Method for finding grains created by lightning discharge from the Younger Dryas Boundary layer,

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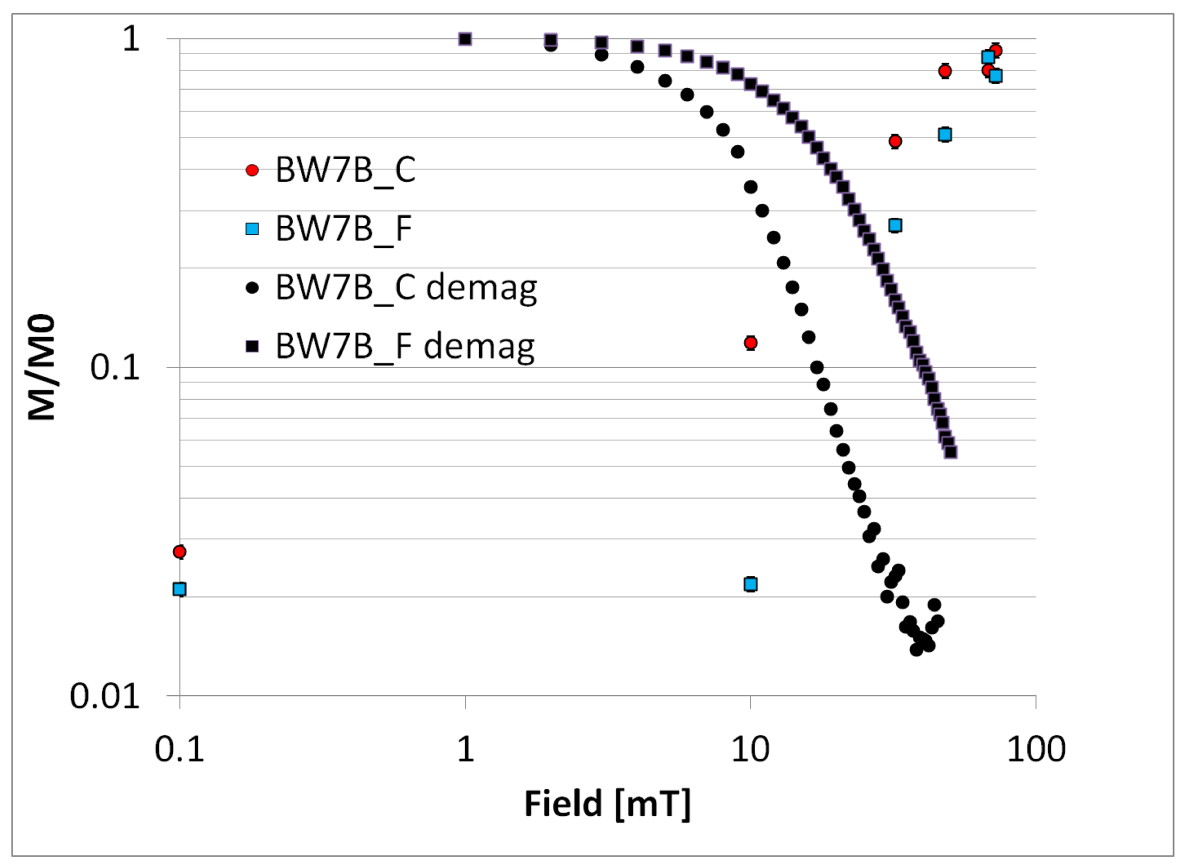
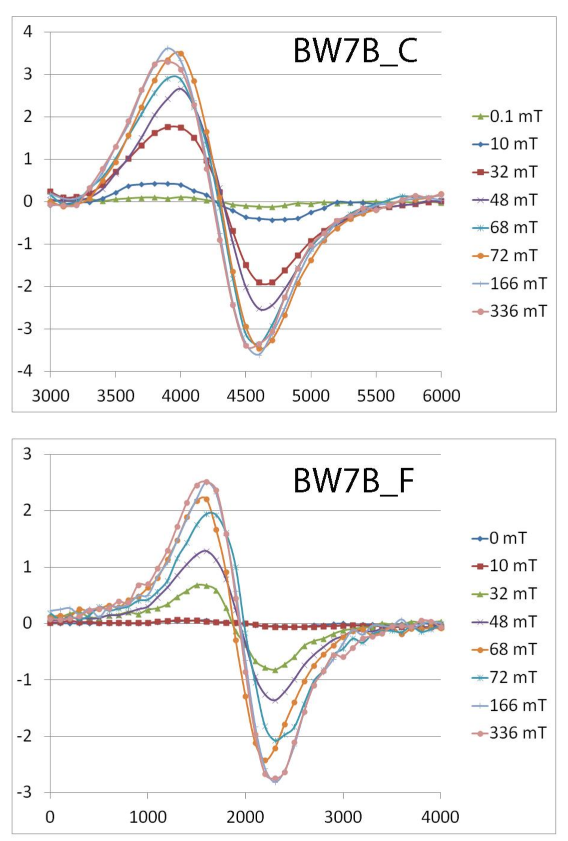
