



STACHEM Project



3D Scanning and IR Thermography of Djin Block No.9 in Petra Jordan

**Talal Akasheh
CulTech for Archaeology and Conservation Amman Jordan
Paestum November 20-22, 2009**

Partners

- M. Cabrelles, S. Galcerá, S. Navarro, J. L. Lerma, T. Akasheh, and N. Haddad
- a Photogrammetry & Laser Scanning Research Group (GIFLE), Universidad Politécnica de Valencia, Valencia, Spain b CulTech for Archaeology and Conservation, Amman, Jordan c Dept. of Conservation Science, Queen Rania's Institute of Tourism and Heritage, The Hashemite University, Zarqa Jordan

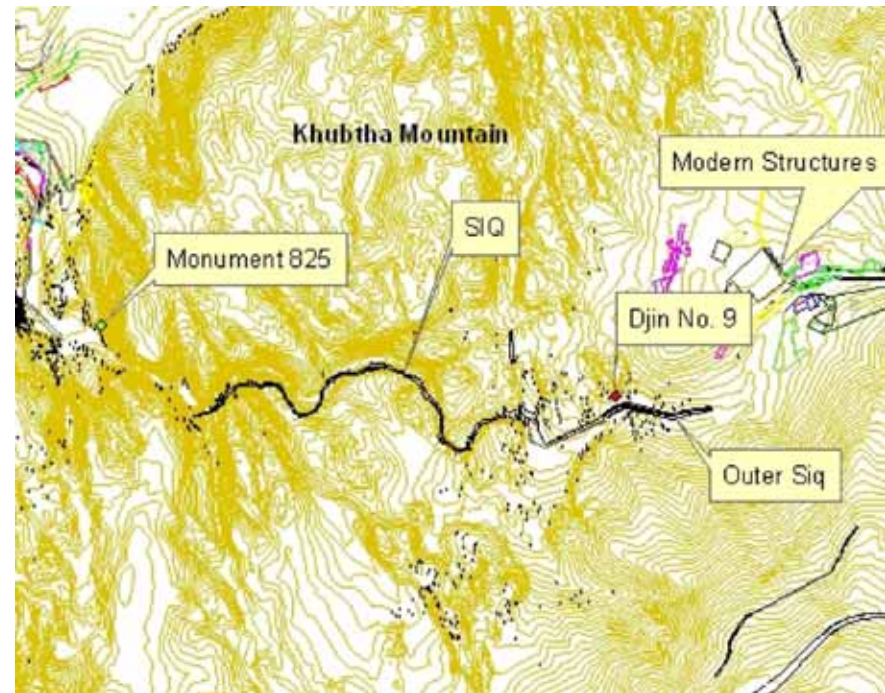
Description

- Djin Block No. 9 is a 3D funerary block carved from Ordovician Sandstone. It is the first important monument that meets you on the descent down the Outer Siq which leads to the Siq main entrance to Petra.
- Its four faces are weathered to different extents. The grave is carved on the roof of the block and contributes to the weathering by holding water for a long time during rainfall. Water and wind erosion are more important than insolation

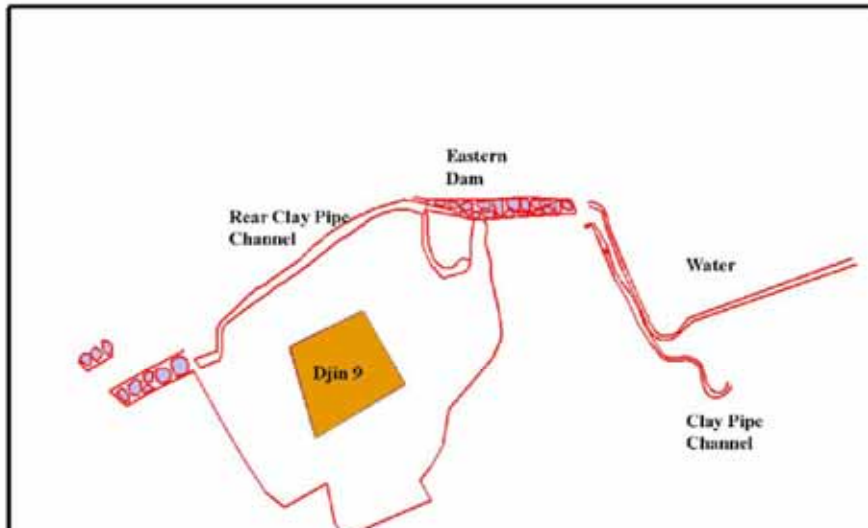
Djin Block No 9 (Cont.)

