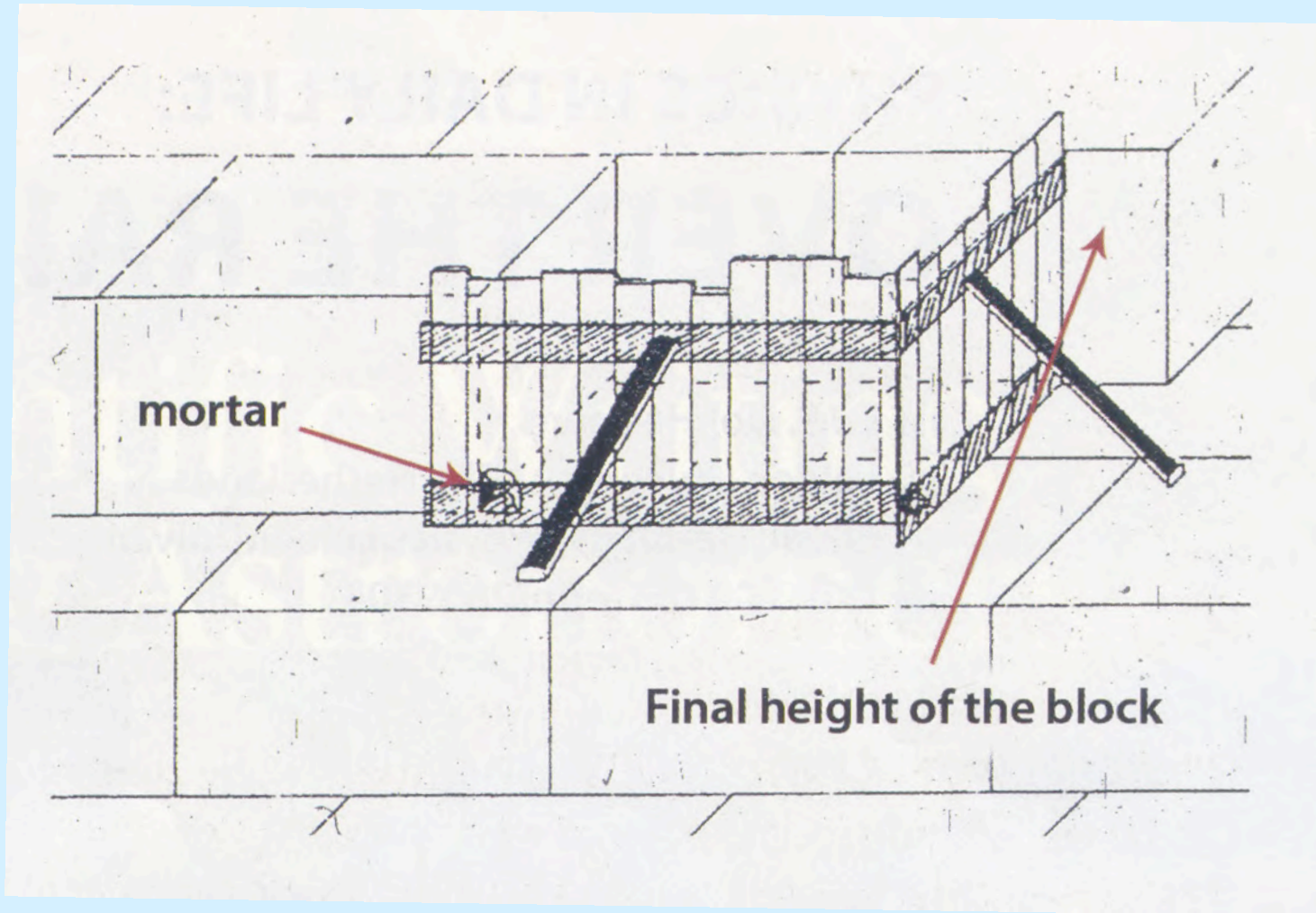


Paleomagnetic investigation of the Egyptian pyramids

Túnyi I., Geophysical Inst. SAS, Bratislava



Demortier 2009,
in «Europhysics
News» Volume
40, Number 1,
January-
February 2009



Mould model
(Demortier 2009)



Porosity stratification of blocks

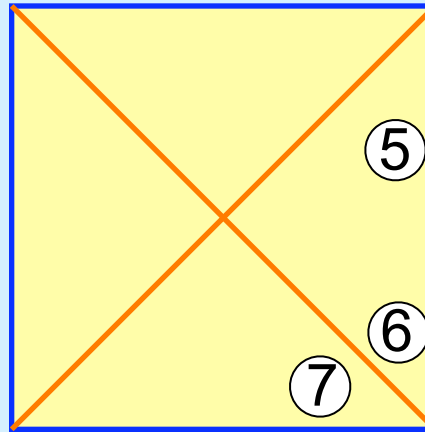


Detail

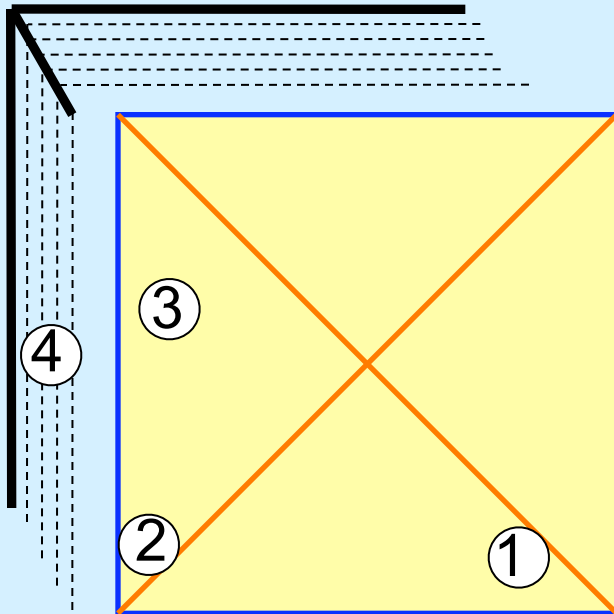
Paleomagnetic study

- Paleomagnetic investigation of the two great Egyptian pyramids: Khufu and Khafre;
- **Objectives:**
 1. if the blocks are artificial, their magnetic moments are parallel, oriented approximately in the north-south direction
 2. if the blocks are natural, then the directions of their magnetic moments are oriented randomly.
- 7 samples were taken from the pyramids and the quarries nearby.

