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RESULTS OF MINERAL EXPLORATION IN KÁRPÁTALJA (CARPATHIAN UKRAINE) REGION

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INTRODUCTION

All geological investigations which are in connection with ores, minerals and other geological-type row-materials have been carried out by the Kárpátalja (Carpathian Ukraine) Geological Prospecting Company. It was founded 31. May 1950 and its centre was pointed out in Visk locality and in 1954 year it was removed to Beregovo (Beregszász). This town has given the centre until today. Expences of the reserach activity had been produced from the budget in 90% rate until 1994 year.

Main tasks of this company are as follows: geological mapping and all geological-geophysical works which are necessary for the recovery of row materials for the mining industry. I. g. apart from the detailed geological mapping (12.800 km^2 area) more than 60 km.s long gangway, 15 km prospecting shafts, 700.000 m^3 trenches, 10.000.000 m.s long boreholes were realized during 45 years period.

MAIN RESULTS OF THE PROSPECTING

I. *Ore fields*

1. *Beregovo (Beregszász) district:* Muzsijevo (Muzsa) and Beregovo (Beregszász) and Kavaso hydrothermal gold and polymetallic mineralization as well as related kaolinite and alunite accumulation (Muzsijevo and Kavaso); perlite (Senay, Varna and Ardo); several smaller ore and non metallic occurrences.
2. *Rachow (Rahó) district:* Sauiak gold and Rachow hydrothermal polymetallic and gold mineralizations and numerous smaller occurrences as well as Talabor and Solotina (Aknaszlatina) huge salt accumulations.
3. *Begany district:* with hydrothermal alunite-barite-gold polymetallic ore deposits at Begany and germanium-rich brown-coal beds and numerous smaller ore and non-ore indications.
4. *Visk district:* mercury accumulations at Saian and Grendes localities and zeolite at Seklence as well as numerous smaller ore and non-ore indications.
5. *Peretscheni (Perecsényi) district:* mercury deposits at Dubrinec (Dubrincs) and Olenova localities; kaoline at Dubrinec (Dubrincs) and numerous smaller metallic and non-metallic accumulations.

II. *Numbers of explored occurrences*

Gold and silver	6
Polymetallic accumulations	5
Mercury	6
Brown coal	8
Salt	2
Barite	1
Kaoline	2
Zeolite	1
Bentonite	2
Coloured earths	2
Limestone	4
Dolomite	2
Marble	10
Andesite	22
Brick-clay	38
Keramsite	1
Perlite	4
Sand and gravel	14
Drinking water	17
Thermal water	4
Mineral water	16
Altogether	167

III. *Factories, companies for the utilization of mineral resources of Carpathian Ukraine (Kárpátalja)*

Kárpátalja Gold-Polymetallic Combinate	
Királyháza Chemical Industry	
Borzsava Calcine Works	
Brick factories	28
Ceramic factories	8
Rachow and Királyvölgy Marble Quarries	
Huszt Stone Cutter Works Quarries	12
Sand and gravel pits	10
Mineral water bottler factories	8
Spa	1
Sanitaria	9
Water-works	7
Artesian wells	697

IV. *Metallogenic map of NE Carpathians*

Fig. 1. shows a metallogenic sketch referring to the area of Carpathian Ukraine (Kárpátalja) and adjacent Slovakian, Hungarian and Romanian border zones.

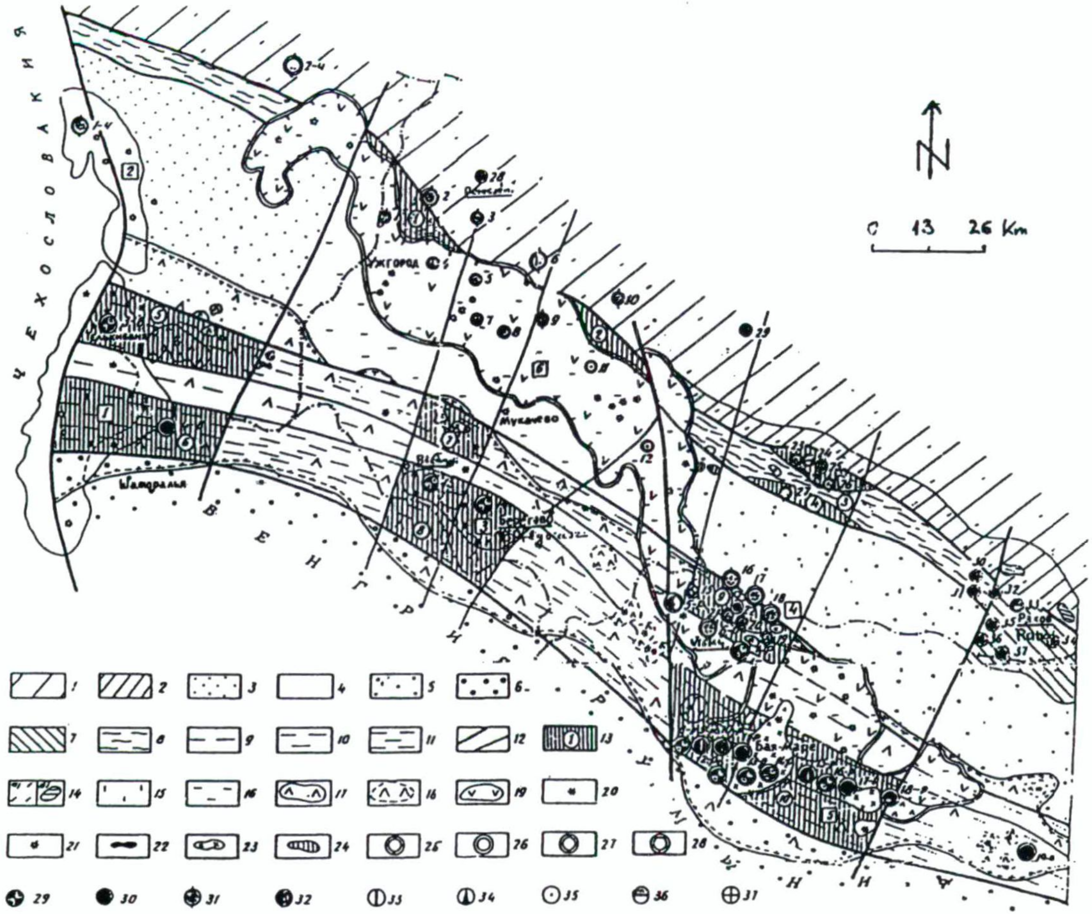

Fig. 1. Metallogenic sketch of NE Carpathians (V. N. ZAJCEVA 1971)

