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New paper on chemical classification of IM1 spherules published in *Chemical Geology*

*Expedition team lead by Harvard astrophysicist Avi Loeb uncovers unprecedented materials from
impact site of 2014 interstellar object*

CAMBRIDGE, MA — September 23, 2024 — A multi-year expedition and investigation into the mysterious interstellar meteor CNEOS 2014-01-08 (IM1) has culminated in the publication of a major new paper by Professor Avi Loeb and his team in the prestigious Elsevier journal *Chemical Geology*. The paper, titled *Chemical classification of spherules recovered from the Pacific Ocean site of the CNEOS 2014-01-08 (IM1) bolide*, presents the first-ever analysis of spherules recovered from the impact site of an interstellar object on Earth.

Funded by a generous \$1.5 million grant from Charles Hoskinson, Professor Loeb and his team conducted an extensive survey over the seafloor in June 2023, collecting around 850 spherules ranging in diameter from 0.1 to 1.3 millimeters. The location of the survey centered on the impact site of the IM1 meteor, 85 km north of Manus Island in the Pacific Ocean, as determined by U.S. Department of Defense satellite sensors that detected the meteor's fireball on January 8, 2014. The spherules were subsequently analyzed using advanced techniques such as micro-XRF, Electron Probe Microanalysis, and ICP Mass Spectrometry, allowing for detailed classification based on their elemental compositions.

Key findings from the paper include:

- 78% of the spherules were classified as "primitive," indicating a chemical composition resembling the primordial material that formed the solar system.
- The remaining 22% represent a previously undescribed group of differentiated spherules, now named D-type spherules. These spherules show evidence of planetary igneous differentiation, with some potentially of terrestrial origin.
- A particularly intriguing subset, termed "BeLaU" spherules, exhibits extreme enrichments in elements like Beryllium (Be), Lanthanum (La), and Uranium (U), with concentrations up to three orders of magnitude greater than known solar system materials. These highly evolved compositions suggest origins that are not yet understood and are unlike any known planetary bodies.

According to Professor Loeb, the material analysis raises new questions: “What is the age and material properties of IM1? Is IM1 natural or artificial in origin? Where did it come from and how long was its journey?”

These questions and others now drive the planning for the return expedition to the impact site, potentially as soon as summer 2025. To find larger pieces of IM1, the second expedition intends to use a remotely operated vehicle, accompanied by a video feed enabling real-time observation of what is being picked up from the ocean floor.

The full paper is available through *Chemical Geology* [here](#).

About Professor Avi Loeb

Avi Loeb is the head of the Galileo Project, founding director of Harvard University's Black Hole Initiative, director of the Institute for Theory and Computation at the Harvard-Smithsonian Center for Astrophysics, and the former chair of the astronomy department at Harvard University (2011-2020). He chairs the advisory board for the Breakthrough Starshot project, is a former member of the President's Council of Advisors on Science and Technology, and previously served as chair of the Board on Physics and Astronomy of the National Academies. He is the bestselling author of [Extraterrestrial: The First Sign of Intelligent Life Beyond Earth](#) and co-author of the textbook [Life in the Cosmos](#), both published in 2021. His forthcoming book [Interstellar](#) is scheduled for publication in August 2023.

About the Galileo Project

[The Galileo Project for the Systematic Scientific Search for Evidence of Extraterrestrial Technological Artifacts](#) is a Harvard-hosted, cross-institutional research project launched in June of 2021 by co-founders Avi Loeb and Frank Laukien. Led by Professor Avi Loeb at the *Center for Astrophysics | Harvard & Smithsonian*, the Galileo Project searches for objects near Earth that could have originated from extraterrestrial technological civilizations. The project has three branches: the study of interstellar objects (ISOs) near Earth, the search for unidentified aerial phenomena (UAPs) and the study of interstellar meteors (IMs). The project currently pursues software development for identifying ISOs in upcoming data sets, the assembly of the first UAP Observatories and the preliminary analysis of their initial data and the results from an expedition to retrieve fragments from the first interstellar meteor, IM1, in the Pacific Ocean.