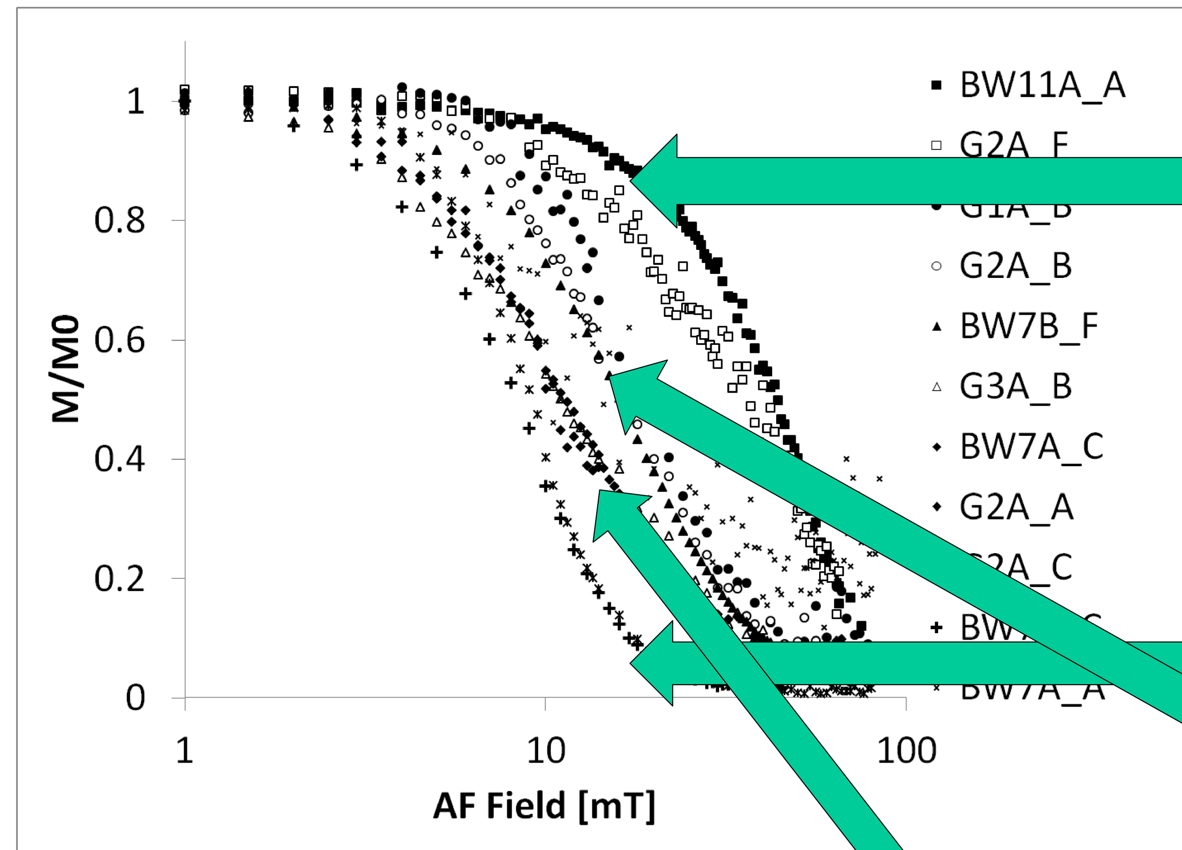
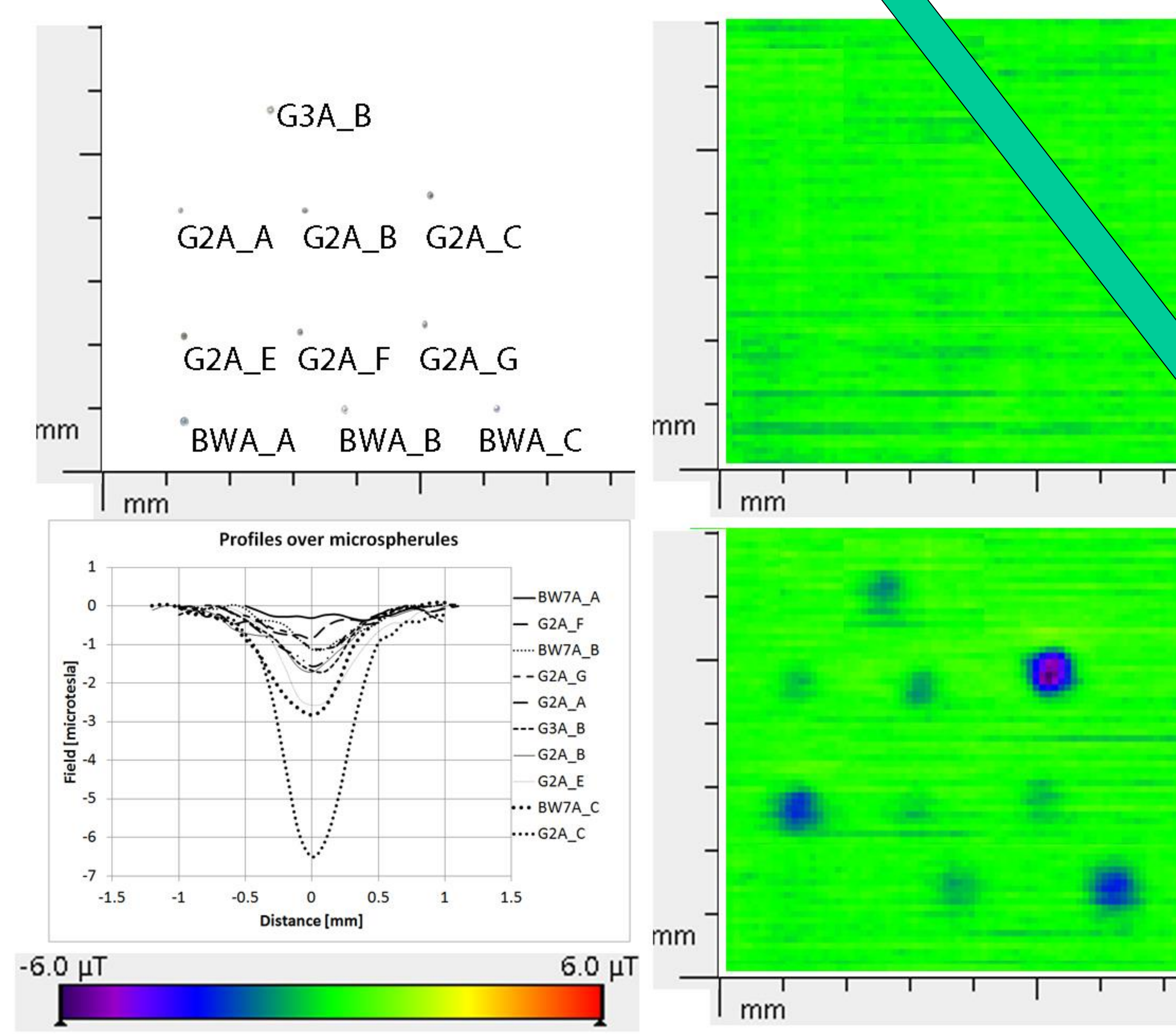
Megafauna extinction