LEGEND: *Structural zoning:* 1-2. Geosynclinal area of Carpathians (1 = miogeosyncline, 2 = Inner Carpathian geosynclinal subzone with spilite-keratophyric volcanism). 3–5 Sub-Carpathian inner folded and fractured zone (3 = East Slovakian, 4 = Csop-Mukacseve, 5 = Solotvinsk, 6 = Hungarian, 7 = Maramures Massif). 8–11 Deep-fractures (8 = Sub-Carpathian, 9 = Old Pannonian fractures, 10 = Dobrony-Visk, 11 = Beregove-Baia Mare) 12. lower degree fractures. 13. uplifts of Pre-Neogene basement. Numbers are marked with circles, as follows: ① Peretscheni, ② Szvaljava, ③ Ugljansk, ④ Pragov, ⑤ Vilyvitány, ⑥ Sátoraljaújhely, ⑦ Dobrony, ⑧ Beregovo, ⑨ Visk, ⑩ Baia Mare.

Structural stages and levels: 14. Elements of Alpine Geosyncline (14a = Cretaceous-Paleogene flysch, 14b = Cretaceous volcanics, miogeosynclinal spilite-keratophyric association with Neogene reactivation). 15. Miocene tuffaceous molasse, so-called „Lower structural zone". 16 = Pliocene tuffaceous molasse, so-called „Upper structural zone".

Magmatic formations. 17= Miocene (from Badenian up to Pliocene) andesite formation. 18= Ditto, in covered position (earlier magma-tectonic cycle), 20–21= Eruption centres (20 = Miocene, 21 = Pliocene), 22–24. Intrusions (22 = Cretaceous-Paleogene, 23 = Miocene, 24 = Pliocene), 25–28= Ore deposits (25 = Pliocene mercury and rare-metall enrichments, 26 = Miocene gold-bearing polymetallic ores, 27 = Cretaceous-Paleogene copper and nickel ores).

Ore fields and occurrences. 29. Polymetallic gold-bearing, 30. Polymetallic, 31. Mercury, 32. Arsenic, 33. Antimony, 34. Tellur and bismuth, 35. Molibdene, 36. Copper, 37. Cobalt-nickel, 38. Iron-manganese. *Delimitation of metallogenic fields:* 39. boundaries of mercury and rare-element occurrences, 40. boundaries of gold-bearing, polymetallic ores.

Volcanic masses: (in quadratic frames) 1 Tokaj, 2 Presov, 3 Beregove, 4 Visk, 5 Baia Mare, 6 Vihorlat-Gutin.

Ore fields in Slovakia: 1–4. Dubnik (Hg), 2–4. Mernik (Hg). *Fields in Hungary:* 3-B. Telkibánya (Au), 4-B. Sátoraljaújhely (Pb, Zn). *Fields in Romania:* 5-p. Tarna Mare (Pb, Zn, Au), 6-p. Komirzan (Hg, Au), 7-p. Biksad (Au, Ag, Hg), 8-p. Raksa (Au, Ag), 9-p. Nistru (Pb, Zn), 10-p. Ilba (Pb, Zn), 11-p. Beica (Cu, Pb, Zn), 12-p. Sesar (Au, Ag), 13-p. Higis (Au, Ag), 14-p. Gilau-Kuci (Au, Ag), 15-p. Baie Sprie (Pb, Zn, Cu, Au), 16-p. Suior (Au, Ag, Pb, Zn, Cu), 17-p. Cavnic (Pb, Cu, Zn, Au), 18-p. Beiuc (Pb, Cu, Zn, Au), 19-p. Cibles (Cu, Pb, Zn). *Fields in Carpathian Ukraine:* 1. Csontos (Hg), 2. Dubrinic (Hg), 3. Turica (Hg), 4. Antalovci (Hg, Te), 5. Lockanevo (Hg, Te, Mo), 6. Olenovo (Hg), 7. Podulki (Te, Bi, Hg, Mo), 8. Viznica (Hg, Te, Mo), 9. Sinjak (Hg), 10. Poiana (Hg), 11. Dehmanov (Te, Bi, Mo), 12. Sholles (Te, Bi, Mo, Cu), 13. Begany (Ba, Zn, Pb, Au, Ag), 14. Beregovsk (Zn, Pb, Au, Ag), 13–14. Miocene origin, 15. Zagodotschnoe (Hg), 16. Beregsurany (Hg), 17. Grendes (Hg, Pb, Zn), 18. Borkut (Hg), 19. Marangosh (Hg), 20. Povorotnoe (Hg), 21. Rovnoe (Hg, Pb, Zn), 22. Bania (Pb, Zn Miocene origin), 23. Monostor (Hg), 24. Aldermirov (Cu), 25. Kamennoe (Ni, Cr), 26. Luzsanskoe (Hg), 27. Dragovszkoe (Hg, As), 28. Tschernogolovo (As), 29. Soimü (Sb, As), 30. Koobclecki Poliaňa (Pb, Zn), 31. Kamen-Klevka (Pb, Zn), 32. Glimea (Mn), 33. Krasno Pleso (Cu), 34. Berlebashka (Cu, Au), 35. Sauliak (Au), 36. Banskoe I (Au), 37. Banskoe II (Au).

◎ Ore deposits (numbers being next to the double circles mean the above-mentioned localities)

In the present difficult economic situation the Central Fund is able to cover the research expences in 20% ratio, only. Therefore, predominant part of the objects momentarily are stopped. Due to the newest governmental regulations, the prospecting and exploitation are legitimated for foreign capitals by concession buying.

