A review of a carbonaceous chondrite: what can we learn from the Kaba meteorite?

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The most famous meteorite of Hungary is Kaba, which fell at night on April 15, 1857, in the vicinity of Kaba village, East Hungary. The reputation making Kaba known all around the world is thanks to its chemical composition: namely, that was the first case when organic material has been detected in a geological sample with an extraterrestrial origin. The intact and aerodynamically oriented fusion crust covered cone shape also may have contributed to its fame.

The chondritic texture was recognized very early by József Török, a professor of the Debrecen Reformed College. Friedrich Wöhler, Ordinary Professor of Chemistry at the University of Göttingen, was the first who analyzed the chemical composition of Kaba in 1858 and found organic matter in a meteorite. Wöhler, who earlier refuted the vitalism theory, stated that the organic substance in the Kaba can be produced by living organisms (Nagy 2007). Later Sztrókay et al. (1961) examined the chemical and mineralogical composition in detail and clarified the abundance of the major elements, the petrographic features and the approximate composition of hydrocarbon compounds.

The Kaba belongs to the oxidized subgroup of the CV3 carbonaceous chondrite class (McSween 1977, Peck 1984). The lithological diversity of Kaba is obvious. Though the ratio of the main petrographic components may vary by various authors indicating the variety in the texture and mineralogy, we can conclude that the total volume of chondrules consisting of olivine and pyroxenes in various size and types, is ~30 %. The amount of olivine-rich inclusions is ~2 % (in volume), while the amount of Ca-Al-rich inclusions is 3 % (in volume). In addition, small (below 20 μm) mineral fragments (olivine (Fa10-90), feldspar, enstatite, hedenbergite, diopside, andradite) in a hydrocarbon-impregnated, phyllosilicate-bearing fine-grained opaque matrix (~55-69 % of total volume) also can be found (Sztrókay et al. 1961, Gucsik et al. 2013). Despite the effects of high-temperature hydrothermal and aqueous alterations the Kaba can be regarded as the least metamorphosed one within the CV3 carbonaceous chondrite group.

The main body of Kaba has been kept in the Debrecen Reformed College, and only small fragments can be found in certain foreign collections. To obtain a sample from the bulk for scientific research is very difficult because generally it is allowed to cut a slice from the bulk only every twenty years. Nevertheless, during the last hundred years, more than one hundred scientific papers have been published about Kaba, especially in the topic of the mineralogical, physical and chemical properties of the meteorite including the compositional analysis of the bulk or certain components (i.e. chondrules, AOAs, CAIs, matrix). The aim of this presentation is to give a summary of what we have learned from the Kaba in the past hundred years and to draw the attention to the unanswered question with regard to its origin, evolution, alteration and the circumstances of falling.

References

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