

Carbon and Fe-Ni spherules and particles of samples at the end of Permian Period and the origins

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Material evidence of shock wave on the largest mass extinction on recent fossil formations of the Earth is shown here at the end of Permian Period. Although there are many reports on cause of the mass extinction, as volcano, mantle-convection or meteoritic impact, however distinct evidence of shock wave formations does not be shown so far. Formation conditions of spherules and melt particles with carbon and FeNi discussed here are high temperature and pressure.

Two localities are discussed on carbon spherules and FeNi bearing particles here.

1) China PTB section. Carbon spherules with 90wt% are extracted from magnetic particles of red-clay layer at the Meishan samples in China, which are varied from 0.002mm to 0.02mm in size. FeNi bearing spherules are also found in the same samples as 0.002mm in size. Bulk analyses of the sample show considerable contents to be impact origin. NiFe rich spherules as aggregates are varied from 100nm to 0.005mm in size. NiFe contents of spherules from the Meishan sample are ranged from 31wt% and 33wt% coexisted with C and Cu.

2) Japan sample of Permian Period. Carbon samples are found at drilled breccias of Akiyoshi, Yamaguchi, which the bulk analyses of the samples show significant contents of impact origin. FeNi bearing particles in Akiyoshi are not so much with variable contents of carbon.

The results are summarized as follows:

- 1) Three carbon types of impact formations are classified from in-situ analyses of C-Fe diagram of spherules and particles.
- 2) On the Earth, intermediate content of carbon can be formed from impacts of target rock without carbon if carbon-rich projectiles are collided. But largest content of carbon spherules of 90wt% can be obtained only impact on limestone with carbon.
- 3) Impact origin of the Meishan section of China can be obtained from carbon spherules with 90% ranged from 0.002mm to 0.02mm in size, and from coexisted elements of Si and Ca except Mg. There is no evidence on mantle-derived rocks with much Mg. All elements found at the present spherules can be explained by impacts on limestone and silica-rich rock on the crust. There is localized S phase on some grain, which indicates that these grains are formed on surface rocks.
- 4) Drilled breccias of Akiyoshi limestone in Japan have high carbon contents of spherules ranged from 41wt% to 93wt% coexisted with Ca contents of 2 to 54wt%, and minor contents of Fe and Ni on higher carbon spherules.
- 5) Ni and Fe contents of spherules from the Meishan samples are higher Ni contents of 1 to 35wt%.
- 6) Ni and Fe contents of small particles from the Akiyoshi samples are from 1 to 7wt%, together with coexisted elements of C and Ca, but without Mg from volcanic magma.
- 7) On the above data, Ni-rich and carbon-rich spherules and particles are formed by impacts of asteroid meteorites.
- 8) High carbon spherules can be formed by impacts on limestone target rocks, whereas Ni-rich particles can be formed by various conditions of impacts due to meteorite origin.