- The ornaments on the block like the cornice (around all sides) and the column capitals are stone insets, stuck with mortar that is heavily damaged by water down flow and dissolution.
- This makes us wonder if the carving was as simple a block as other 3D blocks, which was later reused for the burial of an important person and new decorations were added. The insets have hellenic influence and may have been added during Roman times or late Nabataean period to a earlier Nabataean Style

Djin Block Number 9



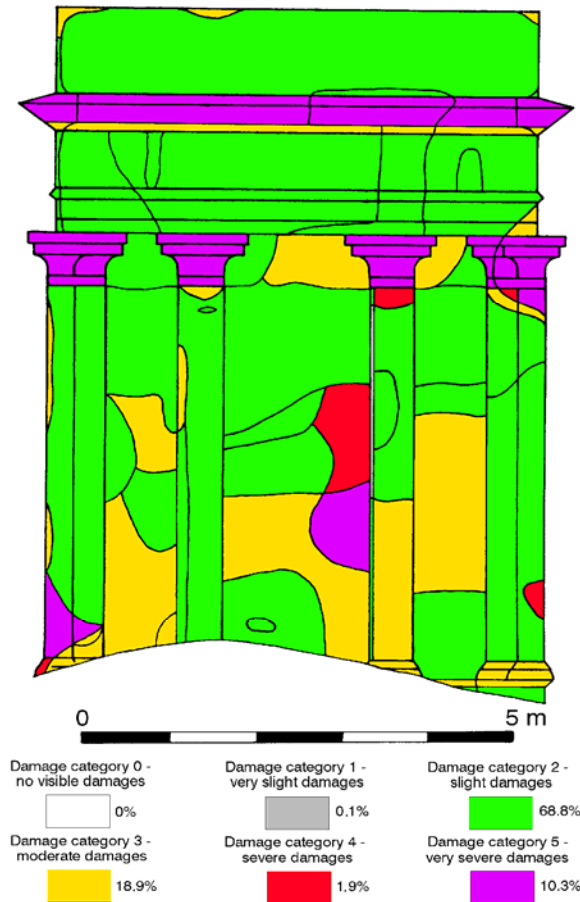
Water Management



Grave on roof

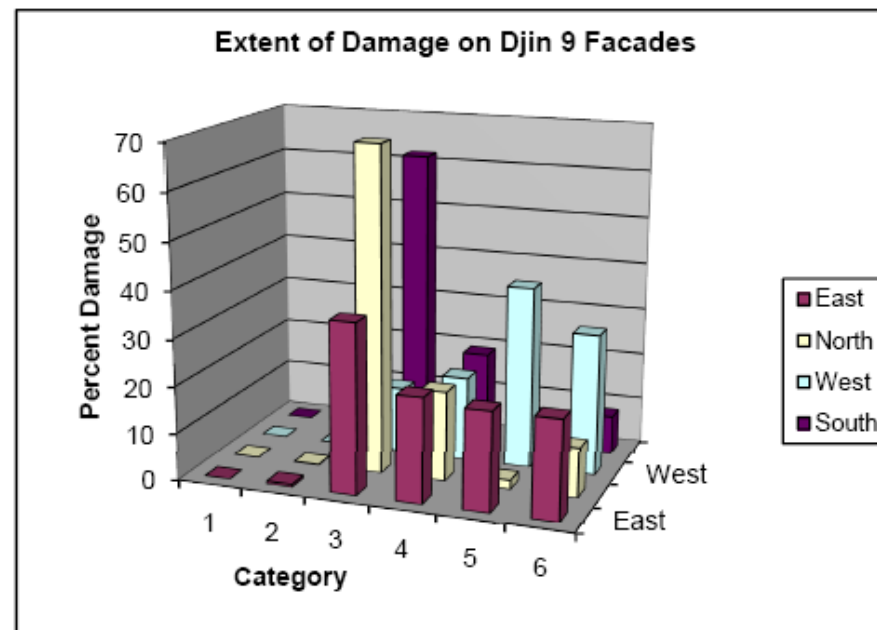


Typical Weathering profile and extent of damage east façade from Fitzner and Heinrichs (Aacheen)



