Tunguska catastrophe: Evidence of acid rain supports meteorite theory

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Evgeniy Kolesnikov photographed the same place 60 years later. The fallen trunks are still there, with the taiga growing in between them. Photo: Evgeniy M. Kolesnikov, Lomonosov Moscow State University

(PhysOrg.com) -- The Tunguska catastrophe in 1908 evidently led to high levels of acid rain. This is the conclusion reached by Russian, Italian and German researchers based on the results of analyses of peat profiles taken from the disaster region.

In peat samples corresponded to 1908 permafrost boundary they found significantly higher levels of the heavy nitrogen and carbon isotopes 15N and 13C. The highest accumulation levels were measured in the areas at the epicentre of the explosion and along the trajectory of the cosmic body.

Increased concentrations of iridium and nitrogen in the relevant peat layers support the theory that the isotope effects discovered are a consequence of the Tunguska catastrophe and are partly of cosmic origin. It is estimated that around 200,000 tons of nitrogen rained down on the Tunguska region in Siberia at that time.

"Extremely high temperatures occurred as the meteorite entered the atmosphere, during which the oxygen in the atmosphere reacted with nitrogen causing a build up of nitrogen oxides," Natalia Kolesnikova told the Russian news agency RIA Novosti on last Monday. Mrs. Kolesnolova is one of the authors of a study by Lomonosov Moscow State University, the University of Bologna and the Helmholtz Centre for Environmental Research (UFZ), which was published in the journal Icarus in 2003.

The Tunguska event is regarded as one of the biggest natural disasters of modern times. On 30 June 1908 one or more explosions took place in the area close to the Tunguska River north of Lake Baikal. The explosion(s) flattened around 80 million trees over an area of more than 2000 square kilometres. The strength of the explosion is estimated to have been equivalent to between five and 30 megatons of TNT. That is more than a thousand times as powerful as the Hiroshima bomb. This almost unpopulated region of Siberia was first studied in 1927 by Professor Leonid A. Kulik.

There are a number of different theories about what caused the catastrophe. However, the majority of scientists assume that it was caused by a cosmic event, such as the impact of a meteorite, asteroid or comet. If it had exploded in the atmosphere just under five hours later, St. Petersburg, which was the capital of Russia at that time, would have been completely destroyed because of the Earth's rotation.

In two expeditions in 1998 and 1999, Russian and Italian researchers took peat profiles from various locations within the Siberian disaster area. The type of moss studied, Sphagnum fuscum, is very common in the peat material and obtains its mineral nutrients exclusively from atmospheric aerosols, which means that it can store terrestrial and extraterrestrial dust. Afterwards, the samples were analysed in laboratories at the University of Bologna and the Helmholtz Centre for Environmental Research (UFZ) in Halle/Saale.

Among other things, the UFZ specialises in isotope analyses of sediments, plants, soil and water and it was asked to help by the team of Moscow researchers led by Dr Evgeniy M. Kolesnikov. Kolesnikov, who has been investigating the Tunguska event for 20 years, has been to Leipzig University and UFZ twice as a guest researcher with the help of the German Research Foundation (DFG) to consult with the isotope experts.

"The levels of accumulation of the heavy carbon isotope 13C measured right on the 1908 permafrost boundary in several peat profiles from the disaster area cannot be explained by any terrestrial process. This suggests that the Tunguska catastrophe had a cosmic explanation and that we have found evidence of this material," explains Dr Tatjana Böttger of the UFZ. Possible causes would be a C-type asteroid like 253 Mathilde, or a comet like Borelly.

Citation: Evgeniy M. Kolesnikov et al. "Isotopic-geochemical study of nitrogen and carbon in peat from the Tunguska Cosmic Body explosion site". *Icarus* 161 (2): 235-243.

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