shape-fabric ellipsoids calculated with the line-intercept code by Launeau et al. (2010). Step size of rotation angle is  $10^\circ$ ; normal distance between search grid lines is 5 pixel. The largest mean grain size in the orientation interval  $[0^\circ; 360^\circ]$  is denoted by  $a$  (long axis of the fabric ellipsoid) while the smallest mean grain size is  $b$  (short axis of the fabric ellipsoid).  $R$  is the aspect ratio of the ellipsoid. The fabric ellipsoids show that Volterra gypsum exhibits a shape-preferred orientation locally.



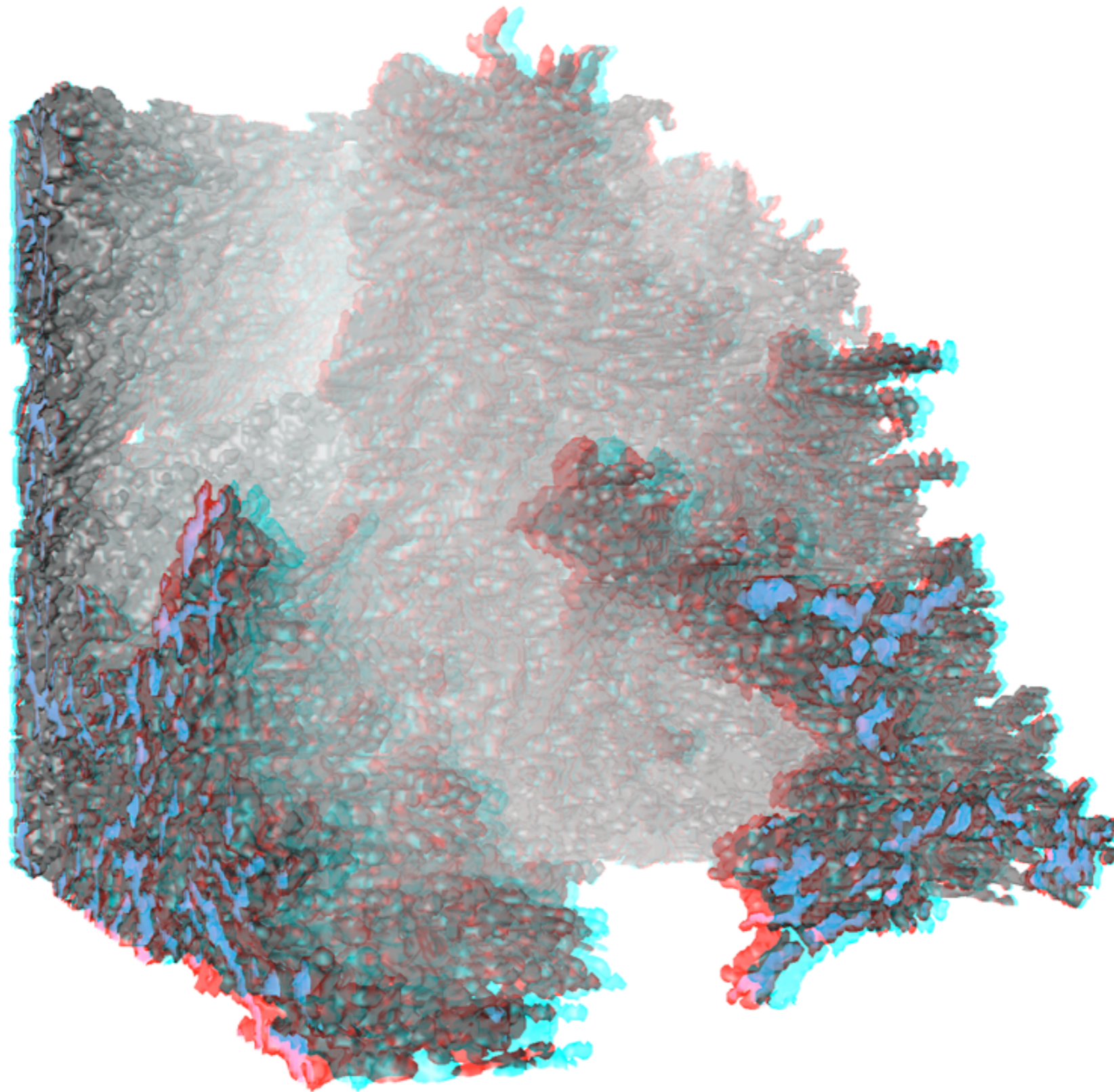
**Suppl. Figure 2** – Temperature-Time curve of the experiment. Note that the tomographic data were acquired at 325 K after each heating period.



**Suppl. Figure 3** - Measurement strategy for the progress of the dehydration front over time from horizontal (upper panel) and vertical (lower panel) tomography slices. The global coordinate system is indicated on the right-hand side of the figure. Measurements of front position over time (as described in the text) are performed with a simple image analysis routine on binary images. The binary images are produced from the tomography data to segment unreacted from reacted material. The outer margin of the sample is easily separated from the background (not shown; compare Fig. 2) by binary thresholding (accuracy is  $\pm 1$  pixel). The position of the front at a given time, however, is determined by manual digitization. We estimate that the accuracy of this procedure is  $\pm 3$  pixel (i.e.,  $< 5$  m).



**Suppl. Figure 4** - Plot of proportions of sample area where reaction has initiated for two horizontal tomography slices (A and B) as a function of time. Note that in slice A the reaction initiation front has reached the centre of the cylinder before the last scan. Black solid line denotes calculation of reaction initiation progress assuming a perfectly concentric front propagation and the diffusivity determined with equation 1 (compare Fig. 5).



**Suppl. Figure 5** – Three-dimensional visualization of the morphology of the largest interconnected pore cluster at the reaction front – requires red-cyan glasses. Note the complexity of the pore shape. Side length of the cube shown is 200 voxel (260 m).