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PRELIMINARY REPORT OF KAPOSFÜRED: A NEW IRON METEORITE FROM HUNGARY

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ABSTRACT

An iron meteorite fell at 3 hr a.m. 7th May, 1995 in Kaposfüred, Somogy County, Hungary (Geographical coordinates are: 17°46′ E longitude and 46°25′ N latitude). The meteorite arrived from NE direction with high inclination path and excavated a crater with 1 meter 10 cm deep in the garden of Mnr. M. TÖRÖK. The mass of the meteorite is 2.2 kg. EMPA studies showed that the new iron meteorite may belong to the Si-bearing group of irons (and mesosiderites), a rare group with 5 members in meteorite collections.

THE HISTORY OF THE FALL OF THE KAPOSFÜRED METEORITE

On the evening of 6th May, 1995 Mnr. MARCELL TÖRÖK, priest of the Kaposszerdahely Roman Catholic Parochy, decided he will get up as early in the morning as lightening allows to scythe the fresh grass in his garden. Next dawn awaking to the lightening of the window he opened his door and suddenly observed an impact of a bright object in front of him 7-8 meters in his garden. He felt the hot air of the incoming object and observed that it had a lightning tail, but right now he closed the door. Because of the Bosnian war at that time, his first idea was that a projectile landed in his garden. According to his watch it was 3 o'clock a.m. so he returned to his bed and waited for lightening the sky. After about two hours when the spring sky lighted out he went out to see the object. He found that the impacted body has thrown out the ground toward west, in the direction of the Kaposvár-Fonyód railway. The diameter of the crater was about 1.5 meter and depth 1 meter and 10 centimeter. The crater was elongated toward western direction, and this fact was in accord of the arrival path of East-North-East of the falling body. He also observed that the projectile cut down the peak new branching of the pine and melted the aluminum wire hanged there for drying dress. Then Mnr. TÖRÖK tried to take out the piece of object from the bottom of the crater, and it glued to his dig. Taking out and placing them into a pail of water the two-fist-sized metallic body quickly boiled up and vaporized the water. This was

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the sequence of events Mnr. TÖRÖK could remember, when the authors (A. Sz., I. K., Sz. B.) visited him to hear the details of the story about the new meteorite fall in Hungary.

Before the meteorite fall Mnr. TÖRÖK decided to build a church on his farm-site and asked one of us (A. Sz.) to make the plans and ordered the work. During the preparations of the building the story of the meteorite fall turned out and A. SZABÓ brought the iron meteorite specimen to the Eötvös University, Department of Petrology and Geochemistry. Preliminary investigations (K. G-S.) with the electron microprobe of the department revealed remarkable Si content of the metal.

Attending the 22nd NIPR Symposium on Antarctic Meteorites one of us (Sz. B.) had the occasion to hear the presentation of invited lecturer T. MCCOY (National Museum of Natural History, Smithsonian Institution, Washington D.C., U.S.A.), who spoke about their new melting experiments on Indarch EH4 chondrite (MCCOY et al. 1997a). In his lecture T. MCCOY has shown their (Washington Group) and those of WEISBERG et al. (1997, New York Group) measurements on the EH4 chondrite melt phases: especially focusing on their results between 1100-1450 degrees centigrade. In this temperature range they found that the metallic phase contained 6-8 weight percent Si in the a highly reducing conditions of E-chondrites. He also mentioned the four remarkable high Si-bearing iron meteorites: *Tucson, Horse Creek, Nedagolla and Mount Egerton.* This sequence of events led authors to the conclusion that Kaposfüred is a new Si-bearing iron, the 5th in this group present in meteorite collections.

The high Si content of some iron meteorites is connected to the reduced overall charater of them. (Even cast iron production in technologies with carbon reduction results in 2.5 weight percent Si content of the metal.) Among meteorites there are five different groups with reduced characteristics: the enstatite chondrites, the aubrites, the high-Si-bearing irons, some mesosiderites and the CR chondrites. To place Kaposfüred among them we sketch the mineralogical composition of these meteorite types.

