Analysis of Kaba using Computed Tomography and 3D Laser Imaging Techniques

Péter Rózsa[1], József Kollár[1], Gábor Mihály Endes[1], Mihály Nagy[2], Árpád Csámer[1], József Vanyó[3], Zsolt Zelei Gábor[1], Arnold Gucsik[3]

[1]*University of Debrecen, Debrecen, Hungary*

[2]*Debrecen Reformed College, Hungary*

[3]*Eszterházy Károly University, Eger, Hungary*

Density is one of the most fundamental features of solid materials. For Kaba meteorite, different values of bulk and grain density have been published e (Sztrókay et al. 1961, Terho et al. 1993, Britt and Consolmagno 2003). To determine volumetric mass density of Kaba meterorite a 3D model compiled by 3D laser imaging technique and produced by 3D printing was used; the inner structure and pattern of distribution of relative density values was studied by using Computed Tomography (CT) technique.

Volume of the 3D model of the meteorite was determined by the classic Archimedean method. To study the interior of Kaba meteorite a General Electric Lightspeed VCT 64-slice CT scanner was used. During the analysis tube voltage of 120kV was used, and the slice thickness was 0.6 mm. Centricity PACS-IW workspace was used for data processing and image evaluation. The relative density values measured by the CT instrument are in Hunsfield Units (HU).

On the basis of the volume of the 3D model (956.0 cm^3) and mass of the meteorite (2579 g), volume mass density of Kaba meteorite proved to be 2.697 g/cm^3, which is in good agreement with the data published by Terho et al. (1993) (2.69 g/cm^3). Based on grain density value of 3.40 g/cm^3 published by Britt and Consolmagno (2003), the estimated porosity is 20.9 %, which corresponds to porosity value characteristic for "oxidized" subgroup of carbonaceous chondrites (Krot et al. 1995). The CT images suggest zonal pattern of radiodensity values, i.e., beneath the fusion crust further zones can be distinguished. In our opinion, the zonal pattern detected CT analysis was formed after the formation of the meteorite but before its impact event; moreover, it can be in a connection with migration of organic material content of the carbonaceous chondrite. Supposing more or less homogeneous initial carbonaceous material distribution, the revealed density distribution pattern suggests that the original average organic matter content of Kaba meteorite is mostly represented by the organic matter content of the inner part (core).

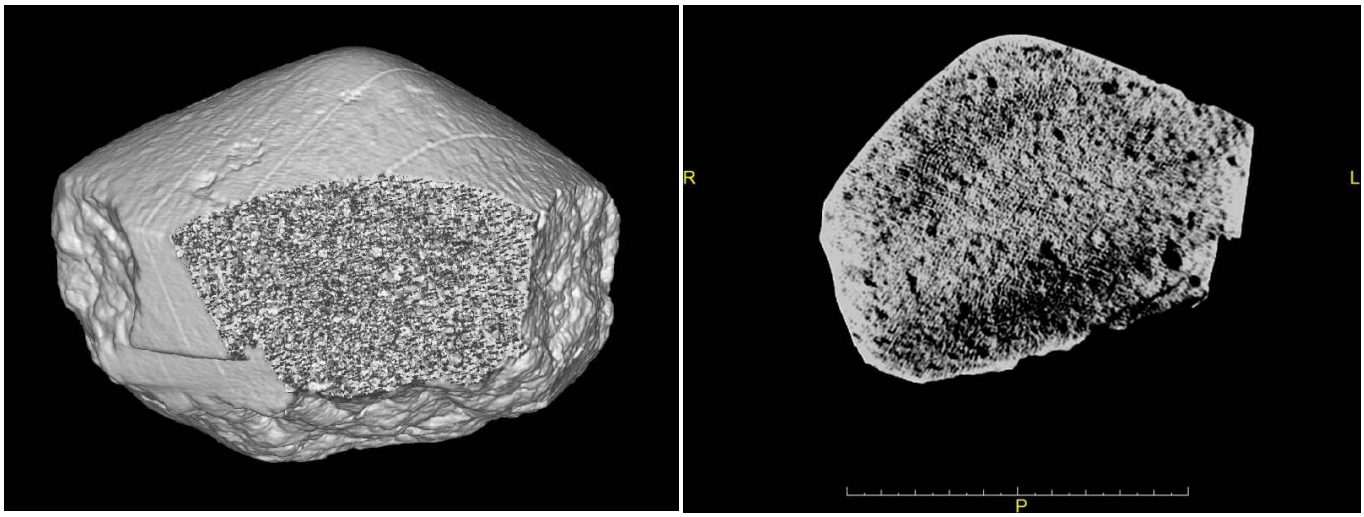

Figure 1. CT images of Kaba. Spherical distribution of radiodensity values clearly visible on the right CT image

References

Britt, D.T. and G.J. Consolmagno, Stony meteorite porosities and densities: a review of the data through 2001, Meteoritics and Planetary Science, 380(8), 1161-1180, 2003.

Krot A. N. and E. R. D. Scott and M. Zolensky, Mineralogical and chemical modification of components in CV3 chondrites: Nebular or asteroidal processing?, Meteoritics and Planetary Science, 30, 748–775, 1995.

Sztrókay, K.I. and V. Tolnay, and M. Földvári-Vogl, The Kaba meteorite, Bulletin of Hungarian Geological Society, 91(2),186-213, 1961.

Terho, M., L.J. Pesonen, I.T. Kukkonen and M. Bukovanská, The petrophysical classification of meteorites, Studia Geophysica et Geodetica, 37, 65–82, 1993.