N

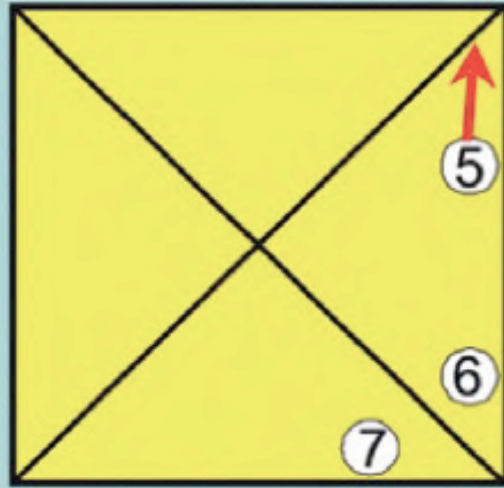


Khufu

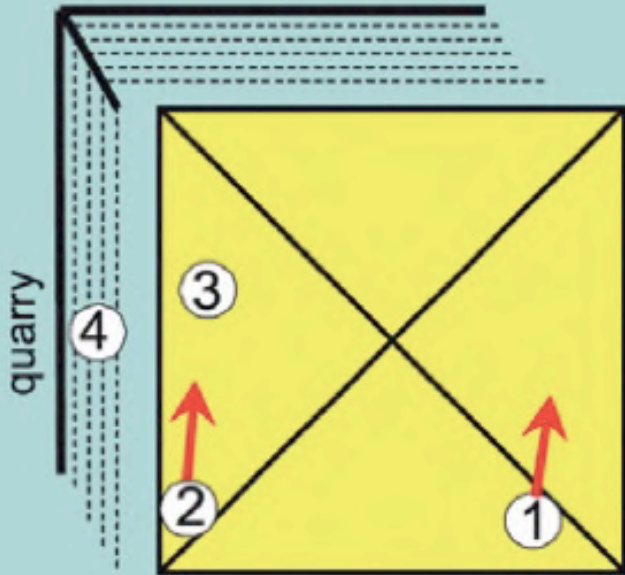


Khafre

Locations of taking oriented samples



Khufu

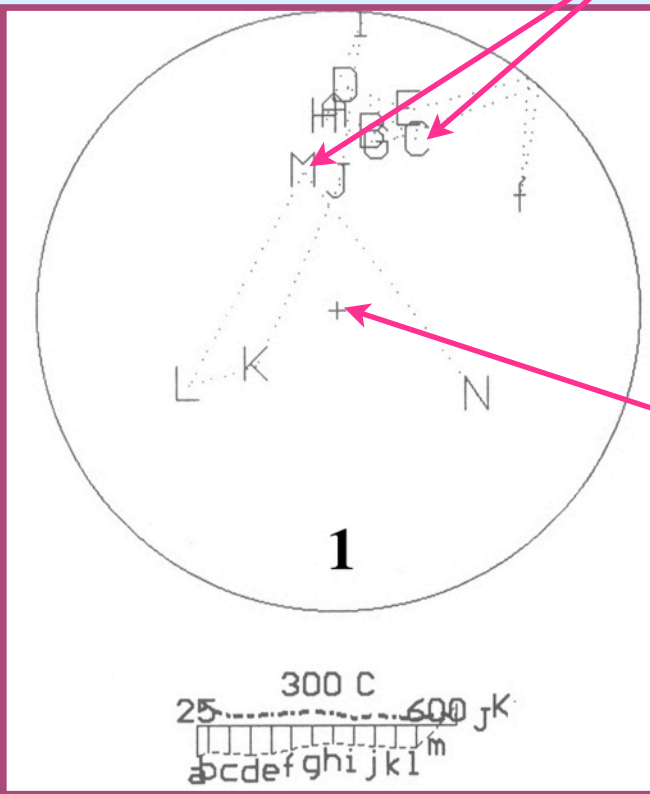


Khafre

Red arrows on samples **1, 2, 5** indicate the directions of magnetic polarisation vectors

Directions of the magnetic polarisation in the samples

N



The angular differences between direction of the true geographic North and the directions represented by the dots indicate declination

Origin of the polarisation vectors in the centre of the sphere

The distances between the centre of the big circle and the dots indicate the inclination of the geomagnetic field which magnetised the rocks in the locations where the sampling took place

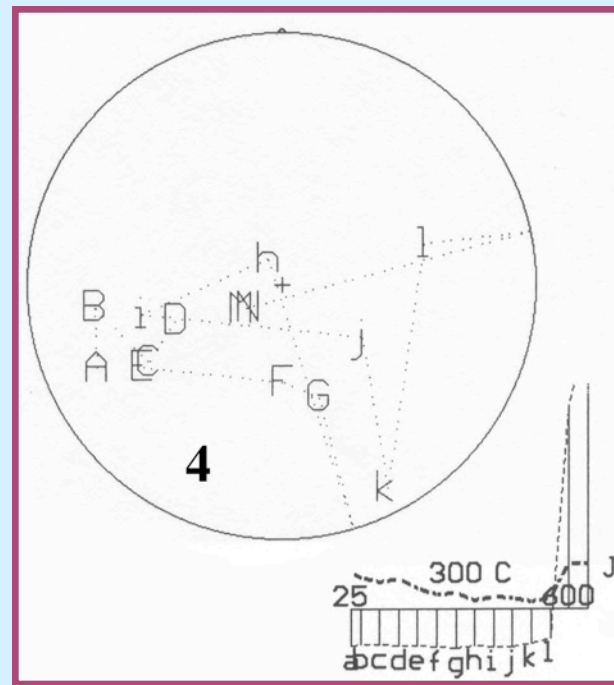
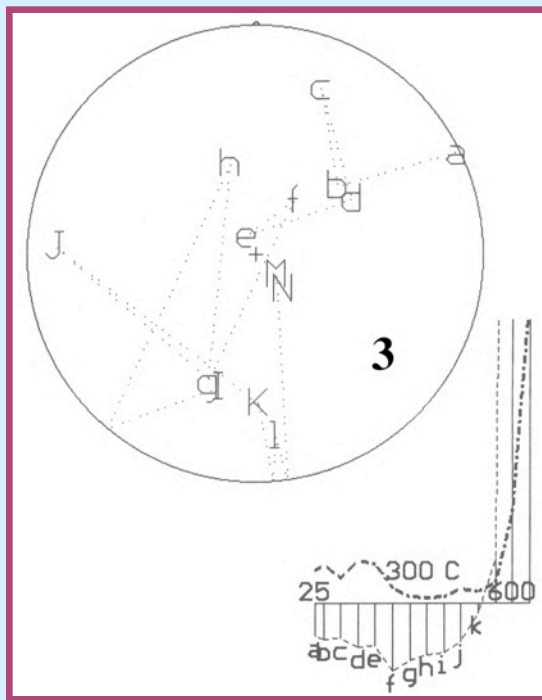
J – Magnetisation

K – susceptibility

Thermal demagnetisation

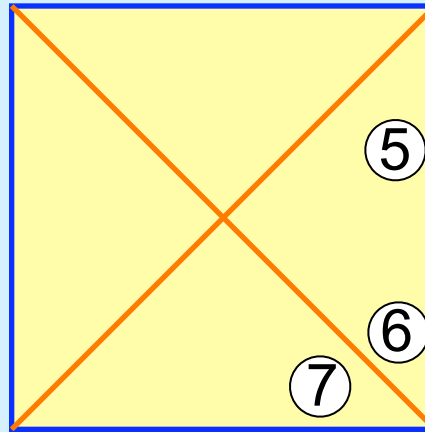
Khafre

Samples n° 3-4

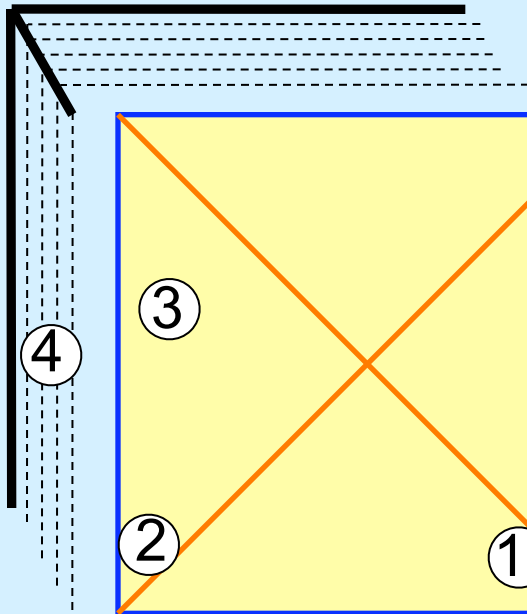


- It is impossible to identify any preferred direction from the range of directions in their magnetic polarisations.
- The material from locations 3 and 4 are very similar in nature.
- Together with the similarity in their magnetic characteristics, we may infer that the block from location 3 has its origin in the quarry near the pyramid.

