

SURFACE TOPOGRAPHY OF GLAUCONITE GRAINS: A PRELIMINARY INTERFEROMETRY STUDY

POP, D.^{1*}, LUTTGE, A.^{2,3}, FISCHER, C.⁴ & ARVIDSON, R.S.²

¹ Museum of Mineralogy, Babeş-Bolyai University; Kogălniceanu St. 1, Cluj-Napoca, Romania

² Department of Earth Sciences, Rice University; Main Street 6100, Houston, USA

³ Department of Chemistry, Rice University; Main Street 6100, Houston, USA

⁴ Geowissenschaftliches Zentrum, Georg-August-Universität; Goldschmidtstr. 3, Göttingen, Germany

* E-mail: dana.pop@ubbcluj.ro

Glauconite is an iron-rich, mica-type clay-sized mineral that forms as a rule in marine environments *via* successive diagenetic processes. It is commonly accepted that one prerequisite factor in glauconite genesis is the existence of a mineral or organic precursor, as microenvironment for the essential chemical exchanges (*e.g.*, ODIN, 1988). The typical granular or globular/pelletal shape of glauconite microcrystalline aggregates is considered to reflect the precursor's outline, at least up to a certain stage in the formation. Based on these constraints, morphological classifications of glauconite (*e.g.*, TRIPLEHORN, 1966) have distinguished diverse grain types such as faecal pellets, fossil casts, macrofossil debris, mineral/rock clasts, volcanic glass shards (based on the precursor type), or "cauliflower", "en accordion"/vermicular, fragmentary, spongy, film/pellicle (based on the grain's final shape). Glauconite grains may also undergo multiple stages of transport and deposition, and thus their morphology at macroscopic and microscopic scales may record complex changes in their environment. Finally, the surface topography of glauconite grains may also reflect mechanical and chemical damage introduced by common methods of sample concentration and preparation, *e.g.*, centrifugation or acid leaching.

The purpose of our study is to understand how the surface topography of a glauconite grain relates to the nature of its precursor and its subsequent history of diagenesis and transport. We have thus used vertical scanning interferometry (VSI) to study glauconite grains sampled from the Transylvanian Depression (Romania), representing diverse depositional environments ranging in age from Cretaceous to Miocene. The mineralogical and geological features of these materials have already been characterized in detail (POP & BEDELEAN, 1996).

Interferometry quantitatively provides surface heights (z) with very high, near atomic scale vertical resolution and a wide vertical scan range from ~100 μm down to ~2 nm. The typical lateral (x , y) resolution ranges from 0.15 to 1.5 μm , depending mainly on the numerical aperture of the applied Mirau objective (LUTTGE & ARVIDSON, 2010). VSI's large scan range permits the study of materials whose high surface roughness ($\gg 1 \mu\text{m}$) would preclude analysis by atomic

force microscopy (AFM). Interferometry data consist of detailed digital surface maps of grain topography. These data permit compact surface characterization by calculation of, *e.g.*, heights' frequency distribution and of several surface roughness parameters. The latter can be used for defining surface building blocks characterized by specific wavelengths and heights (FISCHER *et al.*, 2008).

We have used two VSI instruments with different analytical configurations that allowed taking measurements at both large (overall grain-wise) and small (grain surface-wise) scales. In order to provide comparable data, we have selected for detailed analysis two fixed sizes for the fields of view: 20 x 20 μm (160x magnification) and 50 x 50 μm (50x magnification). Based on synthetic histograms, the typical glauconitic topographic "leitmotifs" have heights (z , in μm) of: 2.6, 1.6 (± 1.1), 0.2, -0.2, -0.7 and -2.6; the maximum frequency corresponds to the 0.2 μm "hill". Among basic building blocks, negative topographic features ("valleys") are less frequent; they were better visualized by using the 50x objective. The grains having supposed faecal pellet precursors show the smoothest surfaces with the smallest z variation interval: 4 to -1 μm . Bioclasts generate more diverse grain topographies, with z ranging from 4 to -3 μm . "Vermicular" grains show strongly asymmetric, narrow histograms with z varying from 7 to -2 μm , probably reflecting the more complex topography of their supposed mica precursors. These preliminary data suggest that predictable relationships exist between the surface morphology and roughness of glauconite grains and the identity of their precursors.

References

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