THE E-METEORITE CLAN: E-CHONDRITES, E-ACHONDRITES (AUBRITES) AND OTHER RELATED REDUCED METEORITES

If the main characteristics of meteorites are connected in some special character, but the chemical and mineralogical compositions of them are rather distinct, we group meteorites to clans. (from Scottish clan: large family). The following meteorites have this main characteristic: they are all reduced, their FeO content is low therefore their silicates are mainly enstatite (and sometimes contain forsterite), and they have higher carbon content than that of ordinary chondrite groups. The clan of E-meteorites embraces E-chondrites, E-achondrites (aubrites), some mesosiderites with great enstatite (and sometimes forsterite) content, and Si-bearing iron meteorites, plus the CR carbonaceous chondrite group. Especially the Si-bearing group contains 4 meteorites: *Nedagolla* (India), (as till Kaposfüred the only fall), *Tucson* (Arizona, U.S.A.), *Horse Creek* (Colorado, U.S.A.), and *Mount Egerton* (W. Australia). Moreover two Antarctic meteorites were found to belong to the high Si-bearing group, too: LEW 88631 and LEW 86539 (MCCOY, 1997). The connection of clan members is evolutionary (BÉRCZI, HOLBA and LUKÁCS, 1995): they represent layers from the highly reduced and thermally evolved E-asteroids (ZELLNER et al. 1977).

E-chondrites

Mineral components of E-chondrites are similar to those of other chondrites, but they are present in them with different ratios. They consist of chondrules, lithic and mineral fragments, refractory-rich inclusions, sulfide and metal: all of them embedded in a relatively small amount (10 %) of opaque (carbonaceous) matrix. The FeNi metal is present at ca. 20 wt % (ca. 11 vol. %), as an average concentration, but its range varies between 15 to 30 % for EH and EL groups (SEARS et al. 1982). Sulfide is present at ca 15 wt %. Another characteristic difference is between EH and EL chondrites that the size of the chondrules are larger in EL chondrites: there they may even larger than 2 mm but in EH chondrites chondrules are small, in the k.100 mikrometer range. The pyroxenes are low-Ca orthopyroxenes of enstatite with the range of En$_{95\text{-}99}$ and Wo$_{1\text{-}2}$ content. If olivine exists, it can reach the 5 wt %, but mainly in 3 petrologic class chondrites. (Olivines have the range of Fo$_{100\text{-}95}$ content). The most characteristic E-chondrite (and also E-achondrite) mineral is oldhamite - CaS. Ca-phosphate, pentlandite, daubreelite, schreibersite and perryite are also present (i.e. LODDERS, 1996). The metal grains of E-chondrites contain reduced Si in amount of 1.5-2.5 wt % for EH3 types, 2.0-3.5 wt % for EH4-5 and EH6 types and 0.1-0.9 wt % for EL3, 0.5-0.7 wt % for an EL4 (RUBIN, 1997), 2.1 wt % for an EL5 (SEARS et al. 1984) and 1.1-2.1 wt % for EL6 types. (RINGWOOD, 1961, WASSON and WAI, 1970, NEWSOM and DRAKE, 1979, WEEKS and SEARS, 1985, WEISBERG et al. 1997).

There are groups in the E-meteorite clan, which contain metal or metal grains with more or less Si content. These unique meteorites are: **1.** a chondrite - ALH 85085 - with ca. 40 wt % metal FeNi content, but only ca. 1 wt % sulfide content and 3 metal Fe-Ni grains with higher Si content of 3.3, 4.8 and 7.5 wt %, - ALH 85085 resembles in general to CR chondrites (WEISBERG et al. 1988). **2.** the Bencubbin mesosiderite: it has also some metal grains with higher Si content with 2.3 wt % Si in the Fe-Ni. (NEWSOM and DRAKE, 1979, WEISBERG et al. 1997.). **3.** Cumberland Falls has E-chondrite like inclusions with lower Si content, - maximum 0.25 wt % - , in metal grains (NEAL and LIPSCHUTZ, 1981). **4.** It was also shown, that CR chondrites may contain iron grains with 0.25 % Si content, especially it was found in a metal grain of Murchison (GROSSMAN et al. 1979).