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 (Bunch et al., 2012). In the layers of sediment from this era, there have been worldwide discoveries of nanodiamonds, glass particles, scoria-like objects, and microscopic spheres with an average diameter of ca. 50 micrometers, largely composed of Si, Fe and O. 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 found in areas of nuclear weapons testing. Thus, the subterranean layers contain particles that have been subjected at that point in time to temperatures greater than 2000 degrees Celsius, far higher than produced by normal terrestrial processes.

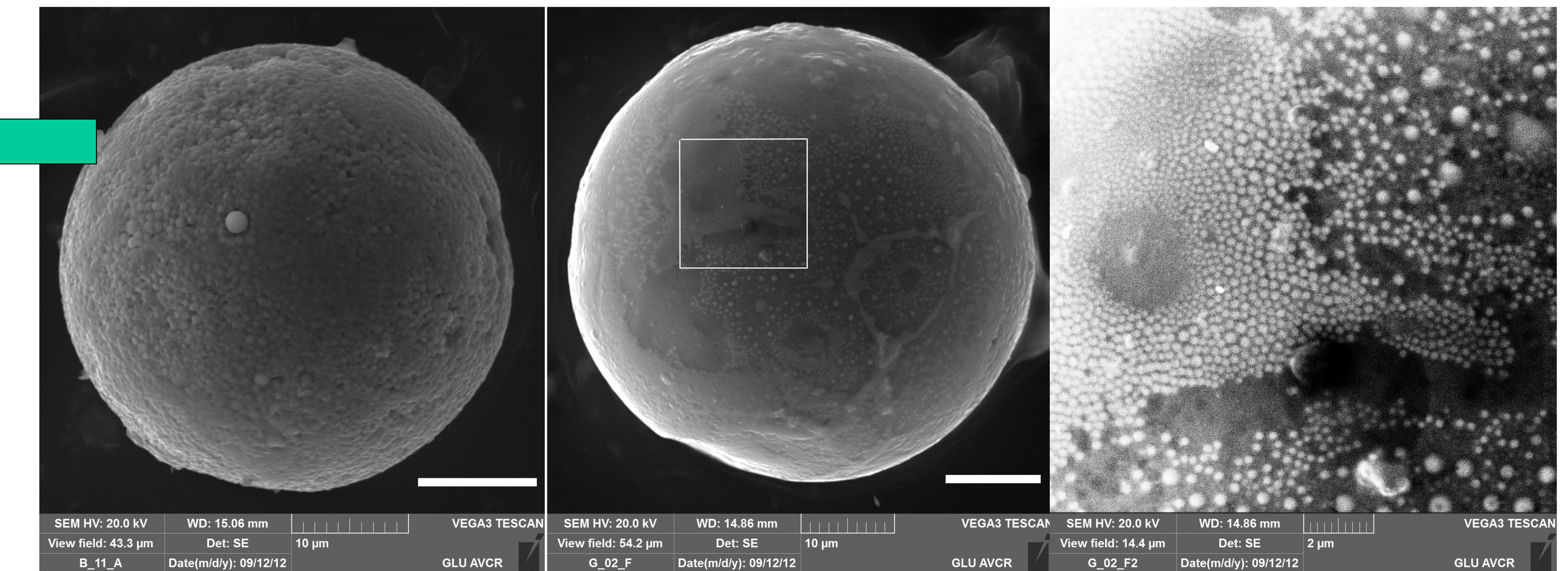




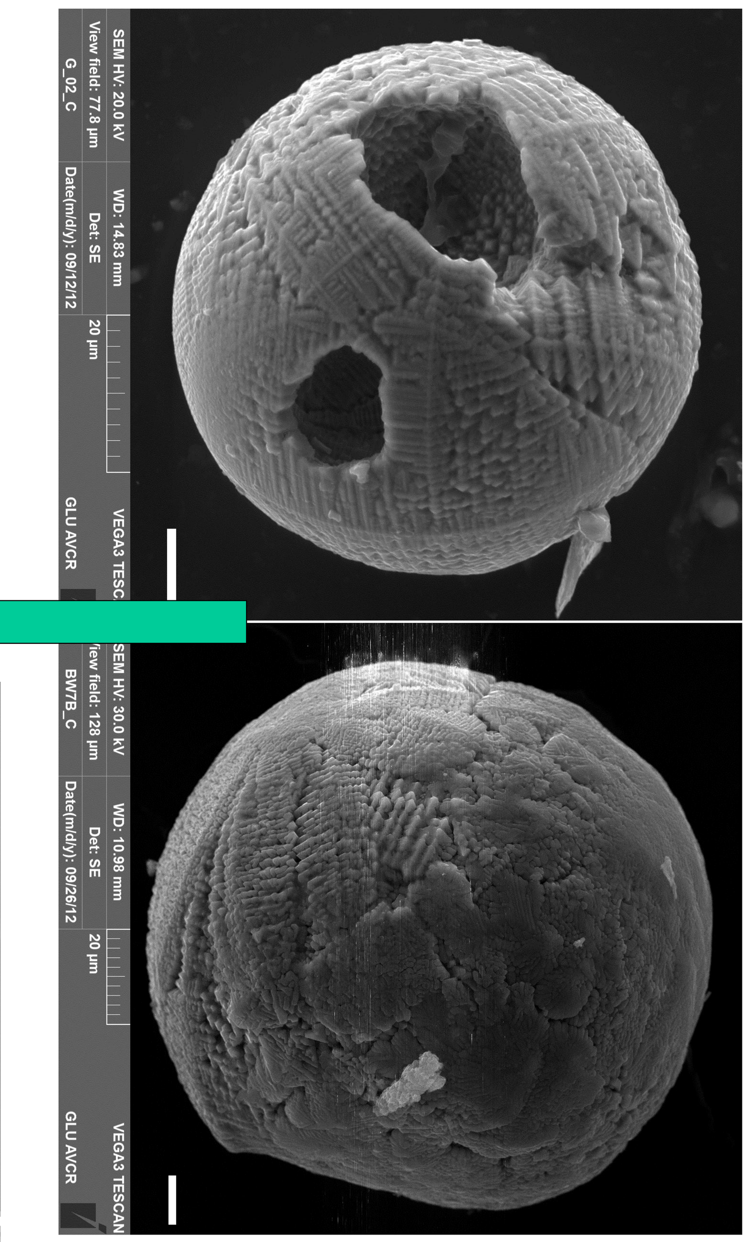


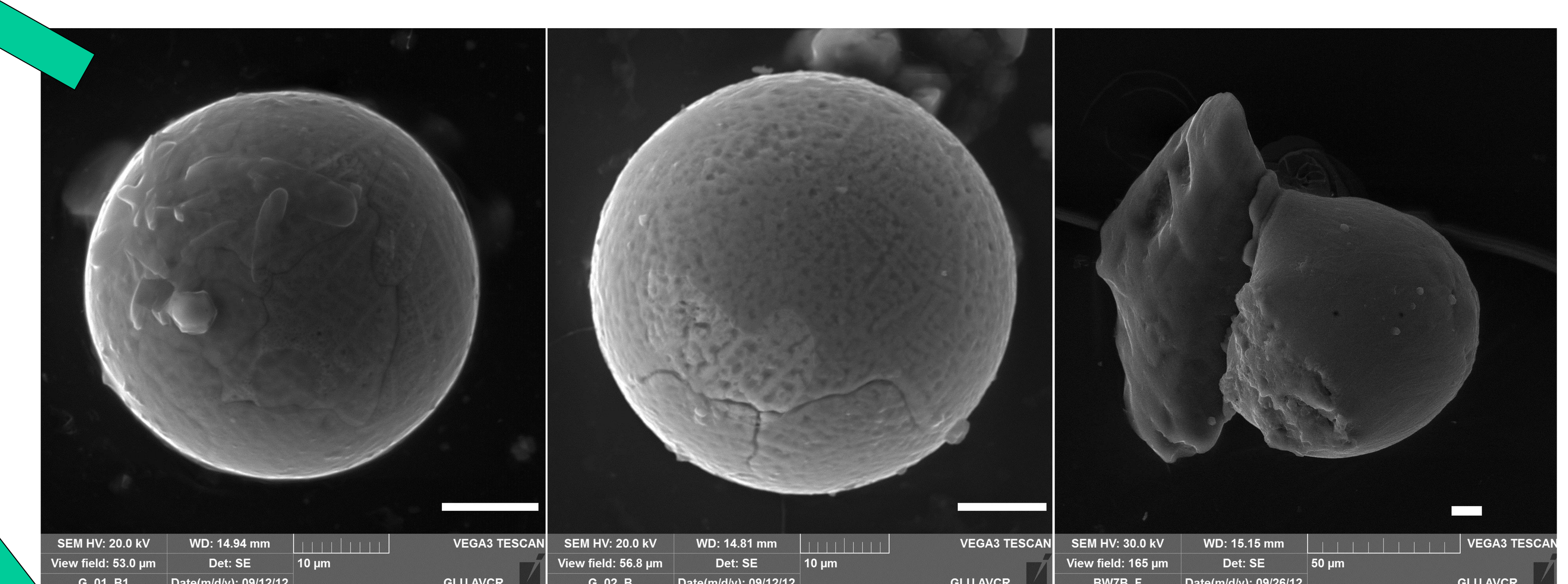


