# XXIII. STUDIES ON METALLIC SPHERULES FROM OCEANIC SEDIMENTS IN THE GH79-1 AREA

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## Introduction

The final goal of this study is to obtain extraterrestrial information from metallic spherules from deep-sea sediments, which cannot be or hardly be obtained from the meteorites.

In 1876 J. MURRAY deduced that metallic spherules taken from deep-sea sediments obtained during the Challenger Expedition were of cosmic origin. This conclusion was confirmed and extended during recent 20 years. From deep-sea sediments PETTERSSON and ROTSCHI (1955), LAEVASTU and MELLIS (1955) separated magnetically the metallic spherules and found they were similar to those described by MURRAY. SMALES, MAPPER, and WOOD (1958), using the instrumental neutron activation method, found that nickel-cobalt-copper ratio in a collection of these spherules was also similar to that in iron meteorites, MILLARD and FINKELMAN (1970) studied magnetic spherules and detected nickel, cobalt, and trace of iridium from several spherules using the instrumental neutron activation method. SHIMAMURA *et al.* (1977) measured potassium anomalies in metallic spherules sampled from deep-sea sediments which were produced through the spallation reactions of iron component with high energy cosmic rays in outer space.

The cosmic origin of the larger deep-sea spherules is indicated by their chemical composition, which is identical with that of iron meteorites. Whether these spherules existed as small extraterrestrial particles that were completely preserved during their atmospheric passage, or whether they were produced by air-friction from large iron meteorites as they passed through the atmosphere, was not decided by these studies. The extraction and identification of cosmic spherules from the atmosphere, rain water and snow is a far more difficult problems than the extraction and identification of metallic spherules from deep sea sediments. The very slow sedimentation rate on the floor of the deep sea highly concentrates the comic dusts.

Furthermore, contamination from industrial sources is absent in the deep-sea sediments. In the atmosphere, dust from many terrestrial sources is constantly introduced. The dust includes sand grains, volcanic ash, and industrial debris. Some of these materials, particularly olivine sand or artificial stainless steel debris, contain such large concentrations of iron and nickel that bulk analysis of atmospheric dust samples must be carefully investigated.

Metallic spherules sampled from deep-sea sediments have been studied well and many spherules were confirmed to be of extraterrestrial origin.

The criteria of extraterrestrial matter on Earth are thought to be as follows:

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(1) Siderophile elements such as Ni, Co, Ir, Au, etc., are detected in spherules as much as those in iron meteorites.

(2) Cosmic ray produced radionuclides such as $^{53}Mn$ are determined from individual spherules.

(3) Isotopic anomalies caused from spallation reactions by high energy cosmic ray irradiation in outer space are measured in individual spherules using an extremely sensitive mass-spectrometer.

(4) Studies on iron oxides and iron-nickel alloy structures in metallic spherules reveal the close connection with iron meteorites.

(5) Discovery of fossil tracks of heavy cosmic charged particles in silicate spherules proves their extraterrestrial origin, nobody succeeded, however, in such a discovery in the world.

But the spherules sampled from deep-sea sediments suffered doubly degenerations, thermal degeneration during the entry in Earth's atomosphere and chemical one by sea water in deep sea sediments for a long time.

**Experimental procedures and results**

The metallic spherules were picked up from the magnetic fractions of the same sediments, which were used for the studies of silicate spherules.

The spherules and the reference samples (tiny pellets of iron meteorites) were washed by distilled water and then by pure acetone using an ultrasonic cleaner. They were mounted on polyethylene microcapsules and then irradiated for a few hours in a reactor (TRIGA-II), whose thermal neutron flux was approximately $0.7 \times 10^{12}$ n/cm$^2$, sec. After irradiation, they were removed from the capsules and then mounted on polyethylene disc holders. For the gamma ray measurements, Ge(Li) detectors and also low level Compton suppression system consisted of a Ge(Li) and a well type NaI(Tl) scintillator were used.

The obtained results are listed below:

| Sample Code | Size ($\mu$m) | Weight ($\mu$g) | Fe (%) | Co (%) | Ir (ppm) | Ni (%) | Remarks (GH79–1) |
|---|---|---|---|---|---|---|---|
| H | 440 | 212 | 69.8 | 2.97 | 14.5 | 4.2 | #1458 |
| J | 380 | 122 | 70.6 | 0.35 | 4.3 | 5.4 | #1474 |
| K | 320 | 89 | 66.1 | 0.27 | 7.7 | 1.9 | #1458 |
| L | 400 | 102 | 66.6 | 2.7 | 5.0 | 6.9 | #1458 |
| M | 330 | 85 | 83.3 | 1.3 | 8.2 | 5.4 | #1478 |

All spherules listed above were confirmed as of extraterrestrial origin. And they were sent to the Institute of Mass-spectrometry of René Bernas, Orsay, France for the purpose of detection of the cosmic-ray-produced radionuclides using accelerator-mass-spectrometry.

Because of unknown sedimentation rates, quantitative treatments of accretion rates of cosmic matter were impossible. On the other hand, radioactive treatments in each or bulk samples must be done in a large scale. The sampling of a large number of the metallic spherules from deep sea sediments is in progress.

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