E-achondrites with Si-bearing iron

These achondrites are similar to other achondrites in their enstatite mineral component, but they are anomalous in respect of the iron content in them. Because of the amount of iron some of them was classified earlier as anomalous mesosiderites, too. The high Si-bearing iron emerges the following achondrites: *Horse Creek, Mt. Egerton, Bencubbin, Norton County, Aubres, Pesyanoe, Shallowater, Cumberland Falls* (WAI and WASSON, 1969, WASSON and WAI, 1970, NEWSOM and DRAKE, 1979). These members of the E-meteorite clan represent the links from E-chondrites to E-achondrites and Si-bearing irons, but final conclusion about these connections can asserted from melting experiments.

E-CHONDRITE MELTING EXPERIMENTS: E-METEORITE CLAN CONNECTIONS

Till E-chondrite melting experiments only the reduced character was the genetic link for the members of the E-meteorite clan. The most controversial question was the survival of oldhamite, a high melting point sulfide from E-chondrite melting to aubrites.

(DICKINSON et al. 1992, 1996, LODDERS, 1996, FOGEL et al. 1996, MCCOY et al. 1997a, b).

First melting experiments on the EH4 chondrite Indarch (DICKINSON et al. 1992) revealed that in the highly reduced conditions of melting of enstatite chondrites, between 1100-1425 Celsius centigrade even Si became reduced and dissolved in the metal phase. The early experimental melting works (i.e. FOGEL et al. 1996, MCCOY et al. 1997a, b) mainly focussed on the solubility of CaS and other sulfides in the partial melts with aubritic composition.The measurements showed the parallel existing phases and revealed that between 1100-1425 degrees first metallic, sulfide (for an interval two sulfides) and silicate phases coexisted, but at 1400 Celsius centigrade only two phases remained: silicate melt which took up all the sulphur, and metal phase which solved large amount of silicon. (FOGEL et al. 1996, MCCOY et al. 1997a, b.) The fact that Si-bearing iron metal was produced during E-chondritic melting, arranged different E-meteorite clan members as products of thermal history intermediate between E-chondritic and separated aubrite, stony-iron and iron meteorites (by Si-bearing metal and by other melt phases). Here we list (Table 1.) all the E-meteorite clan members related to the Kaposfüred iron meteorite (by their reduced state and high Si content in their metal phase). Most of the data are from BM(NH) Catalogue, GRAHAM et al. 1985., and some from WAI et WASSON, 1969. (The Ni-Si dependence in metals for E-chondrites are from KEIL, 1968, SEARS et al. 1984, WEEKS et SEARS, 1985, NAGAHARA, 1991, WEISBERG et al. 1997 and MCCOY et al. 1997a, b.)

TABLE 1

List of related Si-bearing irons and other meteorites in the E-meteorite clan: E & Cr chondrites, mesosiderites and aubrites

Meteorite name	Find or fall: year	Meteorite type	Main mineral phases	Si content of metal phase	Notes
Irons					
Tucson	Found 1850, Arizona, U.S.A.	iron, ataxite, ring-shaped	metal phase, (9.5 % Ni)	0.80 %	688 & 287 kg Wai, Wasson
Nedagolla	Fell 1870 Jan 23. 7 p.m. India	iron, anomalous	metal phase	0.14 %	ca. 4 kg Wai, Wasson
LEW 86539	Found 1986, Antarctica	iron, without silicate inclus.			McCoy, 1997
LEW 88631	Found 1988, Antarctica	iron, without silicate inclus.			McCoy, 1997
Kaposfüred	Fell 1995 May 7. 3 a.m. Hungary	iron, ataxite	metal phase	cca. 0.20 %	ca. 2.2 kg
Aubrites with iron					
Cumberland Falls	Fell 1919 April 9, 12 h. Kentucky, U.S.A.	aubrite with e-chondritic inclusions	Kakangari-like inclus. forsteritic, 19 wt % total Fe	max. 0.25 % in kamacite grains	ca. 13 kg Neal and Lipschutz, 1981
Shallowater	Found 1936, July, Texas, U.S.A.	aubrite with EH chondritic type inclusions	enstatite, small chondrules, 25-75 micron.diam.	0.9-1.1 wt %	ca. 2.1 kg Keil et al. 1989
Horse Creek	Found 1937, Colorado, U.S.A.	metal rich aubrite	metal embedded in large enstatite	2.5 %	570 g Wai, Wasson
Mount Egerton	Found 1941, W. Australia	metal rich aubrite	enstatite, FeNi, schreiber. troilite	2.1 %	1.7 kg Wai, Wasson