N

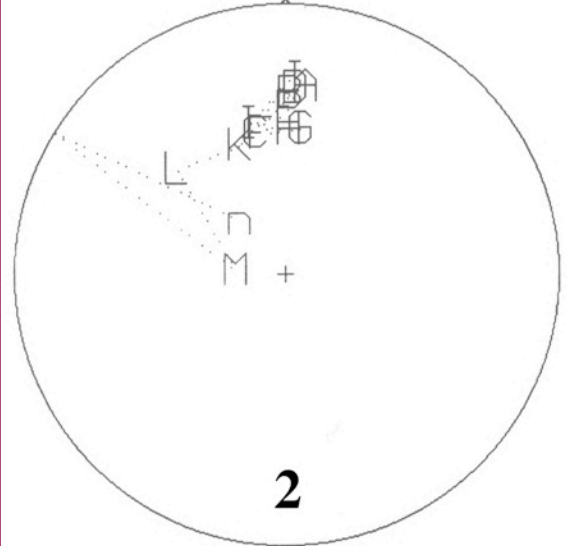
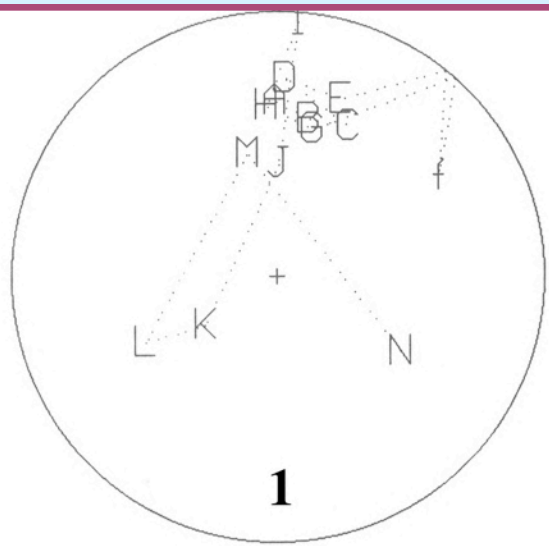


Khufu



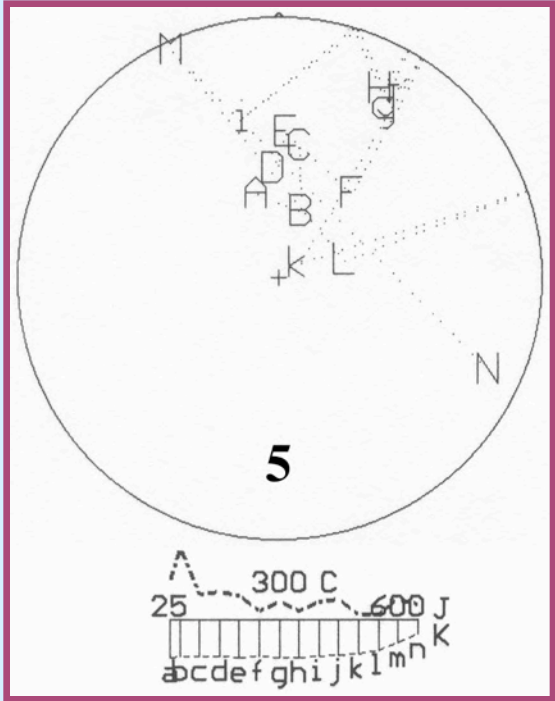
Khafre

Locations of taking
oriented samples

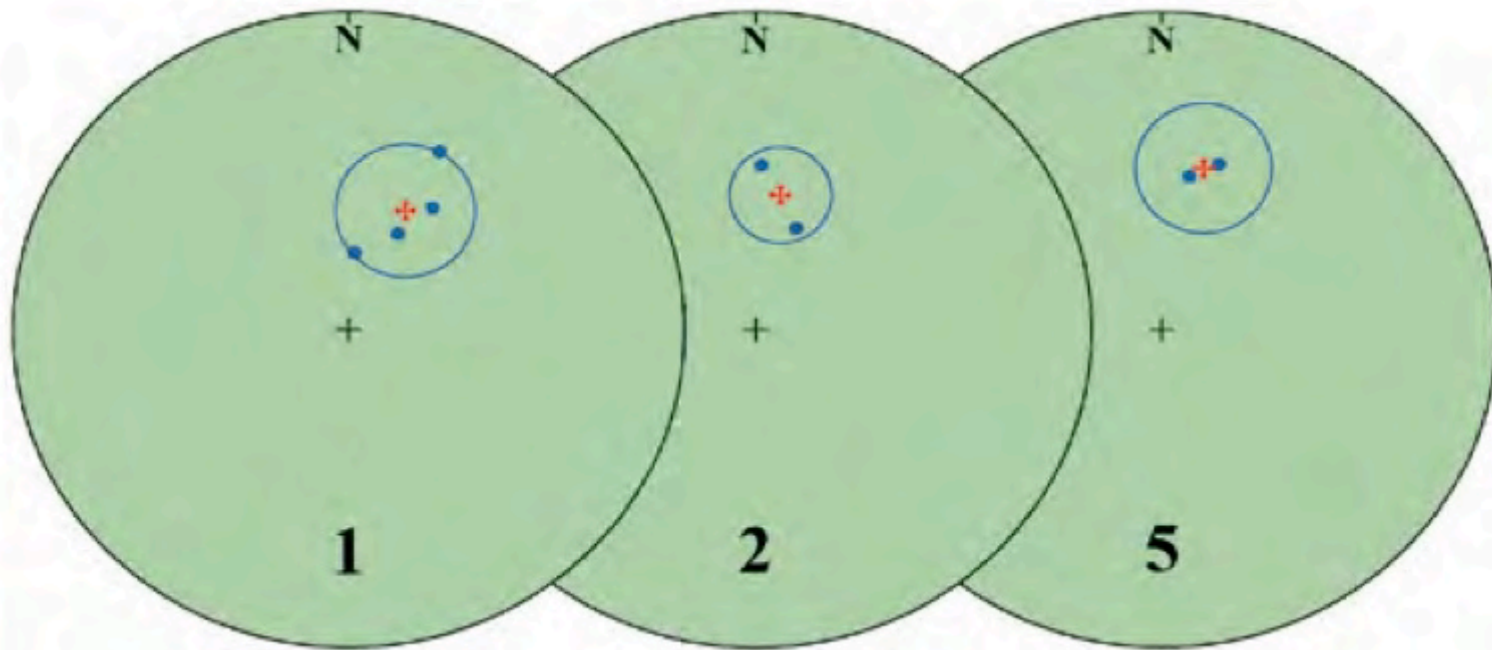


Khafre
 Samples n° 1-2

Khufu
 Sample n°5

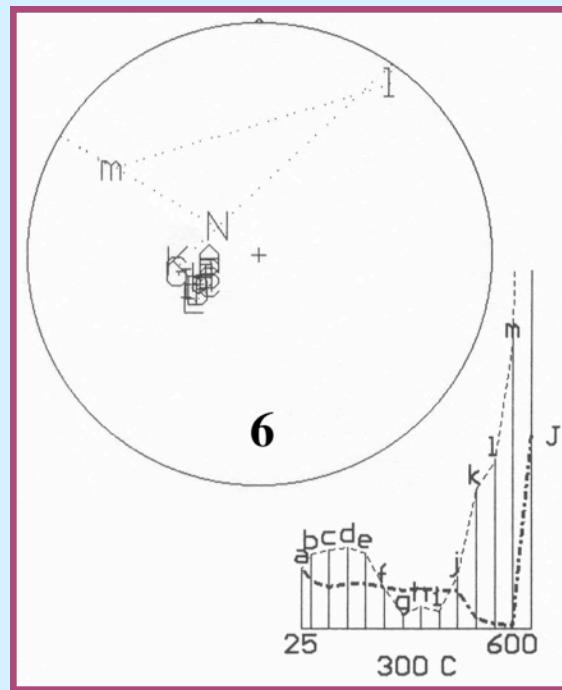
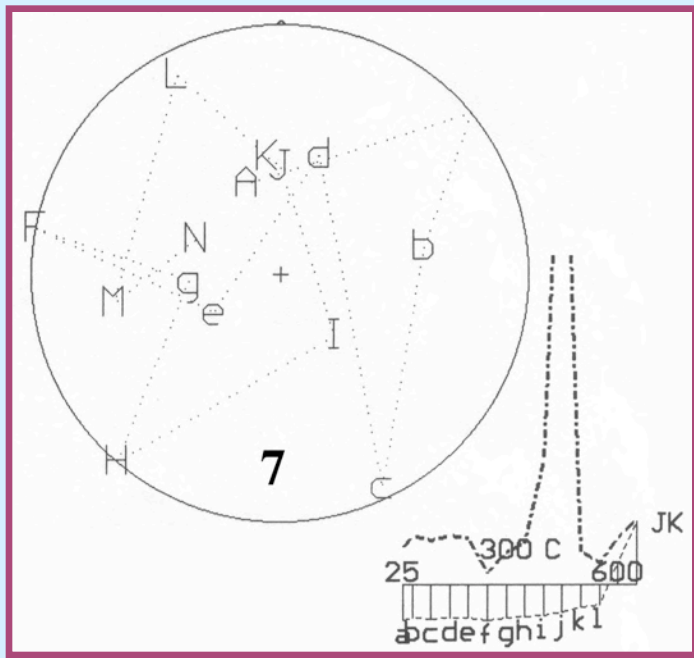