Extent of Facades Weathering

Category	No damage	Very slight	Slight	Moderate	Severe	Severe		
Facade	0	1	2	3	4	5	First Three	Second Three
East	0	0.6	35.8	22	20.8	20.8	36.4	63.6
North	0	0.1	68.8	18.9	1.9	10.3	68.9	31.1
South	0	0	14	17.8	38.4	29.8	14	86
West	0	4.8	61.8	19.1	6.5	8.1	66.6	33.7



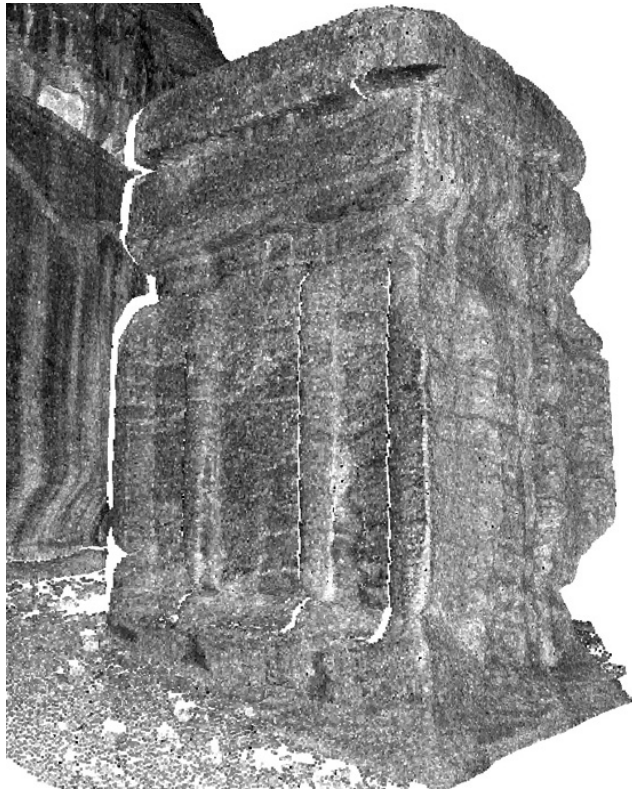
South>East>North>
West Explain why!

Chart 4.1.1: Summary of extent of damage results on the four facades

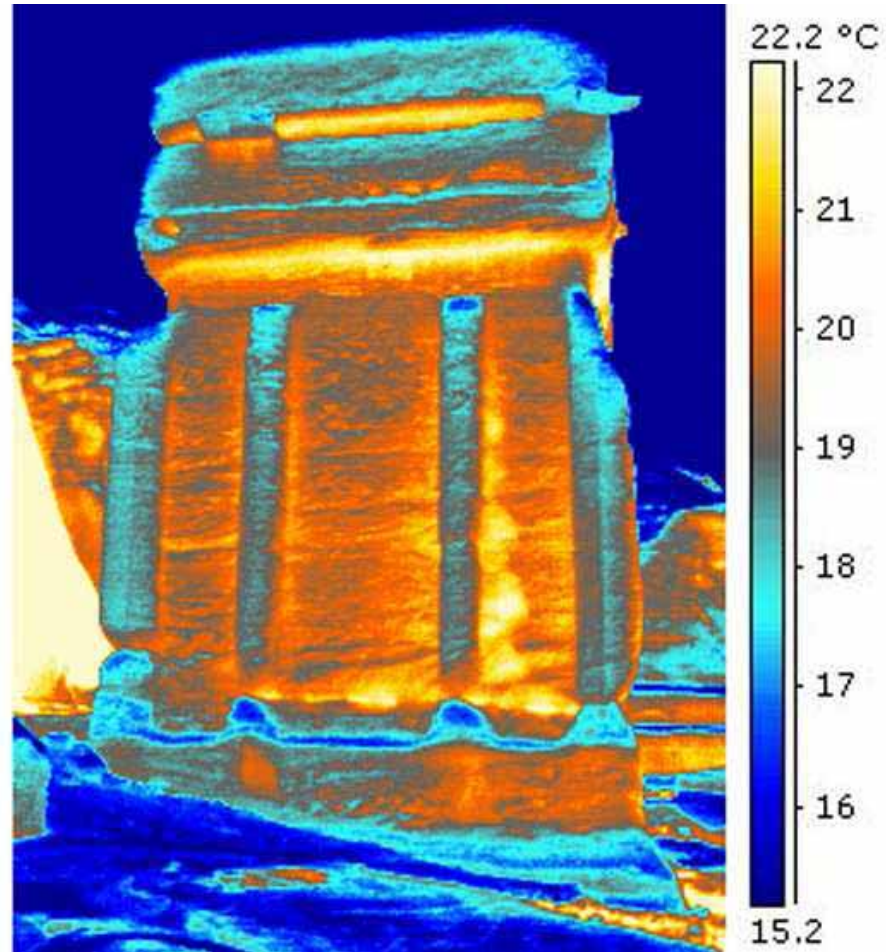
Equipment used for image acquisition and 3D scanning