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THE MAIN GENETIC TYPES OF SPHERULES OCCURING IN THE ROCKS OF HUNGARY

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ABSTRACT

Four types of spherules obtainable from the sediments and deposits in Hungary are discernible by means of SEM and EDAX study of their chemical composition, textural structure and morphogenetics. Of *extraterrestrial origin* and of size 100–200 micron are the following: **Glassy microtektites** (Si), the **micro magnetospherules** (Fe) and the **micro siderospherules** (Si+Fe); on the other hand of *terrestrial origin* and size 200–400 micron are **the magnetopearls** (Fe).

The extraterrestric spherules show all the signs of their origin: as the cold meteorites abruptly were heated up in the Earth's atmosphere and then burst up disintegrating into their elements forming blenddrops rich in gases, and slowly cooling down while rotating with high velocity.

The tektites of different ages (Triassic, Cretaceous, Miocene) are to be found abundantly in thin clay layers of the deposits. The white and light yellow transparent tektites with low density contain small crystallites while the honey-yellow tektites of high density contain after anorthite oldhamit pseudomorphoses. Both types have blendclothfibres on their surface. The glassy tektites of different ages elements and to their proportions are completely similar to the anorthosite of the Moon's crust. All these facts prove that the material of the glassy tektites comes from the Moon's crust anorthosite minerals by escaping from there during impacts of meteorites and heated up and disintegrated into micro compound droplets when arriving into the Earth's atmosphere. The abundance of tektites in the different layers signals the ages of some big meteorite crashes on the Moon's surface.

The morphogenetics of terrestrial magnetopearls signal the process of slow and uniform crystallisation at low temperature.

The spherules, which were studied with SEM and EDAX methods are from Triassic, Miocene, Pannonian sediments and placers of Hungary.

The geological setting of these spherule deposits were presented by L. DOSZTÁLY (Budapest, Sopron), E. KROLOPP (Arak) and GY. GYURICA (Maros river mouth).

The studied spherules can be divided into 4 types according to their chemical composition, fabric and genetic features (PLATE I).

1.	Glassy microtektites	(Si)	Triassic, Miocene	extraterrestrial
2.	Micro magnetospherules	(Fe)	placer	extraterrestrial
3.	Micro siderospherules	(Fe+Si)	placer	extraterrestrial
4.	Terrestric micro magnetopearls	(Fe)	Pannonian	terrestrial

1. The **glassy microtektites** are from the thin grey clay interlayers of the Triassic limestone in Budapest at 104–120 m depth, respectively and from the Miocene clay

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sediments of Sopron at 35–40 m. The 1 cm thick grey clay interlayer in the Triassic limestone contains drop and sphere shaped microtektites of 100–200 micron size and is a honey yellow colour. They have small bubble craters on their surface and bubbles inside. Their material is rich in Si and Ca and contains also Mg, Al, K and Ba in minor amounts blend (PLATE II). The magnification by several thousand times shows drops of soft and bubbling blend material. On their surface blendfibres are visible which were impacted into the soft drops or spun on their surface (PLATE III). The blendclothfibres on the spherules derive from the disintegrated material of the meteorite by forming crystallite plates of pseudohexagonal shape (PLATE IV). The fluidal texture of the drops with the crystallites immersed shows the direction of intense rotation of their crystals and fibres, indicating also the presence of considerable physical and chemical forces involved in their formation.

The drops differ by their densities. The drops of lower density are colourless or light yellow and contain only nuclei of crystallites (PLATE III). The drops of higher density are of dark honey yellow colour; prismatic crystals of hexagonal cross section are immersed along with other crystals in the state of growing (PLATE V). The well-developed prismatic, isometric crystals of platy shape according to (001) are similar to a Ca-rich feldspar. Their CaS content, however, alludes to the meteorite mineral oldhamite. Supposedly, they are pseudomorphs of oldhamite after Ca-rich feldspar, anorthite (PLATE VI). The more exact study is made difficult by their small size; 1.5 micron diameter and 3 micron length. The chemical composition of glassy tektites is very similar to that of the anorthositic crust of the Moon's surface both as to the elements occurring and also their percentages (TABLE 1), (MAYER 1987).

TABLE 1

Weight %	Lunar soil	Anorthosite 60025	Glassy Tektite Triassic	Glassy Tektite Miocene
SiO_2	45.20	43.90	44.43	39.39
CaO	15.30	18.90	34.20	37.62
Al_2O_3	26.60	35.20	9.59	9.38
MgO	6.30	0.27	7.21	9.20
TiO_2	0.58	0.02	—	—
BaO	—	—	2.45	2.80
K_2O	0.11	0.03	0.95	0.80
MnO	0.07	0.03	0.63	0.71
FeO	5.50	0.67	0.54	0.10
Cr_2O_3	—	0.04	—	—
Na_2O	0.47	0.49	—	—

The rocks of the Moon's surface contain almost pure anorthite of Ca content ($CaAl_2Si_2O_8$), a plagioclase feldspar with negligible Na content. The above facts suggest that the material of the glassy tektites originates from the Moon, and through impacts of meteorites it had escaped from the Moon's surface and arrived into the Earth's atmosphere. After heating up, it disintegrated into microblenddroplets. The plastic and bubbling microblenddroplets were hardened by the large physical and chemical forces and as a result become extremely resistant. They arrive floating slowly to the Earth's surface due to their smallness. The long cooling and their hardened material ensure the conservation of their genetic characteristics. This is confirmed by the fact that the glassy tektites which come from Triassic and Miocene layers are identical to those on the surface with respect to their morphology, composition, texture and genetic characteristics, as if the 200 million years have not passed. This proves that they were formed from the same material by the same genetic process.

In conclusion it can be stated that the abundance of glassy tektites in layers of different ages can be linehad with some big meteorite impacts on the Moon's surface (KÁKAY-SZABÓ, 1996).

2. The **micro magnetospherules** have been recovered partly from a placer of the Maros river mouth and partly from the sand of a playground Budapest. EDAX examination of the material has shown but iron content.

The morphogenetics of magnetospherules clearly shows the origin and process of their formation. While during the magmatic processes on the Earth's surface an abrupt cooling of the material takes place and therefore a crust is formed, the meteorite which arrives in a cold state into the Earth's atmosphere is abruptly heated up but then breaks into parts which cool down slowly. Thus small droplets are obtained which show in a very delicate manner their genetic features.