- Samples from locations 1, 2 and 5 exhibit the same demagnetizing characteristics and their paleodirections are nearly identical;
- The blocks from which these samples were cut have identical carriers of magnetism and probably also identical rock material – perhaps artificial limestone (geopolymer)



Paleomagnetic directions from locations 1, 2, 5

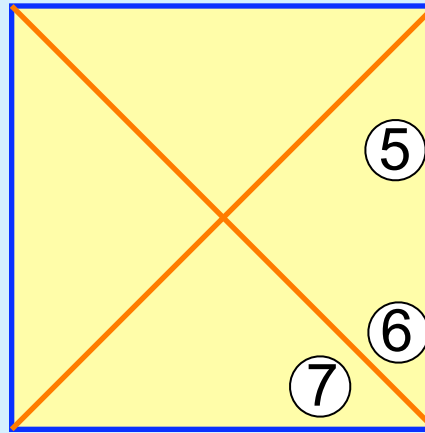
- Dots: directions of specimens from the same location
- The red cross symbols represent the mean directions
- The blue circles indicates the region in which the polarisation vector projection falls with 95% probability
- In principle, they correspond to the declination and inclination of the geomagnetic field in Egypt
- These blocks seems to be artificial



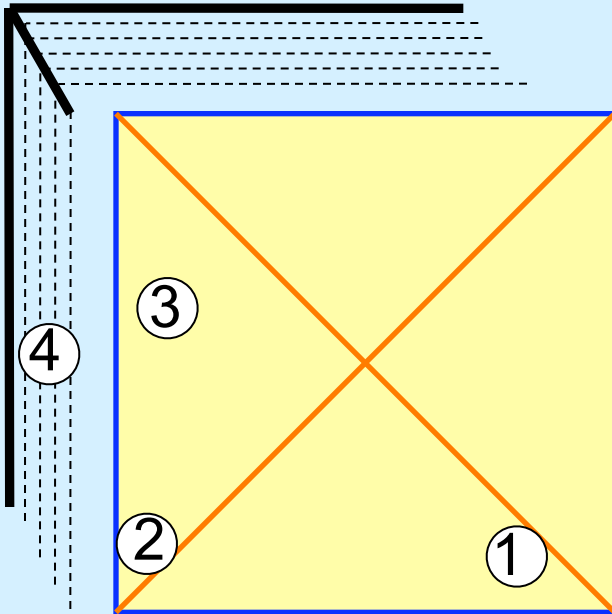
Khufu Samples n°6-7

- The sample from location 7 shows demagnetising characteristics similar to those from locations 3 and 4.
- It suggests that the block from which the sample was taken comes also from the quarry near the Khafre pyramid.
- Although the sample from location 6 allows one to determine the preferred magnetic direction, the rapid change in magnetic susceptibility at low temperatures makes this paleodirection irrelevant.
- Therefore, we conclude that the rock material of the block from location 6 is different from that of blocks at other locations.

N

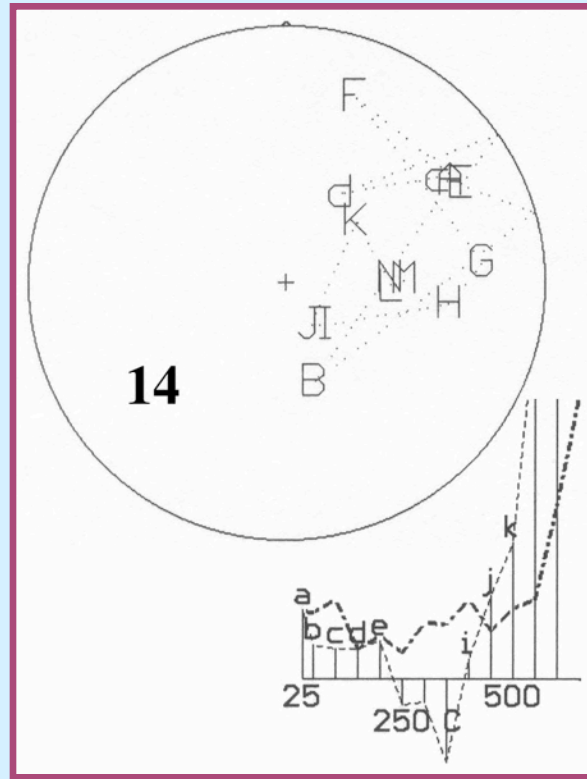
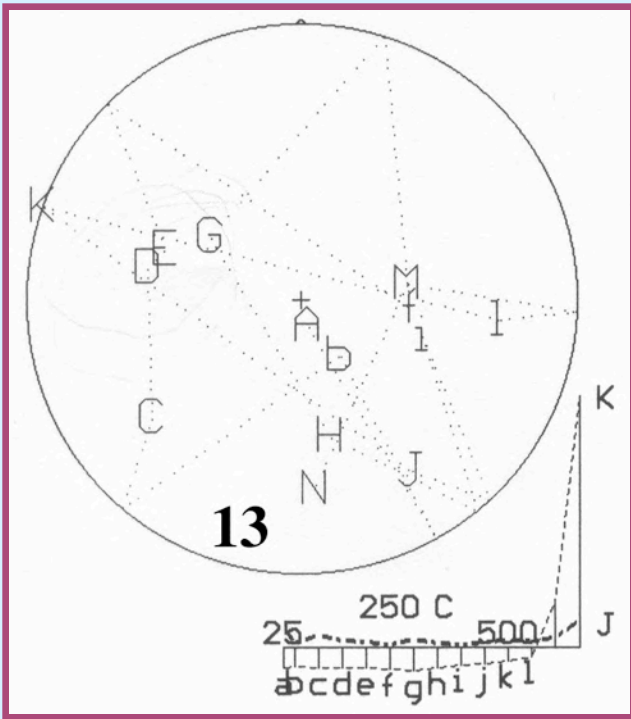