Meteorite name	Find or fall: year	Meteorite type	Main mineral phases	Si content of metal phase	Notes
Norton County	Fell 1948 Febr. 18, 16.h.56.m. Kansas, U.S.A.	aubrite with some nickel-iron inclusions	enstatite, olivine (9%), 1.6 % total iron	0.7 %	ca. 1000 kg, Keil and Fredriksson
Aubres	Fell 1836 Sept. 14. 15.h. France	aubrite	enstatite	0.68 %	0.8 kg, Wasson, Wai, 1970
Pesyanoe	Fell 1933 Oct. 2. 6. a.m.	aubrite	enstatite	0.58 %	ca. 3.4 kg, Wasson, Wai,
Peculiar high-Fe meteorites					
Kendall County	Found 1887, Texas, U.S.A.	anomalous iron +silicate aggreg.	kamacit, silicate and graphite	metal may have been reduced	ca. 21 kg
Bencubbin	Found 1930 July 30, W. Australia	mesosid.metal-silicate breccia, CR chon. related	ca. 60 wt % metal phase, 40 wt % silicate	3 clasts with Si content of 2.3 wt %	54 kg, Newsom, Drake,1979,Weisberg et.al.1997
ALH 85085	Found 1985, Antarctica	related to the CR & EH3 types, unique new type	more than 40 wt % metal phase, 1 wt % sulfide,	3 high Si-bear. grains with 3.3, 4.8 & 7.5 wt %	Weisberg et al. 1997
Enstatite (H) chondrites				Ringwood, 1961, *Keil, 1968,* Weeks	and Sears, 1985, Weisberg, 1997
EH3 chondrites		enstatite chondrites, very poor in matrix material (10 %)	enstatite, sulfide, kamacite, taenite, schreibersite, Lodders, 1996.	1.5-3.5 wt % Si content in metallic grains, av.: 2.5 wt %	i.e. Quingzhen, KotaKota, Parsa, Y-691, PCA-91383, Y-74320,
EH4-5 chondrites		enstatite chondrites	like as in EH3, Weisberg et al.	2.8-3.8 wt % Si content (av. 3.2)	i.e. Indarch,
EH6-7 chondrites		E-chondrites in composition, but without chondr.texture	like as in EH3, i.e. Lin, Kimura, 1997, Kimura et al, 1993.	ca. 2.0-4.0 wt % Si content in metallic grains	QUE 94204, Y-82189,Y-8404, 8414, Y 86004, Happy Canyon
Enstatite (L) chondrites					
EL3 chondrites		larger chondrules than in EH chondrites	like in EH chondrites, but different ratio	ca. 0.2-0.8 wt % Si content in metallic grains	i.e. ALH 85119, MAC 88180, PCA 91020,
EL4 chondrites			plus sinoite, Rubin, 1997	between 0.5-0.7 wt %	QUE 94368
EL5 chondrites		large chondrules 0.98-1.6 mm diam.	enstatite, troilite, kamacite, plagioclase	2.1 wt %, Sears et al. 1984,	Reckling Peak A80259
EL6 chondrites			plus sinoite, more Ni in phosphide	1.3 wt %	i.e. Atlanta, Hvittis, Pillistfer

PRELIMINARY COMPOSITIONAL ANALYSES

Atom-absorption

Preliminary atom-absorption analysis revealed the following composition of the meteorite: Fe - 86.84 wt %, Ni - 7.94 wt %, Co - 3800 ppm, Cr - 260 ppm, Si - 2000 ppm. These preliminary data needs further confirmation, mainly about the Si-content of the meteorite.

