DIFFERENTIATION PROCESSES OF SUBSTANCE IN IMPACT EVENTS

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Introduction: On the border of gray and red-colored Lower Devonian deposits in the South-West of Ukraine, a zone with high values of remanent magnetization and magnetic susceptibility was identified. Here, microparticles of native iron and nickel, iron-nickel intermetallides, which can be seen as an impact event, are found.

Methods: In the sample from the middle of the Lochkian stage (~ 415 million years ago) in the Devonian system was allocated 26 microparticles with the size from several μm to 700 μm. Total number of microprobe analyzes are 132, from 1 to 15 analysis points for each particle. The studies were carried out on the SEM "Tescan Vega II" with an energy dispersive spectrometer at the Borok geophysical observatory.

Results: With the help of electron microscopy and microprobe analysis, the chemical composition, morphology, structural and texture features of all objects were studied.

Discussion: Microparticles are a joint product of the melting of meteoritic matter and target rocks under an impact explosion. As a result of explosive expansion and deposition on the Earth's surface in the microparticles of the melt, there is a rapid differentiation of the substance, the main processes of which are:

1) Physical and chemical differentiation, separating ore and silicate melts due to their immiscibility, which is caused by a significant difference in surface tension forces in melts of different compositions. According to this mechanism, in our samples a separation of the ferrous melt with variable admixture of Ni, Zn, Cu, Mn, Cr, Ti, V occurred, more rarely - W, Sn from the silicate melt.

2) Crystallization differentiation, which generates the formation of residual liquid (silicate or nickel with iron impurity) melt, which is then separated from the previously formed crystalline phase. Microparticles of native nickel with an admixture of iron are formed in a similar way.

3) Phase-kinetic differentiation, consisting in the squeezing of residual liquid melt from the crystallized part of the melt by the flow of counter-air during explosive expansion of impact melts. In the formation of microparticles of native nickel, all three of the above processes are involved. Physical and chemical differentiation leads to the separation of a ferrous melt with an admixture of Ni, and crystallization differentiation generates solid microparticles (Fe-Ni) -alloys, and the squeezed residual melt (phase-kinetic differentiation) generates particles of native nickel with an admixture of iron.

4) Phase-gravity differentiation is in evidence in small microparticles, when the melts that generate them, due to a small mass, are rapidly decelerated and divided into heavier dense phases in the lower (frontal) part of the drop and lighter phases in the upper (tail) part of the drop.

5) Kinetic-density differentiation consists of isolating the heavier Ni-melt from the lighter silicate melt by the centrifuge principle during the explosive expansion and rotation of the mixed silicate-nickel melt, which was formed from the initial ore-silicate melt after leaving out from ferrous melt (with a nickel impurity) by physical and chemical differentiation.

Conclusions: The analysis of the composition, structural and textural features of the studied impact microparticles shows us that the melt that generated them at the time of the impact explosion as a result of the melting of the meteorite substance and the target rocks during the explosive expansion and deposition on the surface of the Earth manage to significantly differentiation of substance. An important mineralogical sign of impact origin is the presence of taenite and kamacite, as well as the presence in the silicate phase of minerals of enstatite, anorthite, and olivine. The obtained data can be used as evidence of a reference impact event in the fall of an iron-stone meteorite, and a characteristic set of minerals and geochemical parameters for the diagnosis of catastrophic events in geological history.

The work is performed according to the Russian Government Program of Competitive Growth of Kazan Federal University.