Khufu



Khafre

Locations of taking oriented samples

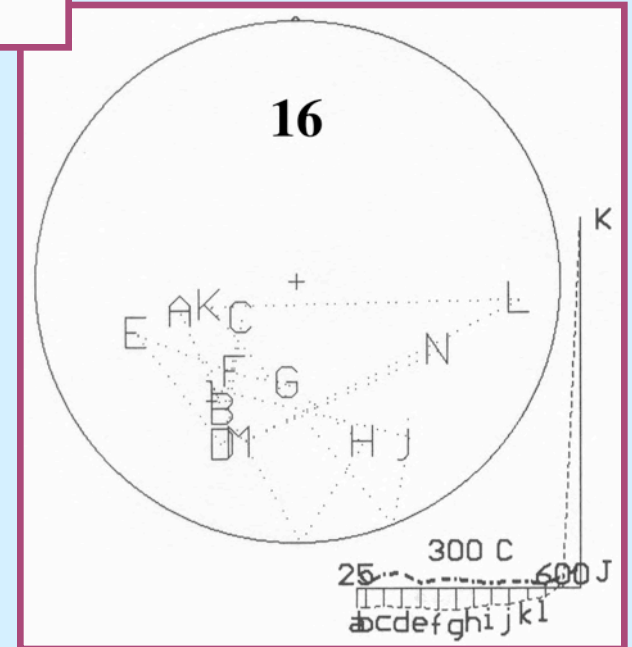
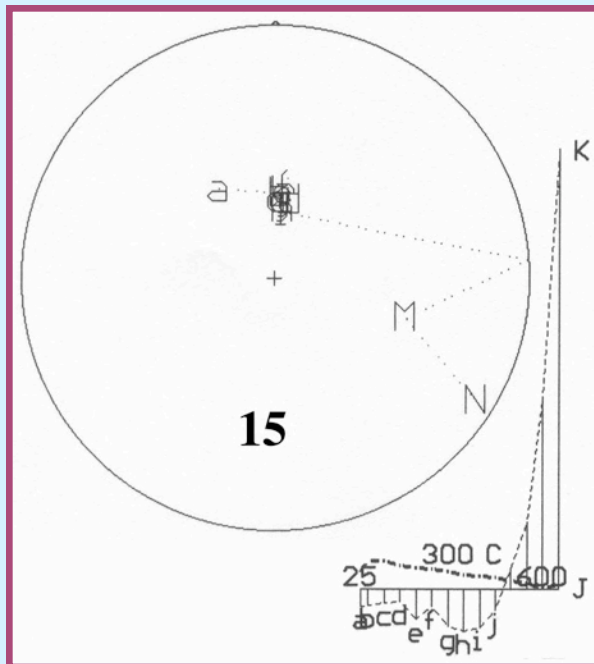


Moqatom quarry

Thermal demagnetization

J – magnetization

K – susceptibility

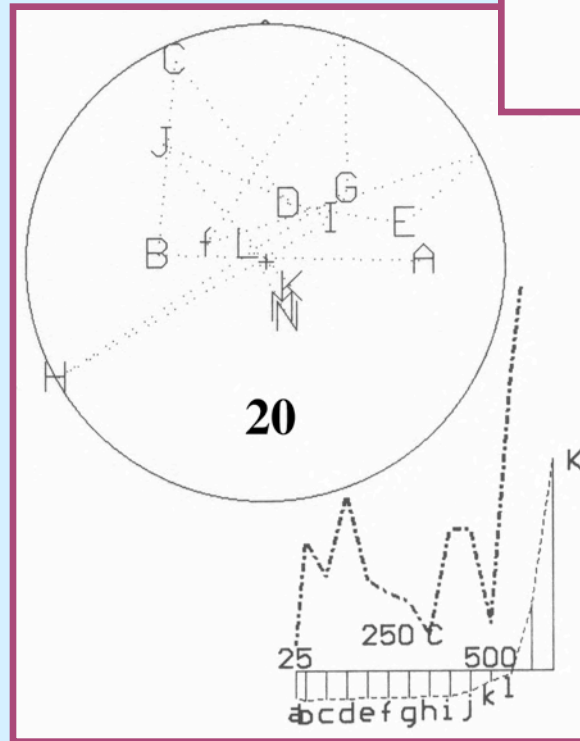
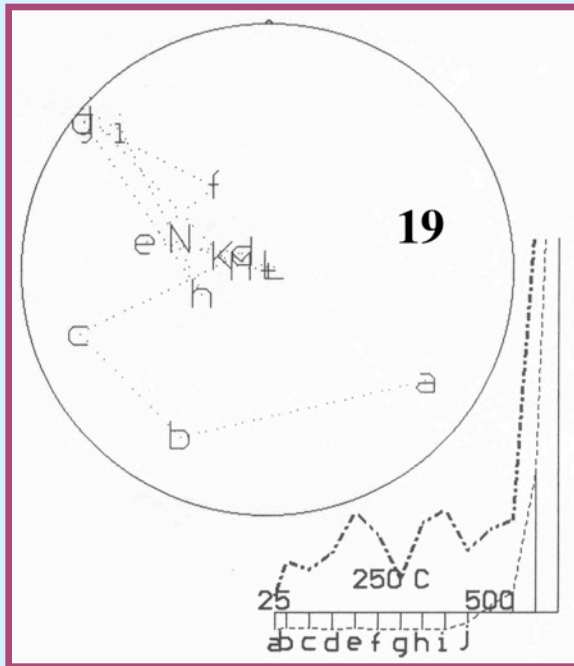
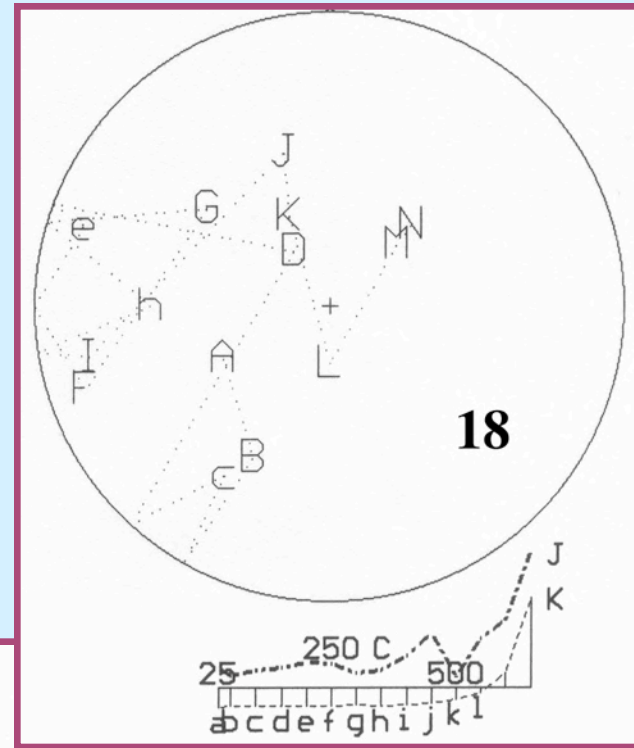
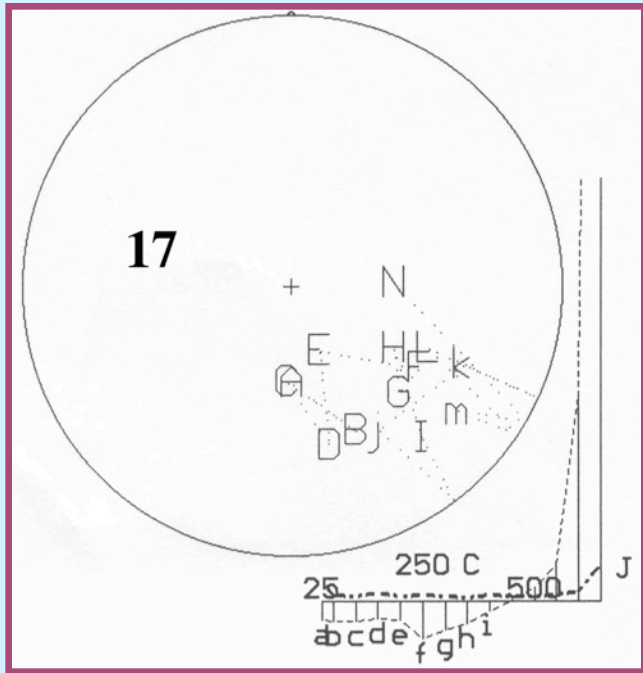


