MICRO-CT IN STONE RESEARCH AT UGCT

Tim De Kock (2019)

Content of unpublished data is reduced in this PDF.
X-RAY MICRO-CT

2D imaging of processes

3D imaging of processes

Water absorption in a limestone (not the same sample left/right)


Dierick et al. 2014. Recent micro-CT scanner developments at UGCT. Nuclear Instruments and Methods in Physics Research Section B: Beam Interactions with Materials and Atoms, 324, 35-40.
SALT CRYSTALLIZATION

- 3 molal Na$_2$SO$_4$-solution cooled to 0° C: sodium sulfate heptahydrate crystallization
- Scans taken continuously during 19 minutes at a rate of 1 scan/80 s (pixel size: 24 µm)


See also (content removed from this ppt):
Derluyn et al. 2015. ICTMS Conf Proceedings
Desarnaud et al. 2015. Journal of Applied Physics
FREEZE-THAW CYCLING

Time-lapse CT

<table>
<thead>
<tr>
<th></th>
<th>1st cycle</th>
<th>2nd cycle</th>
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</thead>
<tbody>
<tr>
<td>start</td>
<td>Scan 00</td>
<td>Scan 01</td>
</tr>
<tr>
<td>0 h</td>
<td>Scan 02</td>
<td>Scan 03</td>
</tr>
<tr>
<td>2 h</td>
<td>Scan 04</td>
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<tr>
<td>3 h</td>
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<tr>
<td>5 h</td>
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<tr>
<td>6 h</td>
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</tbody>
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Temperature (°C)

- 20 °C
- -15 °C

Dynamic CT

- 14400 projections; 100 ms
- 800 projections/rotation
- Acquisition time 80 s

scans 00-16 (this is a video)
FREEZE-THAW CYCLING

Scan 01

This is a video
FREEZE-THAW CYCLING

- opening during freezing
  closing during thawing
  *ice crystallization*
- progressive opening during successive frost cycles
  *fracture propagation*
- reduction in size differences during freezing and thawing
  *residual strain*
- stagnation of crack size
  *accommodation of ice crystallization*
This is a video
2D WATER MIGRATION

0 s  

95 s

170 s  

195 s
This is a video
GYPSUM CRUST

Continuous in situ experiments

- > 100 volumes, 30 min/full rotation, voxel size 5μm
- Continuous scanning for > 3 days
- Hard to visualize together, even more challenging to analyze
GYPSUM CRUST

4D representation (unpublished data removed from ppt)

De Kock et al., 2019. Continuous time-lapse micro-CT of gypsum crust formation on natural building stone. 4th International conference on Tomography of Materials and Structures (ICTMS), Abstracts.
Thank You