The granule of smooth surface (PLATE I), from the Maros river mouth is a solid magnetospherule, 150 micron size with high density. Its fluidal texture and smooth surface show that it was plastic and spun during its origin, but by its greater weight and gasless material it arrived faster to the Earth's surface. The time of cooling was shorter and there was no time for crystallisation. Therefore there is no crystallisation pattern on its surface.

The surface pattern of the particle contains gas bubbles and is 120 micron in size (PLATE VII). Its fluidal texture attests to a plastic state of origin. Its plastic magnetic iron material in the direction of the strong spinning was ordered in to octahedral blocks the junctions of which yielded the surface pattern. The high velocity spinning produced, centrifugal force which affected the ruptures of the junctions. The inner parts of the spherule show also the effects of centrifugal force. A considerable part of the gas content got into the central part, forming a cavity there. A smaller part in the form of small bubbles remained in the material. Discoidal plates were formed by the centrifugal force from the octahedral plate crystals of the material. The sawtoothed edges of the discoidal plate were formed by the sliding of the octahedral plate crystals. The original fluid state of the magnetospherules is proved by the droplet growing to drop from the edge of a discoidal plate and the crystallite immersed in the plastic iron material. A complete conservation of the effects of forces on the magnetospherules is a consequence of their slow cooling. The long travelling of the spherule was a consequence of its gas content, light weight and small size. The resulting slow and uniform cooling assured that all details of its origin were conserved.

3. The **micro siderospherule** comes from the placer in the Maros river mouth. This little black sphere of 100μm size is of a glassy character. Its material contains both iron and silicates. At different points of the drop it has different compositions (PLATE VIII). On its surface rich in magnetic iron of terrestric origin it has a magnetic iron coating of terrestric origin in circularar patches. Those surfaces of the drop which are rich in silicates are blends of Mg, Al, K, which are rich in Si, Ca and have the same composition as the glassy microtektites. This fact, its fluidal texture and the blendfibre on its surface prove its cosmic origin. On those parts which contain iron, there are oval magnetic iron coatings of terrestric origin. The part of the surface which contains silicates is free of terrestric magnetic iron coating, it does not attract the terrestric magnetic iron material.

Consequently, the surface of the siderospherule shows in a spectacular way the mixed composition of the granule due to the terrestric overlays.

4. The **terrestric micro magnetopearls** come from the Pannonian clay of Arak, from a depth of 70 m. Their material is ferromagnetic alpha iron. On the surface on the pearls of 300–400μm size there are uniformly arranged junction lines, with some leaks at some parts. There are also pearls with empty centre (PLATE IX). The inner and outer surfaces are built up of small octahedral crystal plates. The octahedral crystal plates, which are lined up one after the other, have rectangular units and in triplets form an octahedral face, which in turn are arranged beside each other yielding circular units; these joined together form the pearl. The vertices of the octahedral crystal plates point to the inner part of the pearl forming a rough surface. These are formed in sediments of reductive environment by the crystallization of the iron solutions in the sediment pores. On the side of most magneto pearls there is a hole which shows the place where they were sticking during their formation. The magnetopearls are of terrestric origin according to their texture. They were formed by a slow and quiet crystallization at low temperature. They have no fluidal texture.

The microspherules are to be found almost everywhere on the Earth in sediments. The magnification of the order of several thousands reveals the origin and the genesis of each spherule by its genetic features.

ACKNOWLEDGEMENTS

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PLATES

Plate II

1. Glassy microtektite of low density bubble crater and crystallites floating in the blenddrop and blendclothfibres
2. Glassy microtektite blenddrop with blendclothfibres spinned around it and with crystallites floating in it
3. Glassy microtektite of low density with big bubble crater and with blendclothfibres sticking to it
4. Blenddrop of low density with many blendclothfibres sticking to it and with crystallites floating in it

Plate III

1. Surface of a blenddrop of glassy microtektite of low density with blendclothfibres spinned on it and with crystallites floating in it
2. Blendclothfibre spinned on the surface of a plastic blenddrop
3. Blendclothfibre jumped on the surface of a plastic blenddrop
4. Blendclothfibre crashed on the surface of a plastic blenddrop
5. Bubble crater on the surface of a boiling blenddrop with blendclothfibre floating in it and with small crystallites

Plate IV

1. Blendcloth jumped on a blenddrop
2. Blendcloth built from crystallites
3. Blendclothfibre; spinned blendcloth
4. Blendclothfibre built up from crystallites
5. Crystallites pressed out from spinned blendcloth of higher density
6. Vertex of a blendclothfibre with the crystallites grown beside

Plate V

1. Surface of microtektite blenddrop of high density with oldhamite pseudomorphoses and with blendclothfibres pushed on it
2. Oldhamite pseudomorphoses floating in a blenddrop
3. Oldhamite pseudomorphoses floating in plastic blend and crystal germs
4. Developing oldhamite pseudomorphoses floating in a blenddrop
5. Twin oldhamite pseudomorphoses floating in a blenddrop

Plate VI

1. Monocrystal oldhamite pseudomorphose
2. Oldhamite pseudomorphose with cross twin structure
3. Glided oldhamite pseudomorphose twin

Plate VII

1. Magnetospherule with patter surface having some gap at joints showing the effect of centrifugal force
2. The surface of magnetospherule, its plastic material ordered in octahedral pieces on the surface in the direction of spinning
3. The hole where the gaseous material of the magnetospherule centered; on the walls in the inner part of the drop there are discs formed under the centrifugal force from the octahedral plates
4. The sawtoothed edges of the discs are made up from the octahedral plate crystals which glide out

5-6. The droplets which appear on the edges of discs prove the plasticity of the material at the time when the spherule was formed

Plate VIII

1-2. The surface of the siderospherule spectacularly indicates that its material is mixed rich in silicium and iron. The surface which is rich in silicium has no terrestric magnetic iron cover, on the other hand the part rich in iron is covered by terrestric magnetic iron which is attracted

