Morphology and composition of the cosmic dust and micrometeorites in the Transitional Clay Layer at the Cretaceous–Paleogene Boundary in the Gams Section (Eastern Alps)

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Results of investigation of the cosmic substance in the transitional clay layer at the Cretaceous–Paleogene boundary in the Gams section, Eastern Alps, are presented. A great diversity of iron microspherules and particles of different morphologies, pure nickel spherules, awaruite (Ni3Fe) particles, and diamond crystals are discovered. Iron microspherules are also met in the overlying Paleocene deposits. The discovered metallic microspherules and particles are described, their chemical compositions are presented, and their origin is discussed.

Many characteristics of the discovered Fe and Fe-Ni spherules are analogous to those of the spherules found in deep-sea clays of the Pacific Ocean by the *Challenger* expedition, in the Tunguska catastrophe area, at the fall sites of the Sikhote-Alin' meteorite (Krinov, 1971) and Nio meteorite in Japan, in Miocene marls of the Northern Apennines, in present-day deep-sea deposits. In all cases, except for the Tunguska catastrophe area and the fall site of the Sikhote-Alin' meteorite, the formation of both spherules and particles of various morphologies consisting of pure iron (sometimes with a Cr admixture) and Ni–Fe alloy is unrelated to impact events. We derive their formation from cosmic interplanetary dust falling onto the Earth's surface. This process has continued uninterruptedly since the moment of the Earth's formation and is, in a sense, a background phenomenon. Compositions of many particles studied in the Gams section are similar to the bulk chemical composition of the meteoritic substance found at the fall site of the Sikhote-Alin' meteorite (Krinov, 1971). The presence of Mo in some particles is not unexpected. Native molybdenum and molybdenite were also found in the composition of lunar dust collected by the Luna-16, Luna-20, and Luna-24 automatic probes (Mokhov et al., 2007).

Pure nickel spherules with a well-crystallized surface found for the first time are known neither in magmatic rocks nor in meteorites, where nickel invariably contains a significant amount of admixtures. Such a surface structure of nickel spherules could have formed in the case of an asteroid (meteorite) fall, which would result in release of energy sufficient not only for melting the material of the falling body but also for its evaporation.

Awaruite (Ni_3Fe) particles found together with spherules of metallic nickel are a product of the meteorite ablation and belong to the category of meteoric dust, while molten iron particles (micrometeorites) should be regarded as meteoritic dust (according to Krinov's terminology, Krinov, 1971).

Diamond crystals met together with nickel spherules might have formed during ablation of meteorite from the same vapor cloud in the process of its subsequent cooling. However, a final conclusion on the origin of diamond can be drawn after its detailed isotope investigations, which require a sufficiently large amount of substance.

Thus, the study of the transitional clay layer at the Cretaceous–Paleogene boundary revealed the presence of cosmic substance in all parts of the layer (units **J**1 to **J**6); however, indicators of an impact event are fixed only beginning from the **J**4 units.

Microstructure and compositions of many particles, investigated by authors from the Chicxulub Crater (section El Pinon), are similar to the bulk chemical composition of the meteoritic substance found in the Gams section.

Krinov E. L. (1971): New Studies of the Fallout and Findings of the Sikhote-Alin' Meteorite Shower. In: Problems in Cosmochemistry and Meteoritics (Naukova Dumka, Kiev), pp. 117–128.

Mokhov A. V., Kartashov P. M., and Bogatikov O. A. (2007): Moon under a Microscope. Nauka, Moscow.