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# Organics in a Comet's Covering

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## Abstract

The assumption that the comet's dust covering contains an ample quantity of refractory organics is discussed. This assumption is based on isotope distribution in peat deposits at the epicenter of the Tunguska Disaster. The investigation of $^{14}C$, $^{13}C$ and D showed that the Tunguska cosmic body carried organic components to the ground. We came to the conclusion that organics of the Tunguska cosmic body were either solid or sufficiently viscous at temperatures on Earth.

## 1. Introduction

It is well known that nuclei of "old" comets are covered by a refractory screen which could protect ice against warming even during a comet's crossing of the solar corona. Investigations of comet Halley, for example, showed that (i) the comet has a very low geometrical albedo; (ii) the temperature of the nucleus at a distance of ~0.8 AU is 300–400 K, which considerably higher than predicted (180–200 K). Based on these facts, it was concluded that the surface of the nucleus is covered by a thin insulating layer of a black, porous, refractory substance [1].

The Tunguska disaster (TD) provides a unique opportunity to investigate the characteristics of this refractory layer. Since $10^{10}$ kg of water vapor was added to the earth's atmosphere during the TD, we consider the Tunguska cosmic body (TCB) to have been a comet [2].

## 2. Organic component of the TCB

It is necessary to remark that the surface of up-river peat is a unique natural "archive" of matter that falls from the atmosphere. The water-mineral food of moss in peat bogs is exceptionally supplied by aerosols, and that is why the chemical composition and pollution of subsoil waters do not influence the moss food. Moreover, peat sediments make possible an exact reading of the peat level, which in 1908 was the surface of the moss sod and where fallen matter was accumulated, especially since the level of the peat sediment of 1908 in the epicenter was well-stratified by increased ashing due to the total burn of the moss.

L'vov discovered that peat strata that correspond to the period of the TD contain "ancient" carbon (depleted $^{14}C$) in a fair quantity. In addition to the "ancient" carbon, isotopic analyses of peat sediments showed that peat levels located at a short distance from the time of the TD are characterized by an anomalous variation of quantities of both $^{13}C$ and D, enrichment in the isotopic composition of carbon, and depletion in deuterium [3, 4]. The depletion in radiocarbon ($^{14}C$) and enrichment in the Ir (iridium) in peat sediments corresponding to the time of the disaster (radiocarbon and Ir are two independent indicators of extraterrestrial material.) was confirmed by Rasmussen et al [5]. Moreover, in these sediments there were found anomalies of elements of the platinum group and rare-earth elements, which also are indicators of extraterrestrial material. Therefore, we can conclude that material of the TCB reached the Earth's surface near the epicenter, and it was a comet substance.

The fact that the TCB's substance reached ground and was deposited there means that this comet substance contains a part of more complicated compounds than $CO_2$, $CH_4$, or CO, gases under conditions of Earth. Comparing the allocation of aforesaid isotopic and elements anomalies with the nitrogen anomalies, we find an essential difference. The maximum of the nitrogen isotope variation falls on the permafrost boundary of 1908 [6]. In summer 1908 the permafrost level was at a depth of ~ 0.5 m. Nitrogen oxides were presumably washed out of the atmosphere by rain and, taking into account the porosity of peat, flowed down with rainwater to the permafrost level. Therefore, we can state that the TCB's material, comet fragments of which left traces on surface sediments in 1908, was either solid or sufficiently viscous at temperatures on Earth.

It is noteworthy that $^{13}C$ concentrations exceed the background level in the peat sediments are located in the higher "catastrophe" levels and in the underlying strata. In the underlying strata, $^{13}C$ was brought either under the influence of shock waves of explosions or as a result of the partial washing of the substance. However, in the overlying deposits carbon came as a result of assimilation by plants. The conclusion is that the comet organics were consumed by plants based on the following. Peat samples containing heavy carbon were processed by a benzol-methanol mixture within 24 hours to remove any soluble compounds (tar, rosin, lipids…). As a result, the isotopic composition of the sample became heavier, and therefore, heavy carbon was located in the cellulose molecules. The peat stratum where isotopic variations were found is asserted to have grown >13 years [3]. Thus, we came to the conclusion that during these years organic substances of the comet body gradually oxidised under the influence of bacteria and solar/earth radiation. The organic components of this comet substance broke down into $CO_2$ and $H_2O$ and were further assimilated by growing moss.

Therefore, we came to the conclusion that fragments of the TCB (as comet) reached the swamp surface, and we can affirm that comet substance carried interplanetary organic material to the Earth's surface [7].

## 3. Explosions of comets

I was assumed that explosions of comets could be explained by air-tight coverings and sublimation of water [8]. A large surface for sublimation is provided with a porous structure of a nucleus. The explosion could be explained by radiation energy $E_{ch}$, which was accumulated during a characteristic time $t_{ch}$ before the explosion. The calculation of the explosion was made with $E_{ch}=10^{21}$ erg for a comet having a radius of nucleus ~1 km and located at a distance of ~ 2 AU, where solar radiation ~$10^6$ erg/s [9]. It was found that $t_{ch}$ ~ 120 days. As result of the explosion with $E_{ch}$, matter having a mass ~5 $10^8$ kg will be thrown out of the nucleus with a speed of ~0.8 km/s.

Only organics could explain the air-tight behavior of the comet's coverings. The Deep Impact space mission shows that the nuclei of comets contain polycyclic aromatic hydrocarbons. It is very likely that the comet's covering is formed mainly from polycyclic hydrocarbon according to the picture of evolution proto-solar nebula from [10].

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