Plate IX

1. The surface of the terrestrial magnetopearl with lines of the joints and spots of stickings
2. The outer surface of magnetopearl with circular units joining to each other
3. Rectangular crystalline plate units forming a circular structure by joining on their octahedral sides; the pearl is formed from these by joining
4. The inner crystalline surface of magnetopearl
5. The smallest constituents of the magnetopearl, the octahedral plate crystals, which form rectangular units by growing behind each other
6. Rectangular plates, the small units grown together in octahedral form

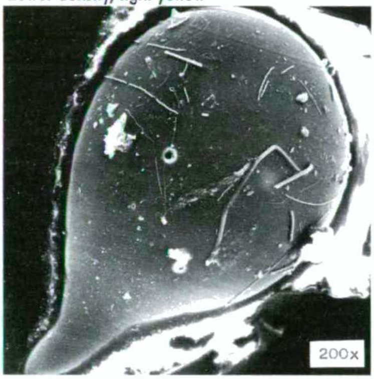
THE MAIN GENETIC TYPES OF SPHERULES FROM HUNGARY

by O. KÁKAY SZABÓ

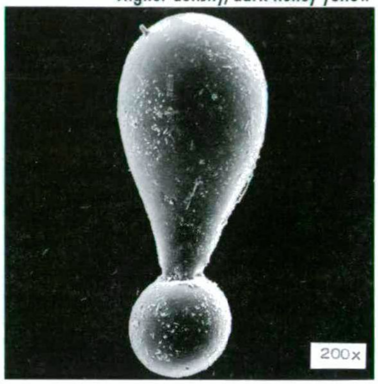
SEM photo: V. TAKÁCS EDAX: K. SOLYMOS Photo-copy: M. PELLÉRDY

GLASSY MICROTEKTITES

Lower density, light yellow

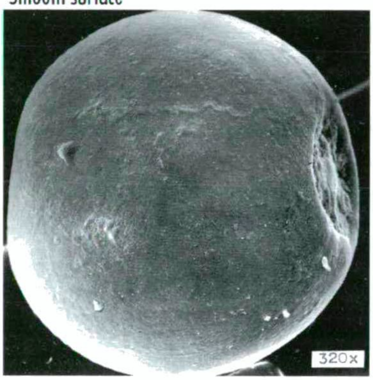


Higher density, dark honey yellow

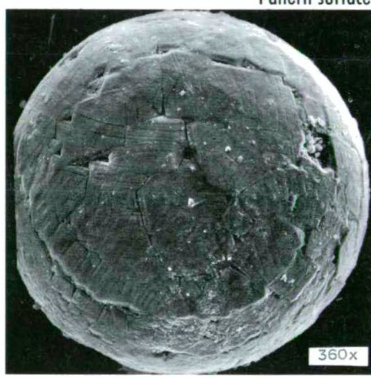


MICRO MAGNETOSPHERULES

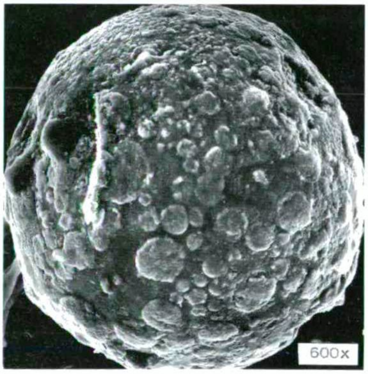
Smooth surface



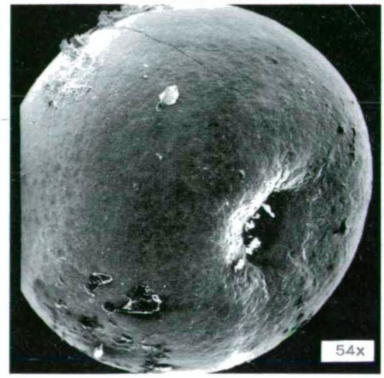
Pattern surface



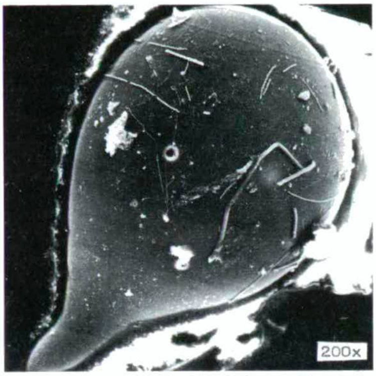
MICRO SIDEROSPHERULE



TERRESTRIC MICRO MAGNETOPEARL



CHEMICAL COMPOSITION OF THE GLASSY MICROTEKTITES



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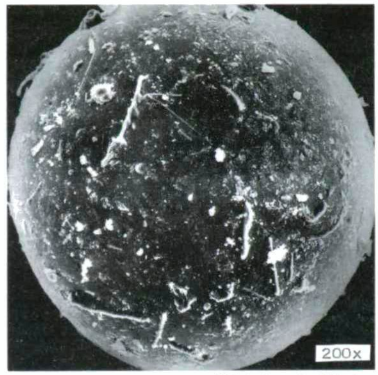

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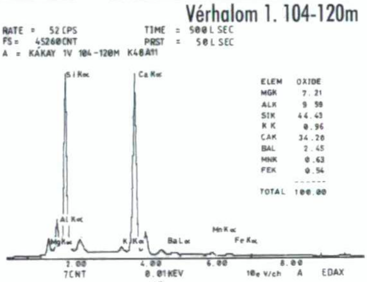
Vérhalom 1. 104-120m

Vérhalom 1. 111,4m



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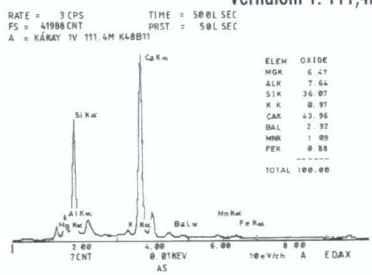
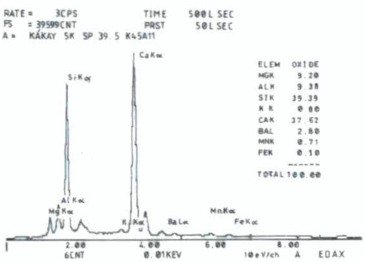
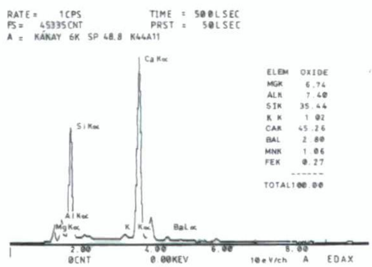


