Magnetism of microspheres from the proposed Younger Dryas impact event 12,900 years ago.

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Introduction: This work refers to the Younger Dryas (YD), a period of global cooling 12,900 years ago that coincided with the extinction of many species of megafauna. There are several proposed causes for these events, one of which is the suspected collision of Earth with an extraterrestrial object, possibly a comet [1]. In the layers of sediment from this era, there have been worldwide discoveries of nanodiamonds, glass particles called scoria-like objects, and microscopic sphereules with an average diameter of ca. 135 micrometers, largely composed of oxides of Si, Al, and Fe. These spheres have been uncovered in 12,900-year-old layers on several continents indicating multiple impact sites. Some of these melted particles contain lechatelierite, which can form only at temperatures near 2000 degrees Celsius, similar to melted particles formed during nuclear weapons testing. Thus, the subsurface layers contain particles that have been subjected at that time to temperatures greater than 2000 degrees Celsius, far higher than produced by normal terrestrial processes.

Material: Sediment, which corresponds to the time period of this event, has been analyzed from two US sites, Gainey in Michigan, and Blackwater Draw in New Mexico [1]. Also, a complete sediment profile was collected in Europe from Svarcenberk Lake in the southern Czech Republic, where samples of this age were radiocarbon dated and investigated by environmental magnetism testing [3,4]. After the freezing of Svarcenberk Lake, 6m-long cores were extracted, from which 5-cm subsections were cut.

Magnetic susceptibility: The magnetic susceptibility data from these cores indicate an increase that we believe coincides with the Younger Dryas period at the depths between 4 and 5m. Extracted samples were subjected to the standard procedure for magnetic separation [5].

Lightning discharge: An alternate hypothesis to the comet collision theory is that microspherules could have formed through normal atmospheric lightning discharges that melted terrestrial sediment. If that is true, we realized that during such discharges, there is a corresponding generation of intense magnetic fields and after the rapid cooling of these spherical particles, high-magnetic characteristics should remain within these particles (Kletetschka, 2001; Kletetschka et al., 2003; Wasilewski and Kletetschka, 1999). Therefore, we focused on investigating the magnetic characteristics of the microspheres. In order to examine their natural magnetic state, non-magnetic separation techniques were utilized (heavy liquids), and after that, nonmagnetic, mechanical separation was performed using sieves of various sizes (100, 200, 325, 400 mesh; ~37, 44, 74, 149 micrometers, respectively). The separated material was then cleaned of excess clay using ultrasound techniques. Next, the separates were analyzed under an optical microscope, and when objects resembling spheres were identified, they were manually placed on glass plates. Finally, the spherules were examined using a scanning electron microscope.

Results: For Svarcenberk Lake, the increase in magnetic susceptibility indicates an increase in magnetizable Fe at the onset of the Younger Dryas, possibly due to the proposed impact. For the other two sites, we measured the amount of remanent magnetization in the microspheres by utilizing a magnetic scanner and a superconducting magnetometer. We found that there was no excess magnetization of the microspheres while residing in the Earth's geomagnetic field (50 microTesla). On the other hand, after being subjected to a powerful magnetic field (1 Tesla), they displayed substantial remanent magnetization. This finding is consistent with the hypothesis that the spherules formed during an extraterrestrial impact, and it refutes the hypothesis that these microspheres could have formed during lightning discharges.

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