- - Leica T1800 reflectorless total station. Measures distances and angles without prisms up to 200 m; standard deviation of about 2-4 mm.
- - time-of-flight MENSIS GS100; panoramic field of view of 360° (horizontal) and 60° (vertical), 5000 points per second. The standard deviation of a single distance measurement is 6 mm at 100 m. This scanner incorporates an internal colour calibrated video (resolution 786 x 576 pixels)
- - Canon EOS-1Ds Mark III digital camera, with a CMOS of complete photogram, resolution of 21 megapixels, focal length of 15-30 mm.
- - FLIR ThermoCAM B4 thermal infrared camera. Range is 7.5-13µm; thermal sensitivity 0.10°C. and produces clear noise-free IR images with a resolution of 320x240 pixels

3D scanner data

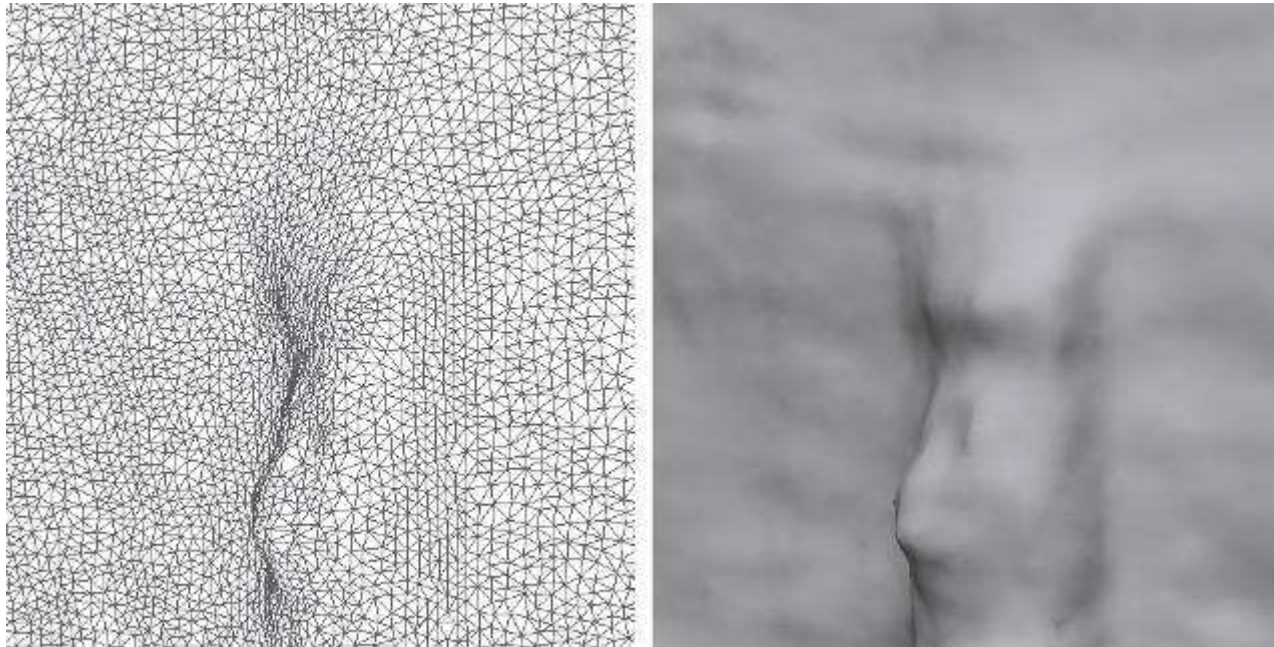


Visible and IR images West Side



- To process the point cloud processing we referenced the raw data to a single object based coordinate system. The residuals of the registration process were better than 4 mm in XYZ coordinates. Noise was removed by filtering.
- a 3D triangulation meshing draped over the point cloud was then obtained. Moreover, tiny holes due to hidden areas
- were filled. The final 3D consisted of 780,000 triangles.