Magnetic analysis of Gainey and Blackwater Draw microspherules. A. Distribution of optical images of spherules' on the scanned substrate. B. Magnetic scan of the substrate in its natural state. C. Magnetic scan of the substrate after magnetizing it with the 1 T pulse field directed into the page. D. Magnetic profiles of each spherule in horizontal direction.

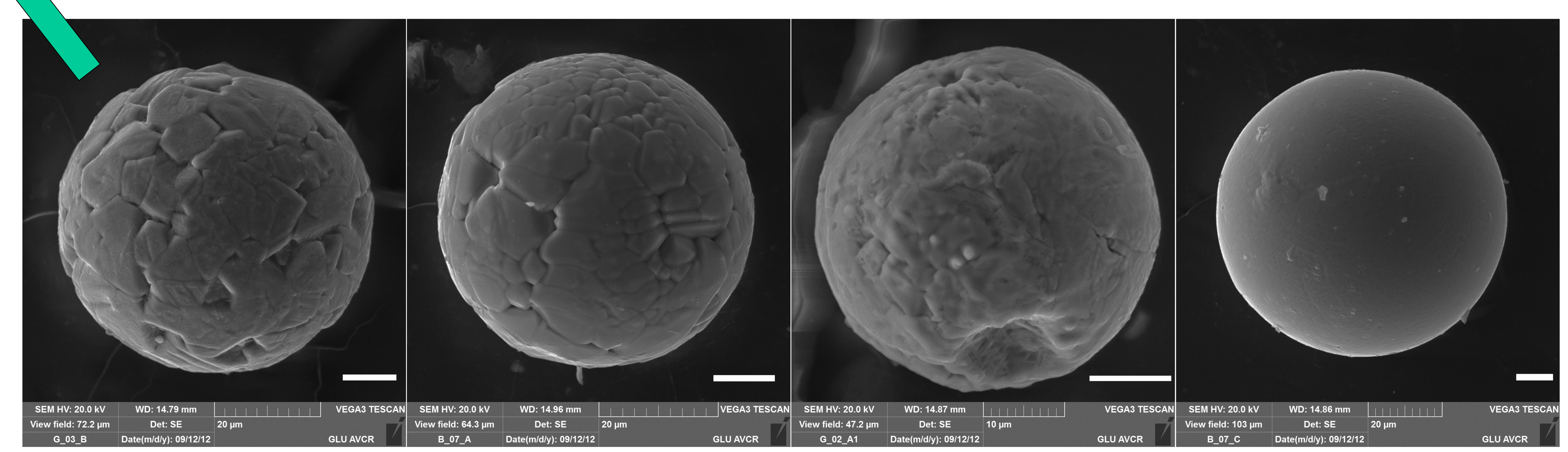


Blackwater draw spherule B11A_A (left) and Gainey spherule G2A_F (middle). The detail of the texture of G2A_F marked by the white square is shown on the right.





Gainey spherule G1A_B (left) and Gainey spherule G2A_B (middle). Blackwater draw is shown attached to the piece of silica rich fragment (right).



Material & Method

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 (Bunch et al., 2012). An alternate hypothesis to the comet collision theory is that microspherules could have formed through 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/Conclusions

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) in the laboratory, microspherules displayed substantial remanent magnetization, revealing their ability to become magnetized. This finding is consistent with the hypothesis that the spherules formed during an extraterrestrial impact, magnetized by an ambient geomagnetic field, and refutes the hypothesis that these microspheres could have formed during lightning discharges, which should have magnetized them towards saturation.

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Acknowledgements: We thank Jaroslav Kadlec for help with SEM data, Allen Lunsford helped with the final setup of the magnetic scanning instrument. We thank Youngwood Science and Engineering (youngwoodscience@gmail.com) for providing the MagScan software free of charge. We acknowledge help from P. Pruner, P. Schnabl, K. Cizkova, S. Šlechta, D. Venhodová, J. Petráček,