SUMMARY

This preliminary report intended to show the place of the new Hungarian iron meteorite Kaposfüred among the related E-meteorite clan members. Detailed compositional measurements will place the new meteorite among the iron meteorite classes, too (SCOTT and WASSON, 1973.). Our thermal evolution studies on the E-type parent body may give a more detailed arrangement of E-meteorite clan members (LUKÁCS and BÉRCZI, 1996, 1997).

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REFERENCES

BÉRCZI SZ., HOLBA Á., LUKÁCS B. (1995): Evolution of chondritic parent bodies I.: Correlation among ferrous components. Acta Mineralogica et Petrographica, Szeged, XXXVI, 143-152.

CASANOVA, I., et al (1993): LPSC XXIV. p. 310. Houston

DICKINSON, T.L., LOFGREN, G.E. (1992): LPSC XXIII. p. 307-308. Houston

DICKINSON, T.L., et al (1992): LPSC XXIII. p. 309-310. Houston

DICKINSON, T.L., MCCOY, T.J. (1996): Experimental REE partitioning in oldhamite: implications for the igneous origin of aubritic oldhamite. LPSC XXVII. p. 309-310. Houston

FOGEL, R.A. (1996): A new aubrite basalt vitrophyre from the LEW 87007 aubrite. LPSC XXVII. p. 369. Houston

FOGEL, R.A., WEISBERG, M.K., PRINZ, M. (1996): The solubility of CaS in abrite silicate melts. LPSC XXVII. p. 371-372. Houston

GRAHAM, A.L., BEWAN, A.W., HUTCHISON, R.(1985): Catalogue of Meteorites. BM(NH), London

GROSSMAN, L., OLSEN, E., LATTIMER, J.M. (1979): Silicon in Carbonaceous Chondrite Metal: Relic of High-Temperature Condensation. Science, 206, p. 449-451.

KEIL, K., NTAFLOS, TH., TAYLOR, G.J., BREARLEY, A.J., NEWSOM, H.E., ROMIG, Jr., A.D. (1989): The Shallowater aubrite: Evidence for origin by planetesimal impacts. Geochimica et Cosmochimica Acta, 53. p. 3291.

KEIL, K. (1968): Mineralogical and chemical relationships among enstatite chondrites. J. Geophys. Res. 73. p. 6945.

KIMURA K., LIN Y., IKEDA Y., EL GORESY, A., YANAI K., KOJIMA H. (1993): Mineralogy of Antarctic aubrites, Yamato-793592 and Allan Hills-78113: Comparison with non-Antarctic aubrites and E-chondrites. Proc. NIPR Symp. Antarct. Meteorites, 6, 186-203. Tokyo

KONG P., EBIHARA M. (1996): Unique features of an anomalous enstatite chondrite LEW87223. 21st Symp. Antarctic Meteorites, NIPR, Tokyo, 81-83.

LIN Y., KIMURA K., (1997): Thermal histories and parent body(ies) of EH chondrites: Evidences from new highly equilibrated EHs (Y793225, 82189, 8404, and 86004). LPSC XXVIII. p. 817-818. Houston

LODDERS, K. (1996): Oldhamite in enstatite achondrites. Proc. NIPR Symp. Antarct. Meteorites, 9, p. 127. Tokyo

LUKÁCS B., BÉRCZI SZ. (1996): Competition of C and H_2O for Fe in E, H, and C chondrites. Antarctic Meteorites XXI. p. 90. Tokyo

LUKÁCS B., BÉRCZI SZ. (1997): Statistical analysis of the NIPR (Japan) Antarctic chondrites; Paths of thermal evolution of parent bodies. LPSC XXVIII. p. 853-854. Houston

MASON, B. (1966): The enstatite chondrites. Geochimica et Cosmochimica Acta, 30. p. 23-39.