Detailed wireframe and rendering



3D model in two modes, wireframe, and
with lights on.

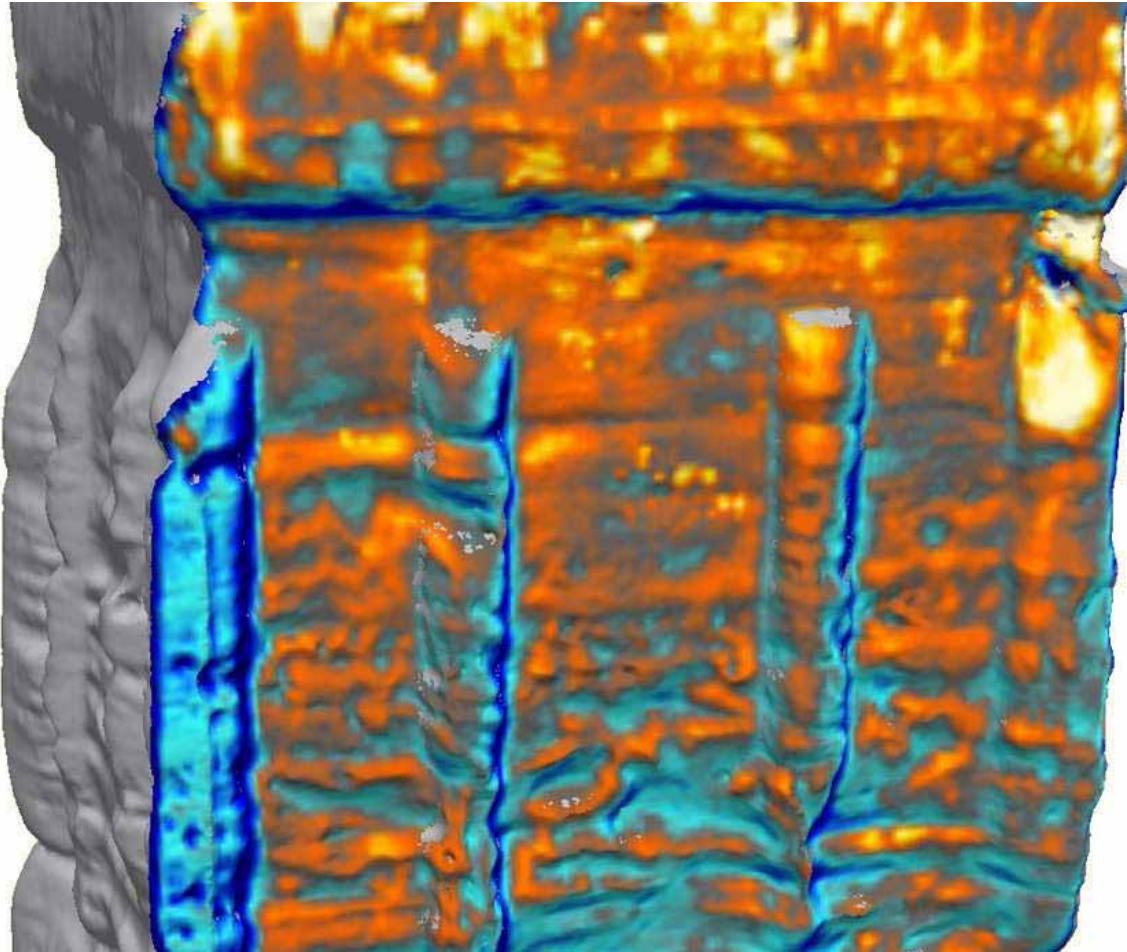
Processing

- The appearance of the 3D model can be improved by draping
- virtual (unreal) texture or real textures captured by a visible or
- multispectral camera. For the purpose of fitting with maximum
- reliability the real texture coming from the real imagery to the
- 3D model, all the images were positioned and oriented in the
- object space following two particular solutions based on the
- well-known collinearity equations, bundle adjustment and
- single image resection. The former was used to adjust the high
- resolution visible images; the latter to add the thermal
- information to the 3D models.

