MORPHOLOGY OF THE OUTER SHELLS OF THE TUNGUSKA SPHERULES.

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A population-sample of 32 spherules magnetically separated, believed to be related to the event of 1908, was studied with scanning electron microscope. The spherules were recovered by L.Kulik during his expeditions (1927 - 1930) from the wrecked area at the Tunguska Podkamennaya. They were first reported by Yavnel [1]. The sizes of the examined two largest spherules were 350 μm and 300 μm respectively, while the remaining ones did not exceed 150 μm. The smallest one was of 7 μm only.

With SEM several distinct morphological patterns were disclosed in the microphotographs: a/compact smooth surfaces, b/rough surfaces decorated with numerous spherulitic fines and fine irregular grains, c/strongly rough surfaces of regolith type, d/surfaces with mosaic fabric, e/spherules "astrakhan" coated. The variation in morphology appeared independent upon the size of spherules.

The pair of the largest spherules differs from the remainning ones. The first sized 350 μm (Fig.1) has a smooth glossy surface. It has an attached smaller spherule (110 μm) which being solidified earlier than the carrier became embedded into liquid or semi-liquid material. The difference in the material properties, manifested during cooling, produced presumably splitting off of the part of the supporting crater-like concave bed (200 μm).

The spherule as seen in Fig.2 (300 μm) is covered by spherulitic fines, sized fromsubmicron to few microns, and dust-like particles. Smooth and glossy spherulitic fines seem to argue for their nucleation and growth at a high cooling rate. There is not excluded that the growth of the largest spherules involved deposition of spherulitic fines on larger spherical aggregates.

The surface of the spherule shown in Fig.3 being smooth and glossy is spotted by flaky textural features compatible with concentric formation of the outer shell. In Fig.4 a spherule is shown with surface of regolith type, rich in pores and irregularly scattered nodules apparently highly weathered. At larger magnifications a glassy matrix is seen as cementing ~1 μm grains with melt-rounded angles. Polygonal mosaic in Fig.5 is likely to be related to a granular core resulting possibly from adhesion of closely packed hardening grains prior to their ultimate petrification. Glossy or dull "astrakhan" coating of spherules (Fig.6) consists of globular nodules, sized few microns, while ordered in rows of length of several tens of microns. The latter were possibly produced by a rapid nucleation of mineral species inside molten liquid matrix.

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MORPHOLOGY OF TUNGUSKA SPHERULES

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References : (1) Yavnel, A. A. (1957) Astron. Zhurn., 34, 794 - 796.

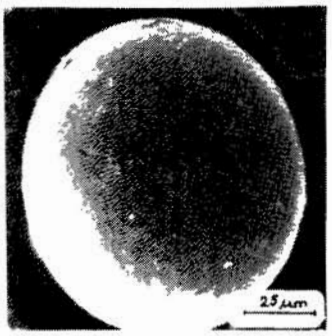

Fig.1

Fig.2

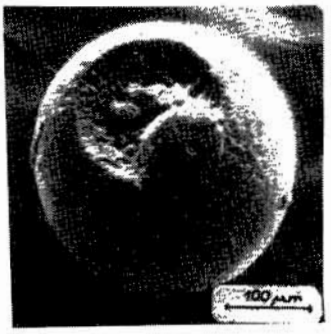

Fig.3

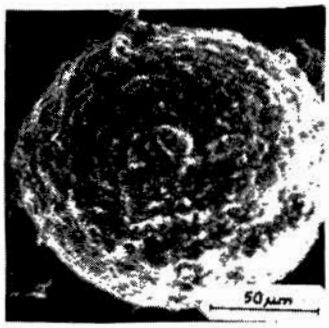

Fig.4

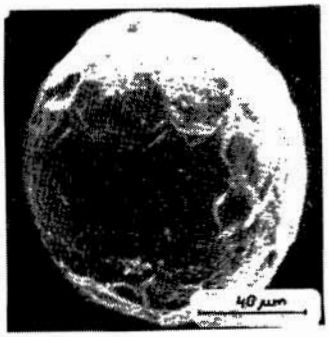

Fig.5

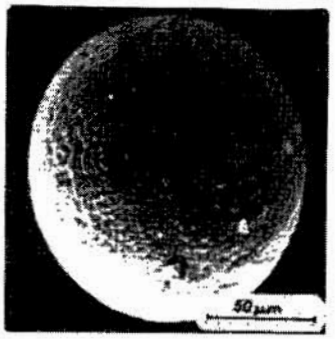

Fig.6