Summarized Analysis and Conclusion of Fireball-Meteorite "2010.02.28. Košice" from Electron Microscopic Examination

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Introduction: We are introducing our detailed investigations about the 2010.02.28. 22:24:44 UTC fireball-meteorite event which named last Košice Meteorite. First we organized our own expeditions to cameras and later to target, to calculate and find the trajectory and pieces. Last we made the detailed investigations by polarizing/petrographic microscope and SEM/EDX.

The Event: February 28, 2010 was a cloudy evening above Central-Europe and therefore original meteor cameras were turned off. At 22:24:44 UTC a fireball meteor arrived and was recorded by independent Hungarian security cameras.

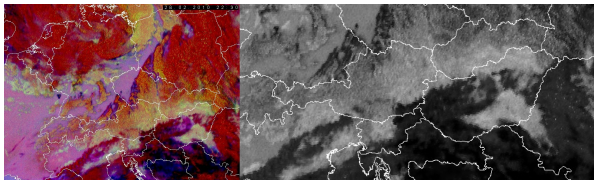


Figure 1. Cloudy above Central Europe February 28, 2010

Figure 2. Unified time synchronized pictures of security cameras

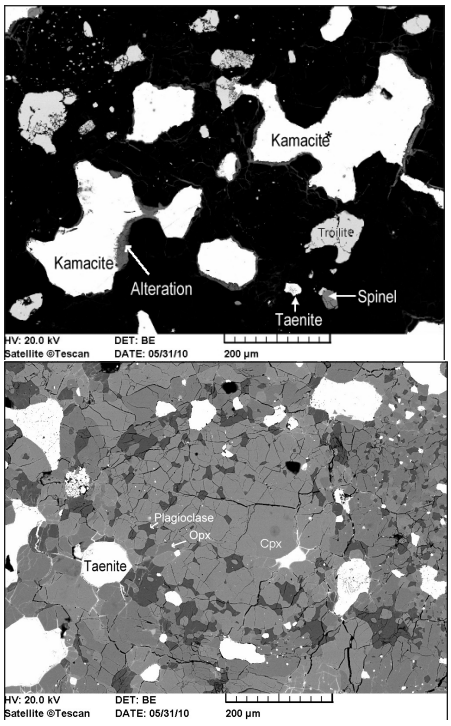
Getting data from "Meteor finder" security cameras: We wrote the methods in our paper [1] and we demonstrated in oral presentation at Tuesday, June 8, 2010 at „The 33rd Symposium on Antarctic Meteorites" at the NIPR, Tokyo, Japan. Here we put additional significant pictures about analyzing and post processing. The unified video visible on youtube by P.G. Vizi [2]

The meteorite: During our missions we collected several potential rocks. Fortunately, one of them was a meteorite. The studied fragment has been deposited in the Eötvös Museum of Natural History, Budapest, Hungary (inv. #BE40643). Another fragment studied has been deposited (inv. #BE40631), see Figure 4 and Figure 5.

Analysis: According the polarizing microscopic examination some part of chondrules are totally altered. Many different types of chondrules occur in the meteorite: barred olivine, olivine-pyroxene, porphyritic, granular-porphyritic. First of all the classification was not too clear because of the state of chondrules, iron content and other mineral components.

Phenocrysts, iron-nickel phases, olivine, pyroxene, feldspar, chlorapatite can be found in the matrix.

SEM/EDX examination: The metallic phases are abundant in the meteorite. Kamacite contains 5.2% - 6.9 % nickel, taenite contains 28% - 55% nickel. The high Ni content of some taenite crystals suggests presence of tetrataenite.



clinopiroxene	w%	6 oxygens
MgO	16.30	0.87
Al_2O_3	1.90	0.08
SiO_2	56.50	2.03
CaO	19.77	0.76
TiO_2	0.59	0.02
Cr_2O_3	0.94	0.03
FeO	3.99	0.12
TOTAL	100.00	3.90

troilite	w%	atom%
Fe	65.84	52.53
S	34.16	47.47
TOTAL	100.00	

plagioclase	w%	8 oxygens
Na_2O	9.21	0.79
Al_2O_3	20.88	1.09
SiO_2	64.95	2.88
CaO	4.04	0.19
K_2O	0.92	0.05
TOTAL	100.00	5.00

kamacite	w%	atom%
Fe	93.84	94.12
Ni	6.16	5.88
TOTAL	100.00	

taenite	w%	atom%
Fe	60.17	61.36
Ni	39.83	38.64
TOTAL	100.00	

tetrataenite	w%	atom%
Fe	44.81	46.04
Ni	55.19	53.96
TOTAL	100.00	

spinel	w%	4 oxygens
MgO	3.37	0.17
Al_2O_3	8.48	0.35
TiO_2	1.59	0.04
Cr_2O_3	58.40	1.60
FeO	28.16	0.82
TOTAL	100.00	2.98

Figure 3. Alteration visible at the edges of metallic phase. Cation number based on 4, 6, 8 oxygen atoms.