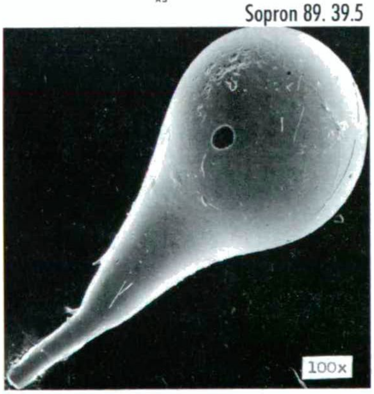


MIOCENE



Sopron 89. 39.5

Sopron 89. 48.8

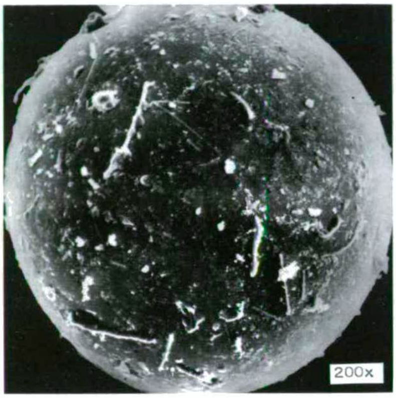


3.

4.

GENETIC STRUCTURE OF THE GLASSY MICROTEKTITES

Surface of the lower density glassy tektites



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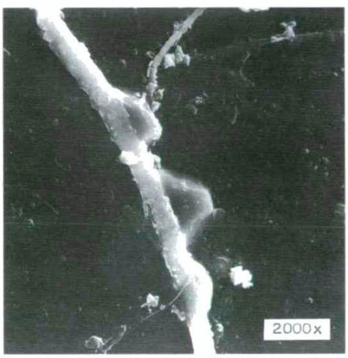

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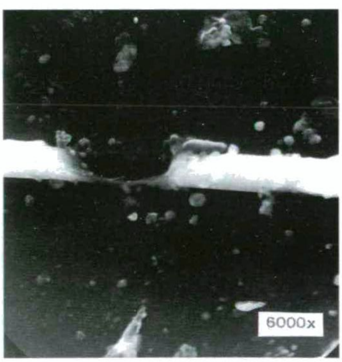

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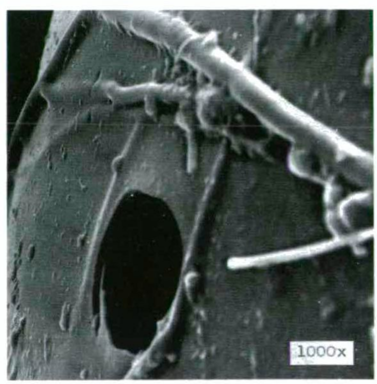

GENETIC STRUCTURE OF THE GLASSY MICROTEKTITES

Figures of surface of the glassy tektites

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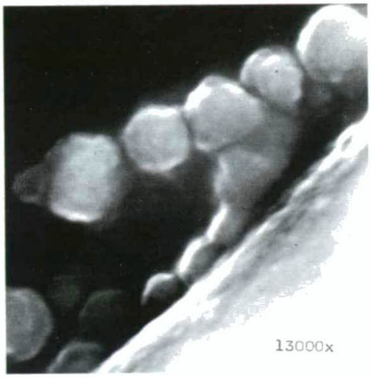

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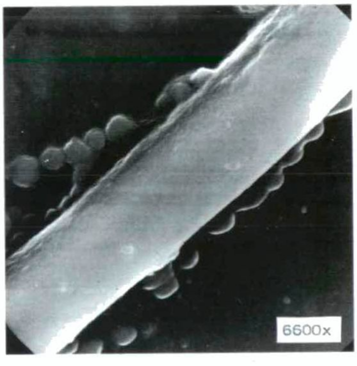

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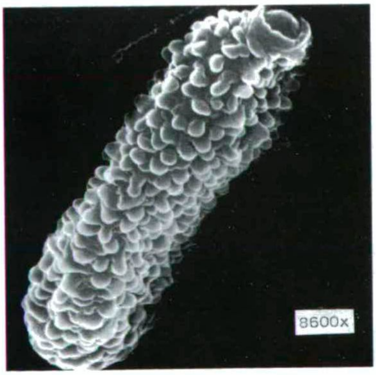

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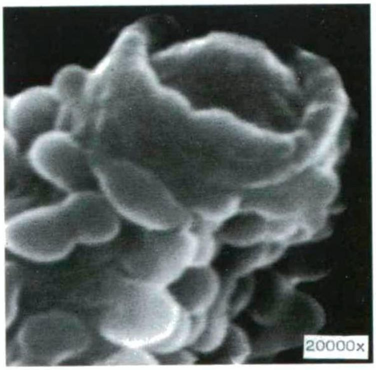
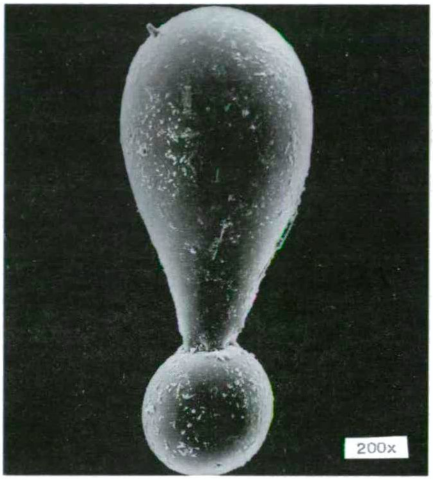


6.