Helwan quarry

Thermal demagnetization

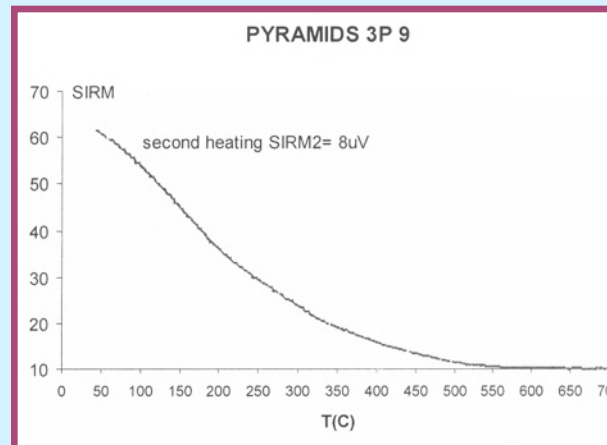
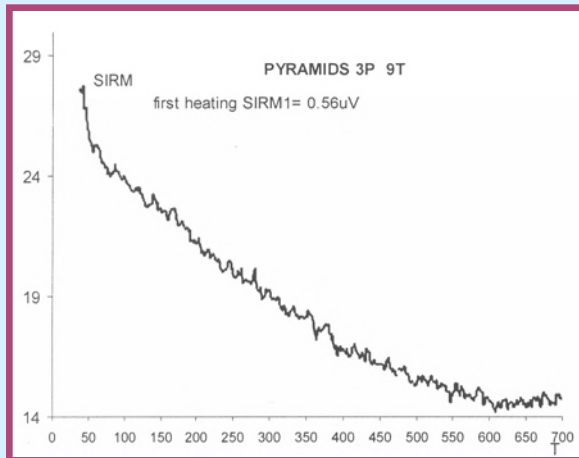
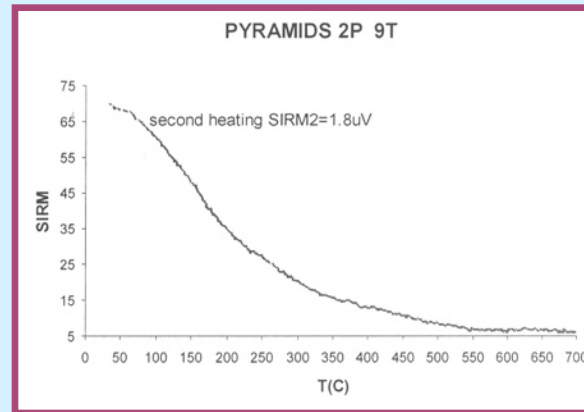
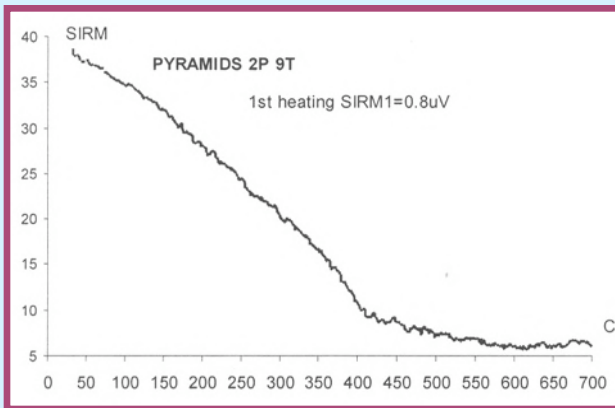
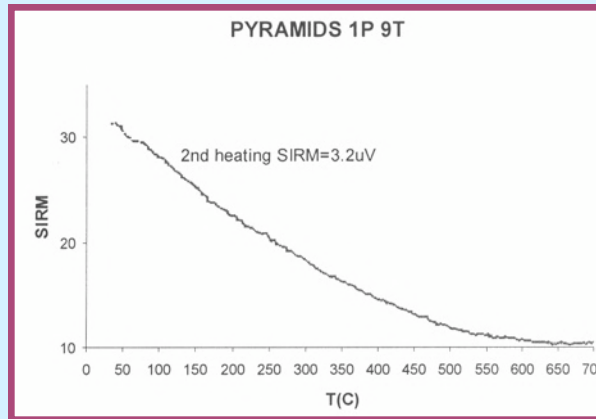
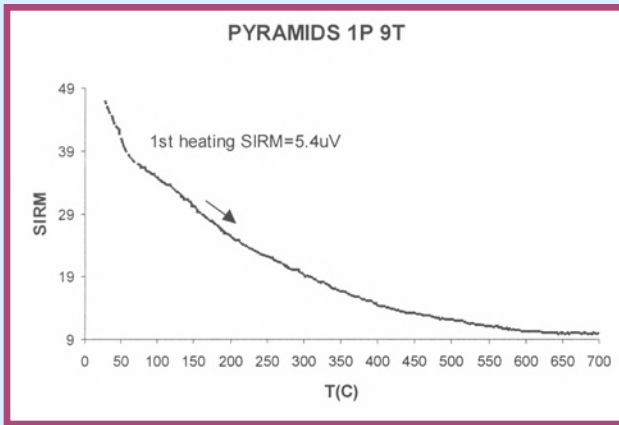
J – magnetization

K – susceptibility



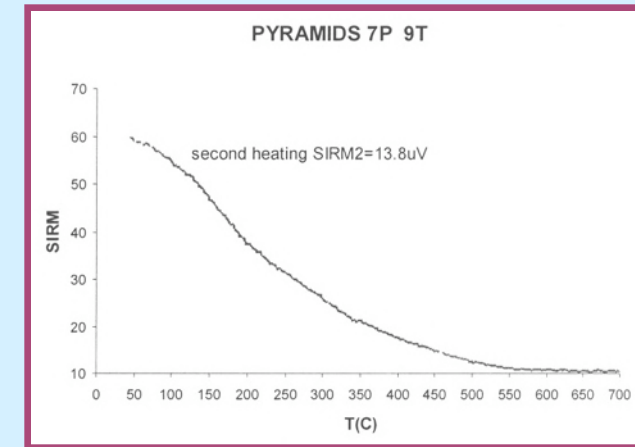
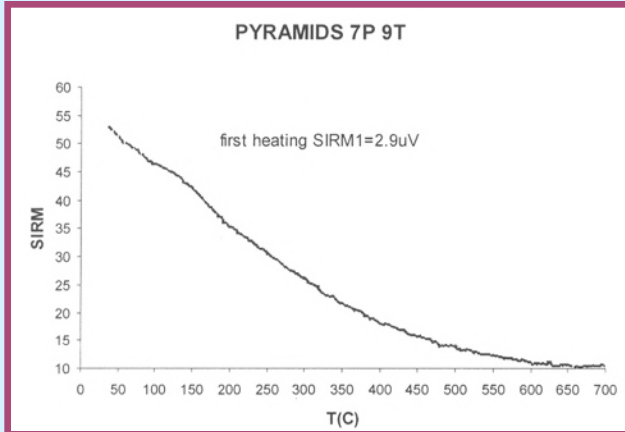
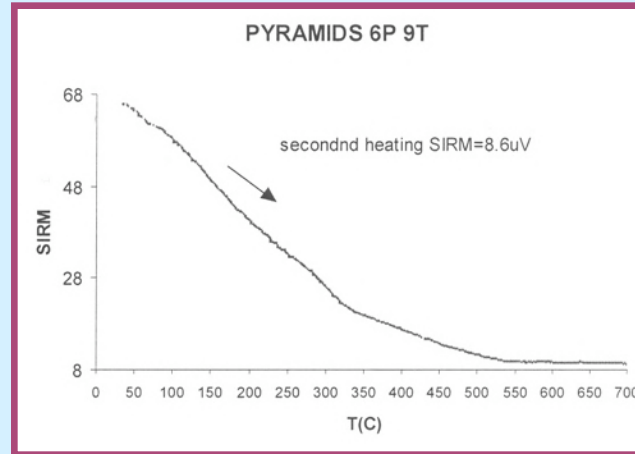
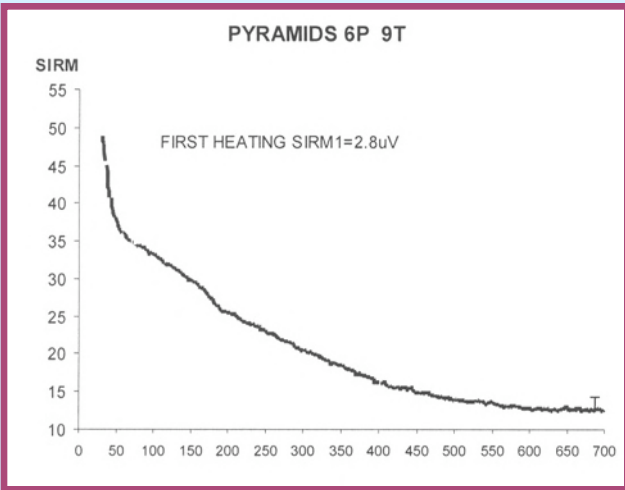
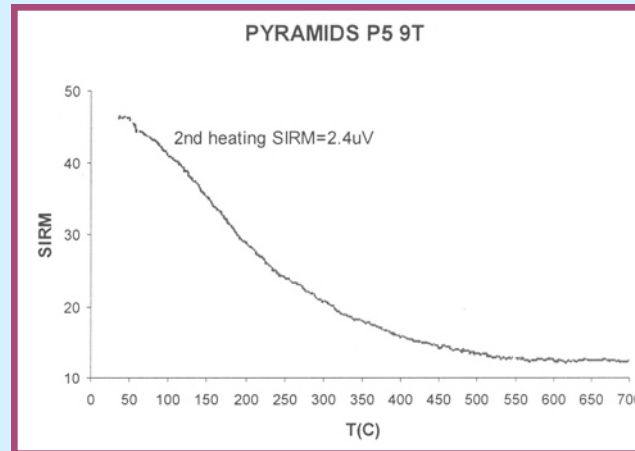
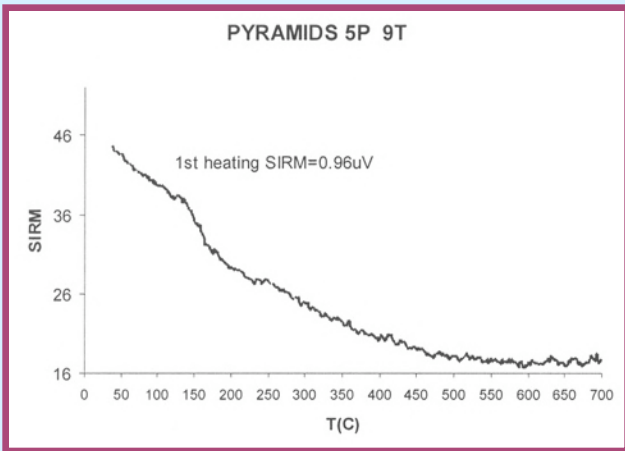
Khafre