MCCOY, T.J. (1997): personal communication, 22nd NIPR Symposium Ant. Meteorites, Tokyo

McCoy, T.J., Dickinson, T.L., Lofgren, G.E. (1997a): Partial melting of Indarch (EH4) from 1100-1425 C: New insights into igneous processes in enstatite meteorites. LPSC XXVIII. p. 903-904. Houston

McCoy, T.J., Dickinson, T.L., Lofgren, G.E.(1997b): Experimental and petrologic studies bearing on the origin of aubrites. Antarctic Meteorites XXII. p.103. Tokyo

Nagahara H. (1991): Petrology of Yamato-75261 meteorite: an enstatite (EH) chondrite breccia. Proc. NIPR Symp. Antarct. Meteorites, 4, p. 144-162. Tokyo

Neal, C.W., Lipschutz, M.E. (1981): Cumberland Falls chondritic inclusions: Mineralogy/petrology of a forsterite chondrite suit. Geochimica et Cosmochimica Acta, 45. p. 2091.

Newsom, H.E., Drake, M.J. (1979): The origin of metal clasts in the Bencubbin meteoritic breccia. Geochimica et Cosmochimica Acta, 43. p. 689-707.

Ringwood, A.E. (1961): *Silicon in the metal phase of enstatite chondrites and some geochemical implications.* Geochimica et Cosmochimica Acta, 25. p. 1-13.

Rubin, A.E. (1997); Formation of sinoite in EL chondrites by impact melting. LPSC XXVIII. p. 1201-1202. Houston

Schneider, D.M., Taunton, A., Benoit, P.H., Sears, D.W.G. (1997): A comparison of the compositions of chondrules in EH and EL chondrites and discussion of some implications. LPSC XXVIII. p. 1257-1258. Houston

Scott, E.R.D., Wasson, J.T. (1973): Classification and Properties of Iron Meteorites. Rev. Geophys. Space Phys. 13. No. 4. 527-546.

Sears, D.W.G., Kallemeyn, G.W., Wasson, J.T. (1982): The compositional classification of chondrites: II The enstatite chondrite groups. Geochimica et Cosmochimica Acta, 46. p. 597.

Sears, D.W.G., Weeks, K.S., Rubin, A.E. (1984): First known EL5 chondrite - evidence for dual genetic sequence for enstatite chondrites. Nature, 308. p. 257-259.

Wai C.M., Wasson, J.T. (1969): Silicon concentrations in the metal of iron meteorites. Geochim. Cosmochim. Acta, 33. p. 1465.

Wai C.M., Wasson, J.T. (1970): Silicon in the Nedagolla ataxite and the relationship between Si and Cr in reduced iron meteorites. Geochimica et Cosmochimica Acta, 34. p. 408-410.

Wasson, J.T., Wai C.M. (1970): Composition of the metal, schreibersite and perryite of enstatite achondrites and the origin of enstatite chondrites and achondrites. Geochimica et Cosmochimica Acta, 34. p. 169-184.

Weeks, K.S., Sears, D.W.G. (1985): Chemical and physical studies of type 3 chondrites - V: The enstatite chondrites. Geochimica et Cosmochimica Acta, 49. p. 1525-1536.

Weisberg, M.K., Prinz, M., Nehru, C.E. (1988): Petrology of ALH85085: a chondrite with unique characteristics. Earth Planet. Sci. Letters. 91. 19-32.

Weisberg, M.K., Prinz, M., Nehru, C.E. (1990): The Bencubbin chondrite breccia and its relationship to CR chondrites and the ALH85085 chondrite. Meteoritics, 25. p. 269-279.

Weisberg, M.K., Prinz, M., Clayton, R.N., Mayeda T.K., Grady, M.M., Pillinger, C.T. (1995): The CR chondrite clan. Proc. NIPR Symp. Antarct. Meteorites, 8, p. 11-32. Tokyo

Weisberg, M.K., Prinz, M., Nehru, C.E. (1997): QUE 94204: an EH-chondritic melt rock. LPSC XXVIII. p. 1525-1526. Houston

Yanai K., Kojima H. (1991): Yamato-74063: chondritic meteorite classified between E and H chondrite groups. Proc. NIPR Symp. Antarct. Meteorites, 4, p. 118-130. Tokyo

Zellner, B., Leake, M., Morrison, D., Williams, J.G. (1977): The E asteroids and the origin of the enstatite achondrites. Geochimica et Cosmochimica Acta, 41. 1759-1767.

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