Surface of the higher density glassy tektites



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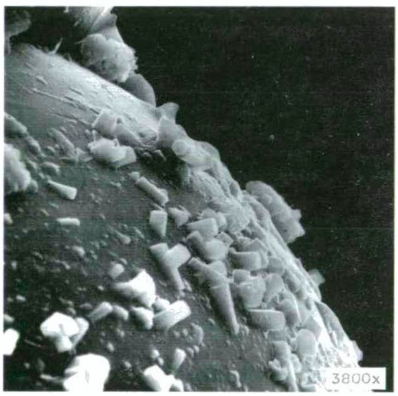

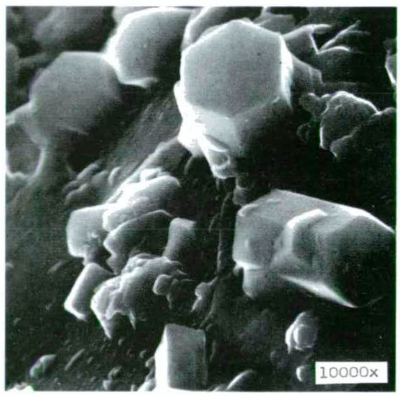

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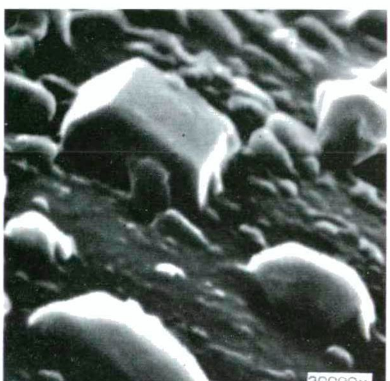

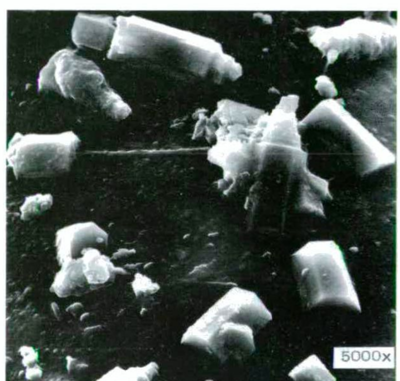

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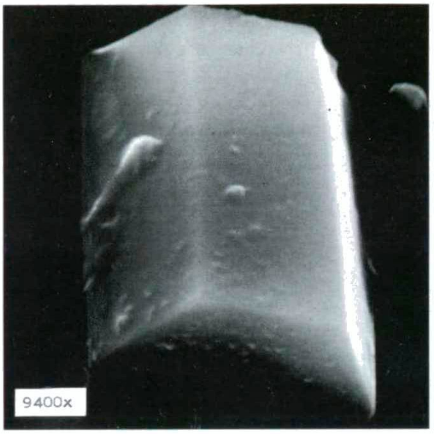
OLDHAMITE PSEUDOMORPHOSE



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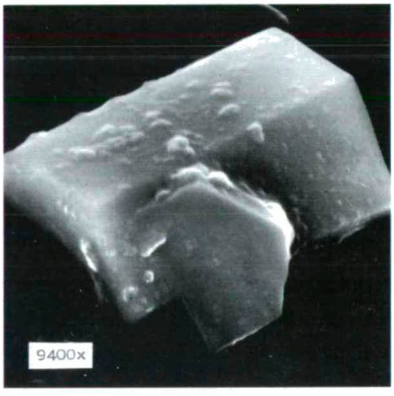

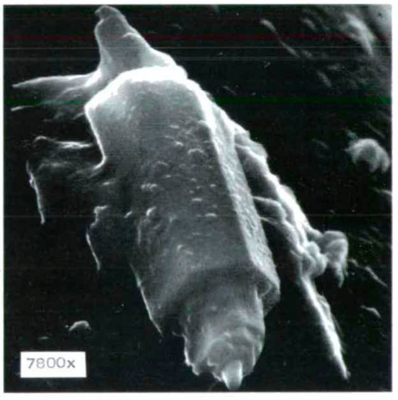

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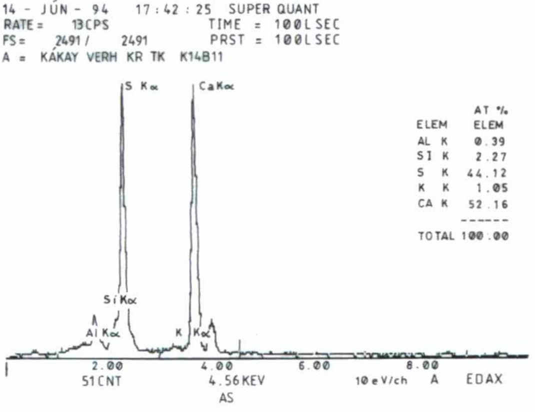
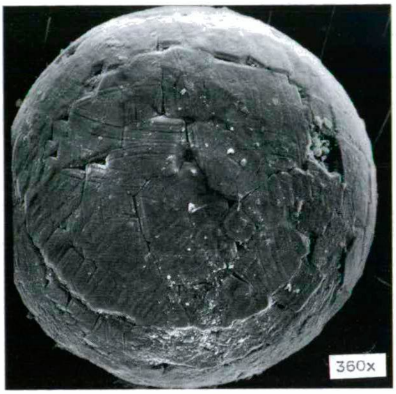


CHEMICAL COMPOSITION OF THE MAGNETOSPHERULE



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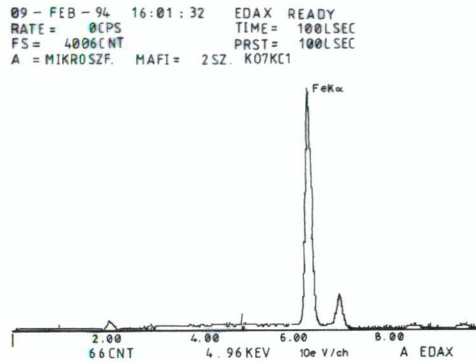

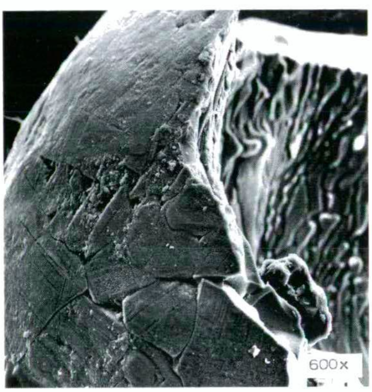

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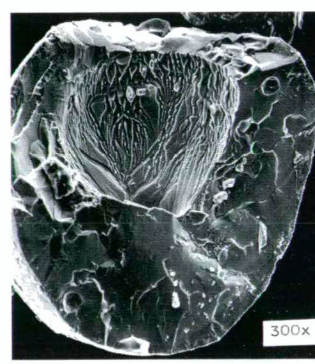

