Evolution of the structure of iron meteorites under terrestrial climate

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Introduction: Meteoritic iron is affected by many factors in terrestrial conditions. First of all, abundance of water induces an oxidization process. Despite rather high nickel concentration in meteoritic iron, rust is forming on a surface of extraterrestrial matter. But also transformation processes occur inside meteorites at rather low climatic temperatures (0.15 of the melting temperature). Such reaction has been observed for the first time in the Bilibino meteorite [1].

Experiments: Structural changes in kamacite were investigated in ancient iron meteorite falls (Aliskerovo IIIAB, Bilibino IIAB). All of them demonstrate uncompleted recrystallization. Polished sections were analyzed using inverted optical microscope Axiovert 40 MAT and SEM SIGMA VP with EDS and EBSD units.

Results: Different percentage of recrystallization was found in Aliskerovo and Bilibino meteorites. 4 % of the section surface in Aliskerovo is occupied by recrystallization products. This value for Bilibino is equal to 80 %. It was noticed that recrystallization started from the kamacite-rhabdite boundaries in the Bilibino meteorite and from the kamacite-schreibersite boundaries in the Aliskerovo meteorite. There are strongly-etched sites in the recrystallized zones. One can suggest that these sites are traces of former boundaries. It is possible to think that the boundaries were moving with jumps because of the position of these sites in the recrystallized zone. Also it was noticed that there is a net of cracks before the recrystallization reaction front. A possible reason for this phenomenon is a wedge of extra material which generates an elastic stress field in the vicinity of the grain boundary [2]. All these phenomena can be explained using the Kirkendall effect on the grain boundary: the boundary shift is the result of the different concentrations of vacancies between the boundary sides.

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