DETERMINATION OF PLANETESIMALS COOLING RATES BELOW 400°C USING STRUCTURE OF CLOUDY ZONES IN METAL

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To date, there are several techniques for estimation of cooling rates of meteoritical parent bodies. One can obtain this data using average particle size of tetrataenite grains in cloudy zones of metal structure. Such approach is a useful tool for better understanding of processes, which take place during differentiation of various parent bodies. In this study we suggest way to modify abovementioned technique.

Metal phases of meteorites are an iron-nickel alloys. Slow cooling results in cloudy zone formation [1] due to spinodal decomposition at temperatures below 400 °C. This zone consists of FeNi (tetrataenite) particles embedded in low-Ni matrix. In iron, stony-iron and stone meteorites, the structure of the spinodal decomposition is formed during cooling in the area of M-shaped diffusion profile of nickel in the range from 30 to 42 wt.% Ni. The microstructure of the cloudy zone in these regions is formed in a practically pure Fe-Ni-Co meteorite metal after exsolution of minor elements such as S, C, and P at high temperatures in their sulphides, carbides and phosphide [2].

Spinodal decomposition is a wave-like process and one can estimate wavelength of such phenomenon using not the average particle size, but the distance between centers of formed particles. Photos of cloudy zone in vicinity of outer taenite rim have been made and processed using FESEM Carl Zeiss SIGMA VP and SIAMS 700 image analysis system. Arrays of data in case of meteorites Annama (H5), Chelyabinsk (LL5), Cheder (IID), Hoba (IVB), Canyon Diablo (IAB-MG), Mundrabilla (IAB-ung), Seymchan (PMG), Sterlitamak (IIIAB), Odessa (IAB-MG), Uakit (IIAB) have been acquired. Results of cooling rates analysis are compared with data from [1-3], which were obtained using measurements of average tetrataenite particle size in close proximity to tetrataenite – cloudy zone boundary.

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