Thermal demagnetization of saturated magnetization



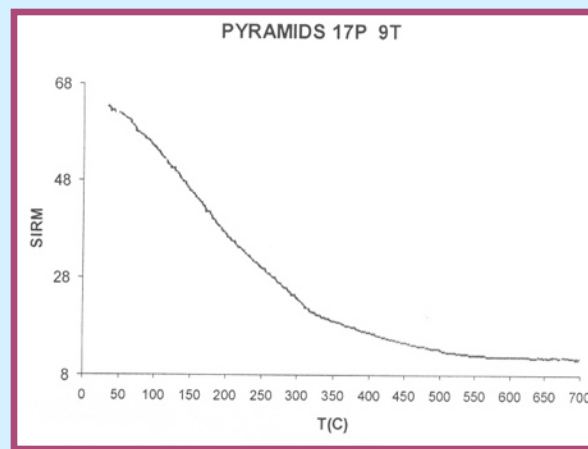
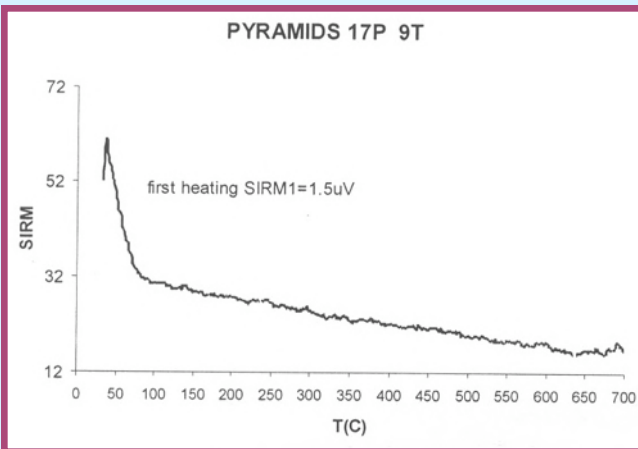
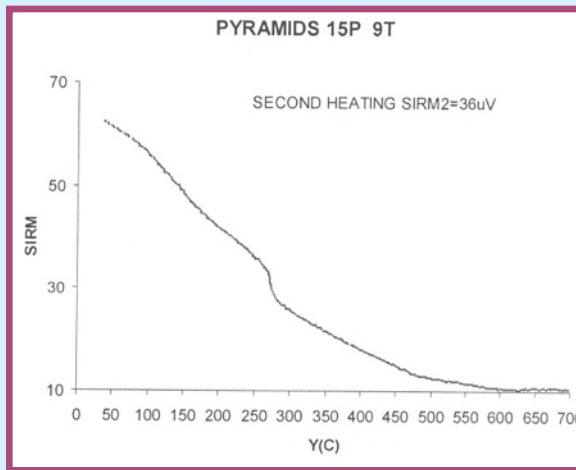
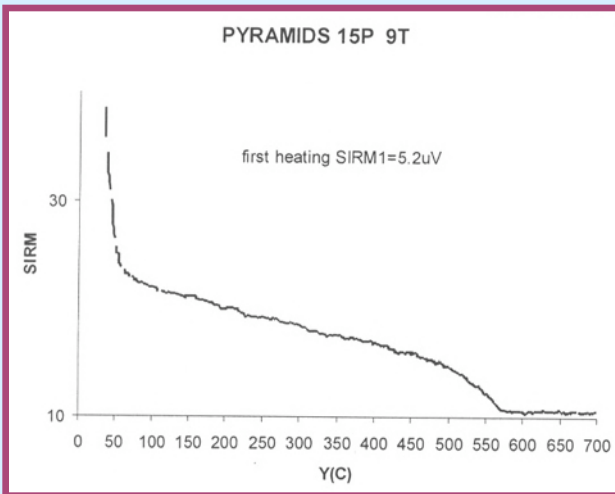
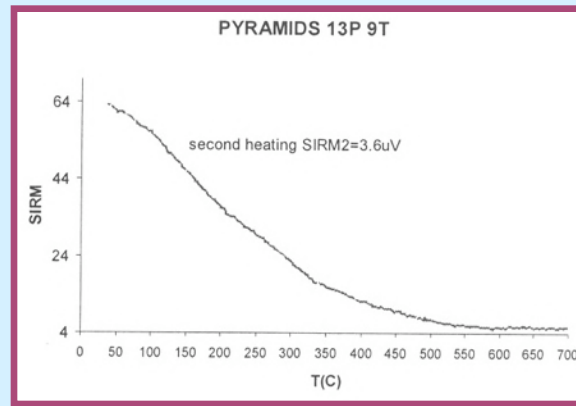
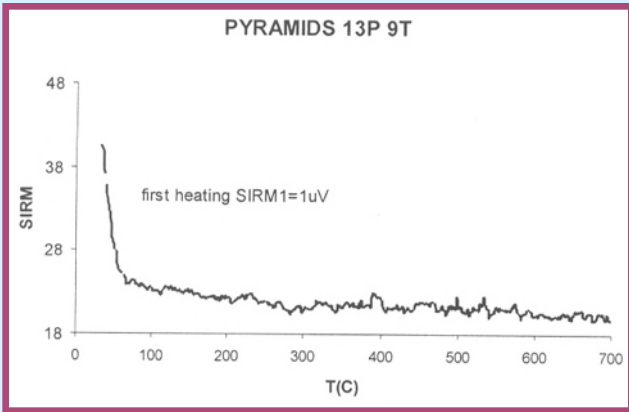
Khufu