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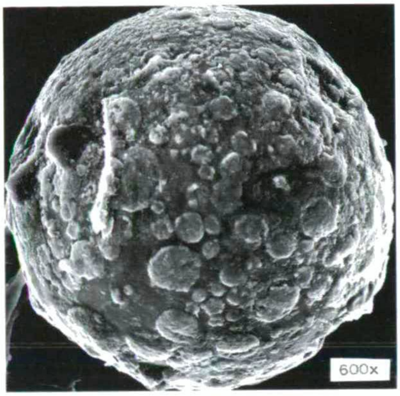
4.

5.

6.

CHEMICAL COMPOSITION OF THE SIDEROSPHERULE



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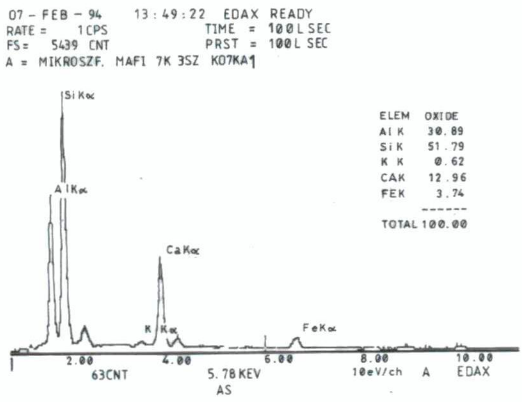
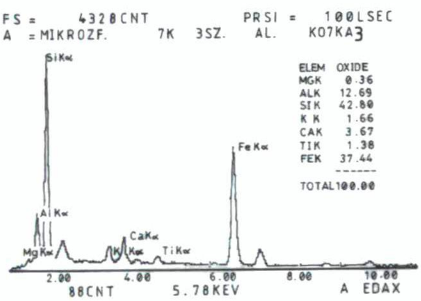
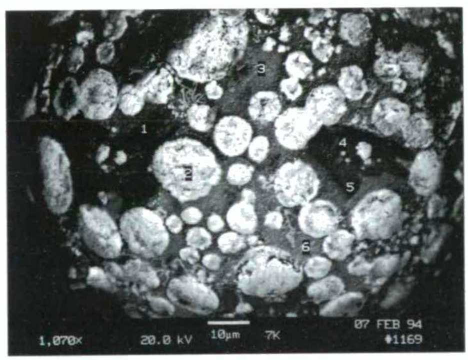
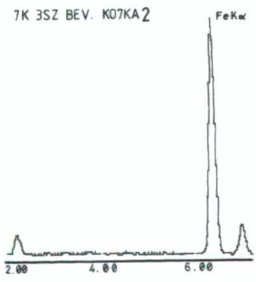
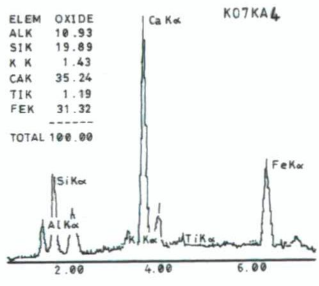
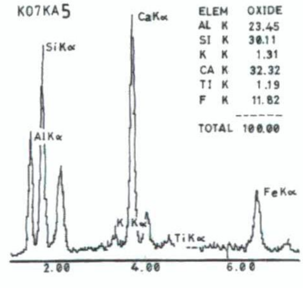




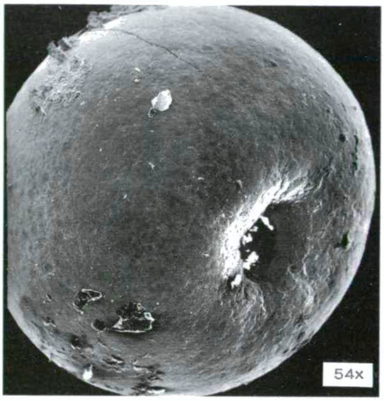


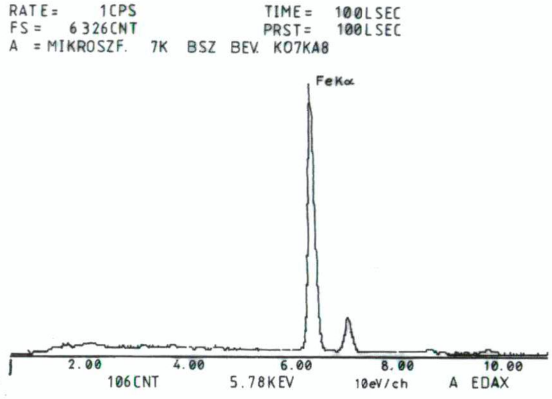






CHEMICAL COMPOSITION AND STRUCTURE OF THE TERRESTRIAL MICRO MAGNETOPEARL





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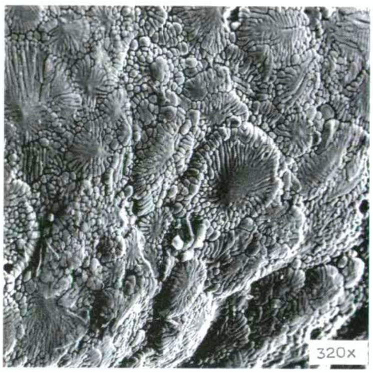
OUTSIDE STRUCTURE



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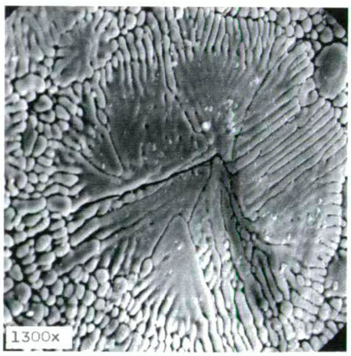

3.

INSIDE STRUCTURE

4.

5.

6.