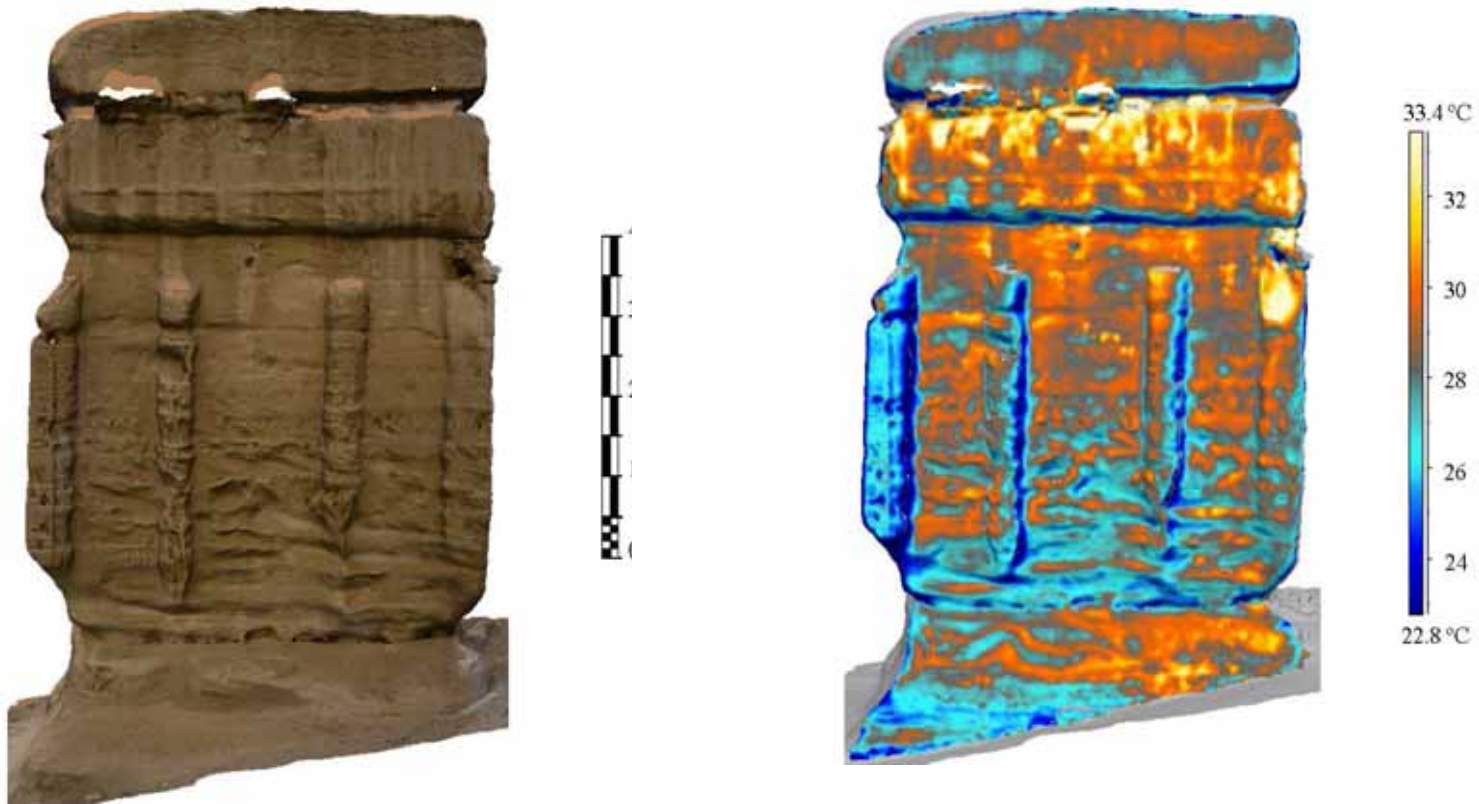
Photorealistic 3D Model



Thermorealist Model Eastern Side



Final results for Eastern Sides



XRF results for calcium