Thermal demagnetization of saturated magnetization



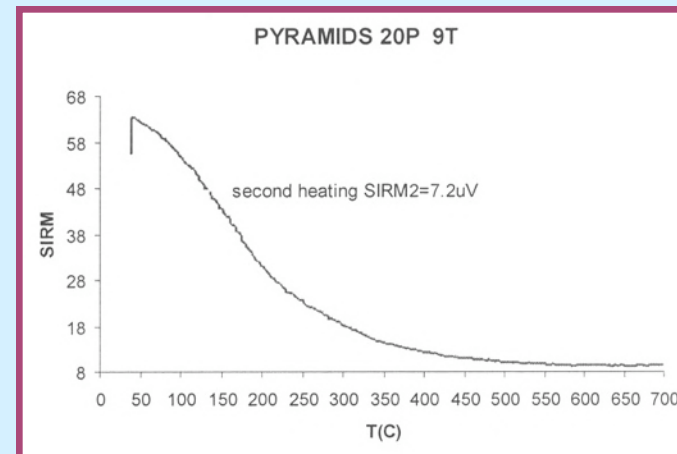
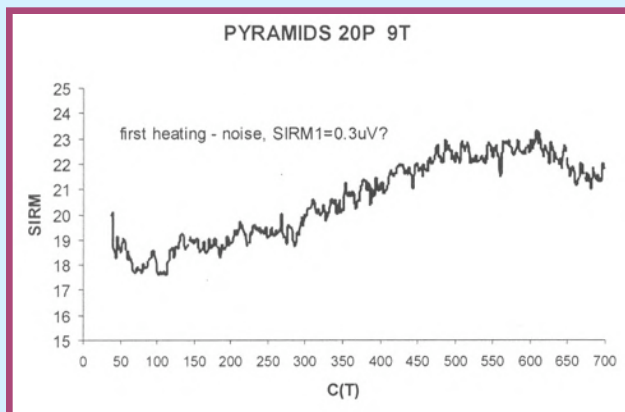
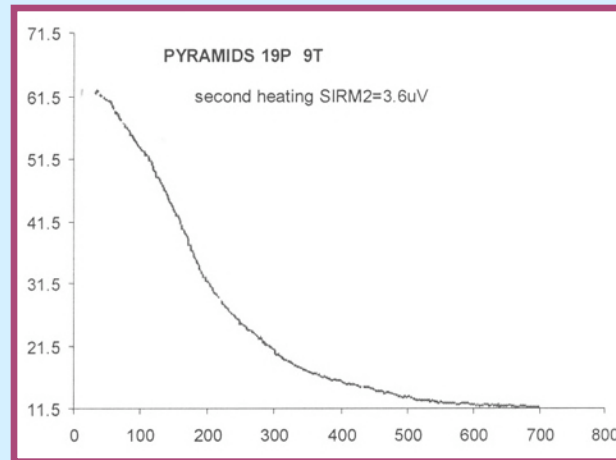
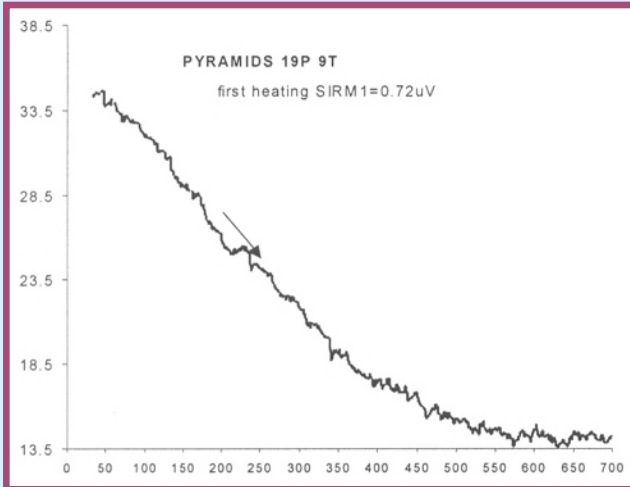
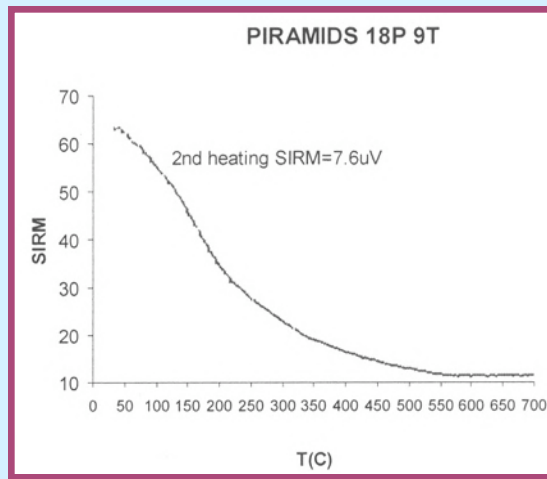
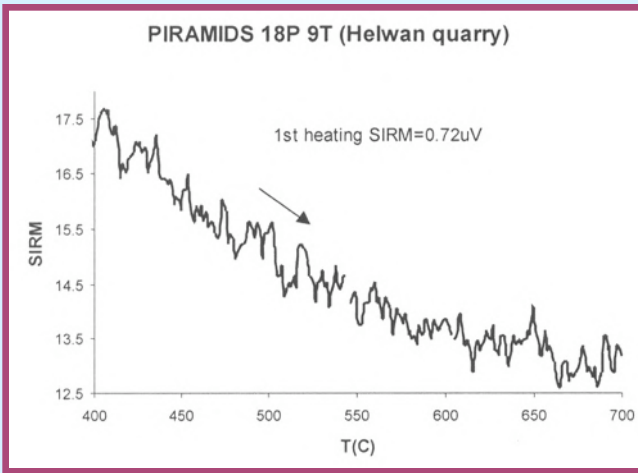
Moqatom quarry

Thermal
demagnetization of
saturated
magnetization



Helwan quarry

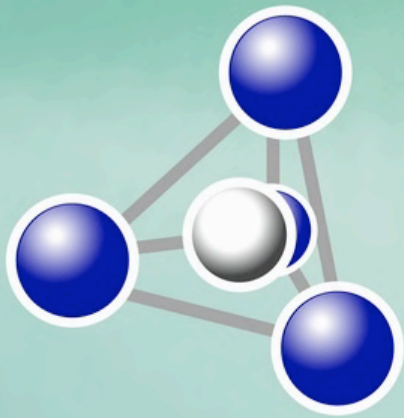
Thermal demagnetization of saturated magnetization



Conclusion

- The results of this project have proved the usefulness of paleomagnetic methods.
- Magnetic analyses suggest the possibility that the pyramids may contain both natural and man-made blocks.

Comments



INSTITUT

GÉOPOLYMÈRE

Frédéric Davidovits, Ph. D.

www.geopolymer.org

THANKS FOR THE



INFO

Relevance of the study

- Paleomagnetism presents evidence for artificial limestone blocks;
- It has been successfully tested for discriminating artificial and natural stones
- It could provide datation for stones or concrete !
- The study needs more samples to improve the methodology.

Thank You

References

- R. Butler, *Paleomagnetism: Magnetic Domains to Geologic Terranes*, Blackwell Scientific Publications, 1992.
- G. Demortier, « Revisiting the construction of the Egyptian pyramids », *Europhysics News*, Volume 40, Number 1, January-February 2009.
- M.W. McElhinny, P.L. McFadden, *Paleomagnetism*, Academic Press, London, p. 385.
- Igor Túnyi, I. El-hemaly, « Paleomagnetic investigation of the great egyptian pyramids », *Europhysics News*, Volume 43, Number 6, November-December 2012.