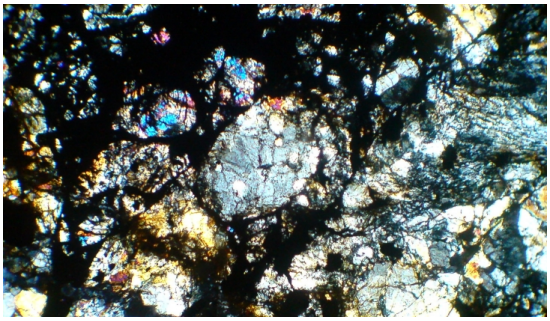


Figure 4. Porphyritic chondrules

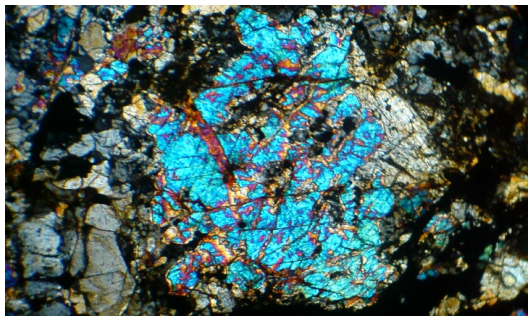
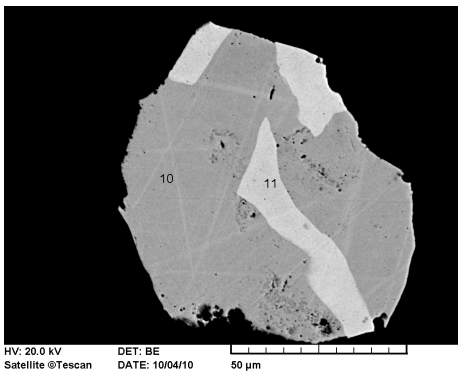


Figure 5. Clinopyroxene



10

kamacite	w%
Fe	94.76
Ni	5.24
TOTAL	100.00

11

taenite	w%
Fe	56.85
Ni	43.15
TOTAL	100.00

14

kamacite	w%
Fe	94.23
Ni	5.77
TOTAL	100.00

15

taenite	w%
Fe	54.00
Ni	46.00
TOTAL	100.00

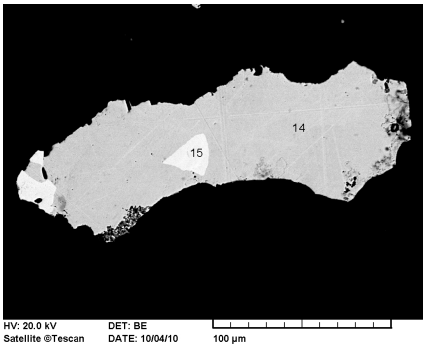
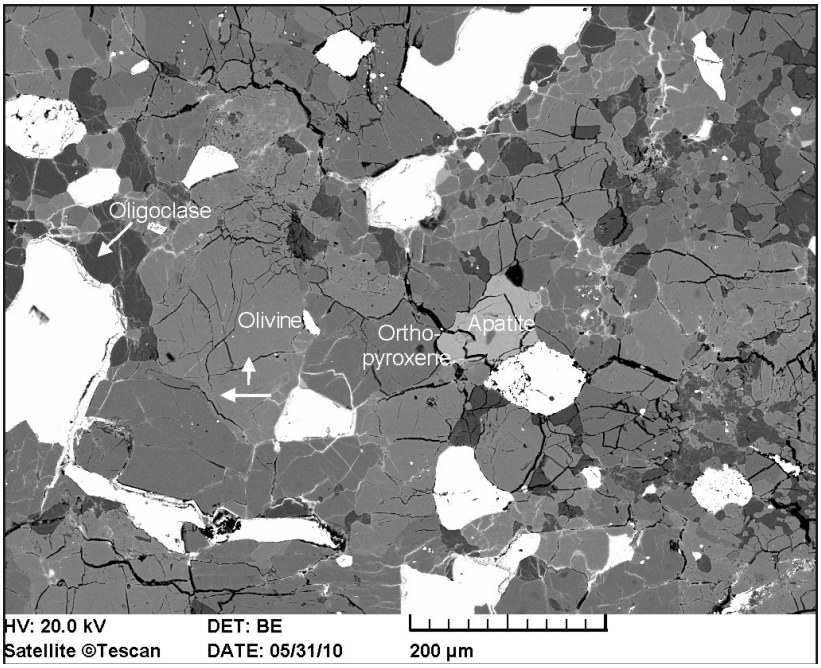


Figure 6. Kamacite and taenite crystals



olivine	w%	4 oxygens
MgO	42.37	1.61
SiO_2	39.36	1.00
FeO	18.27	0.39
TOTAL	100.00	3.00

oligoclase	w%	8 oxygens
Na_2O	9.21	0.79
Al_2O_3	20.72	1.08
SiO_2	65.09	2.88
CaO	4.20	0.20
K2O	0.78	0.04
TOTAL	100.00	5.00

orthopyroxene	w%	6 oxygens
MgO	31.67	1.66
SiO_2	56.95	2.00
FeO	11.38	0.33
TOTAL	100.00	4.00

Figure 7. Kamacite and taenite. Cation number based on 4, 6, 8 oxygen atoms.

Conclusion: From the examinations and measurements of the two pieces the Košice meteorite is approximately H5 type olivine-bronzite chondrite.

References

[1] Kubovics et al. The 33rd Symposium on Antarctic Meteorites, Abstract 'Kubovics', 2010
http://yamato.nipr.ac.jp/AMRC/symposium/2010/abstracts/Kubovics.pdf

[2] Vizi, P.G, Košice (Cassovia/Kassa) Meteorite United Videos, 2010 http://www.youtube.com/watch?v=zd20psyoOrs