INVESTIGATION THE SOURCE OF VESICLES IN THE EUCRITIC FUSION CRUST. A. Nicolau-Kuklińska [1] and A. Losiak[2], [1] Space Research Centre, Polish Academy of Sciences, Bartycka 18a, 00-716 Warsaw, Poland, ank@cbk.waw.pl, [2] Institute of Geological Sciences, Polish Academy of Sciences, Twarda 51/55, 00-818 Warsaw, Poland, anna.losiak@twarda.pan.pl.

Introduction: Over 50 000 tons of objects from space reach the Earth every year and deliver "free samples" from different regions of the Solar System [1]. Most of the meteoric material arrives on Earth in a form of small pieces (from 40 to 1500 µm), and they are at least partially affected by high temperature due to atmospheric entry. Better understanding this melting processes allows to uncover micrometeorites origin and history discovery.

In this study, eucritic meteorites are studied: **QUE 97014**, **EET 92003**, **BTN 00300**, **PCA 91007** and **GRA 98098**. All samples have preserved fusion crust (FC) – melted outermost layer of their bodies. Inside the glassy layer of FC we can observe numerous round vesicles (Fig. 1). The process, that is responsible for vesicle formation is not fully understood. We are testing a hypothesis that variable contents of troilite in the meteorite is the source of the variable number of vesicles in the fusion crust of those meteorites.

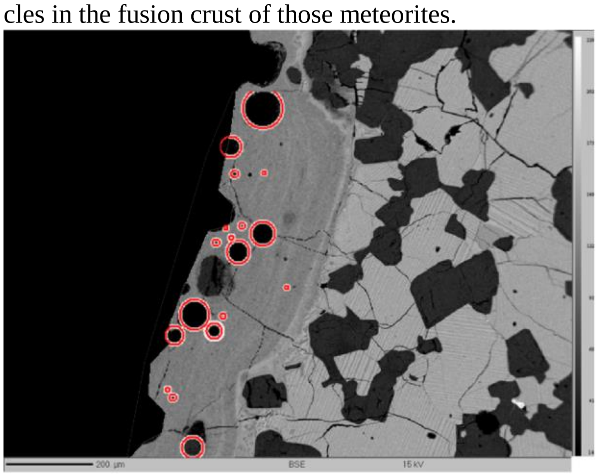

Fig. 1. Vesicles observed in the fusion crust of the GRA 98098 meteorite.

Methods: Our previous analysis allowed to characterize fusion crust of the meteorites in terms of quantity and size of vesicles [2] (see Table 1). Statistical parameters of vesicles were determined by a custom-made Matlab code able to identify vesicles on the SEM images [Fig. 1]. The geochemical composition of the bulk rock and fusion crust of the meteorites was determined by electron microprobe CAMECA SX 100 at the Polish Geological Institute in Warsaw. This allowed to identify troilite crystals in the interior of the meteorites [Fig. 2], and correlate the percentage surface area of the troilite with specific parameters of fusion crust.

Results:

Table 3. Parameters of fusion crusts in studied meteorites.

	QUE 97014	EET 92003	BTN 00300	PCA 91007	GRA 98098
percentage of bubbles in FC / %	42.25	33	27	24	5
average vesicles radius / µm	11.75	11	14	10	12
vesicles radius smaller than average / %	33.25	39	63	39	35
vesicles radius bigger than average / %	59.25	60	37	61	62
the thickness of fusion crust / µm	138	157	152	170	255
avg S content in bulk rock / wt.%	0.024	0.017	0.004	0.011	0.072
avg S content in fusion crust/wt.%	0.052	0.012	0.005	0.010	0.026
Troilite area %	0.113	0.100	0.264	0	0.025

The contents of sulfur, being the most obvious volatile component, which could be exsoluted from the silicate melts at high temperature [3], do not correlate with vesicles occurring neither in the bulk rock nor in the fusion crust. However, some places near fusion crust, contain much more sulfur that surrounding grains and fusion crust.

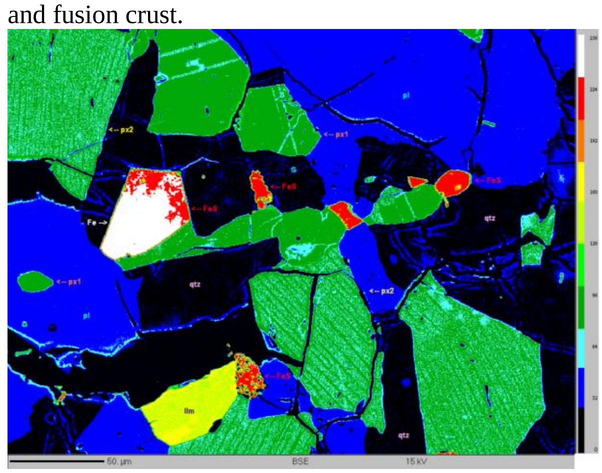

Fig. 2. Troilite crystals FeS (red color) in the interior of BTN 00300 meteorite. Color scale was used to distinguish minerals acourding to their mas. Red – troilite, white – iron, green – pyroxene, blue – plagioclase, dark blue – quartz, yellow – ilmenite.

SEM analyses of all samples of the meteorites show differences with location and size of the troilite crystals within studied meteorites. Percentage area of troilite in bulk composition was used to estimate the amount of troilite present in area of fusion crust before it melted. Troilite content does not correlate with area covered by vesicles in reoccurring (see blue dots in Figure 3). Furthermore, the vesicles are placed in fusion crust uniformly and very close to each other, unlike troilite crystals, located in meteorite at some distance with irregular distribution.

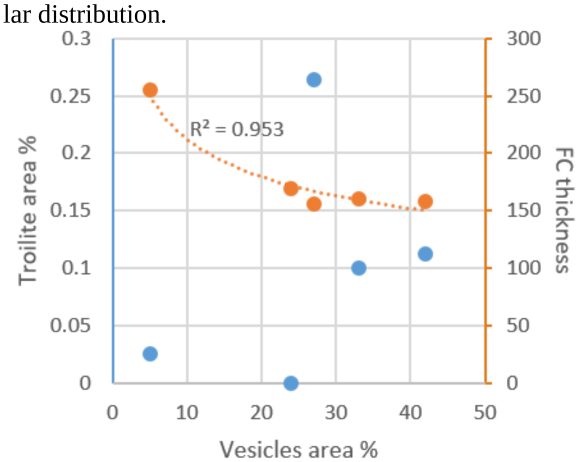

Fig. 3. Relation between percentage of the fussion crust covered by vesicles and 1) percentage surface area of troilite within unmelted part of the meteorite (blue) and 2) thickness of the fusion crust (orange).

Based on our analysis it seems that troilite abundance is not a main factor in the process of forming vesicles, as its contents does not correlate with the percentage of the fusion crust covered by the vesicles.

Interestingly amount of vesicles in the fusion crust correlates with the thickness of the fusion crust. Even though we do not fully understand this process yet, we suspect that thickness of the fusion crust may be in turn related to the temperature of the meteoroid surface during its passage through the atmosphere. Differences in their temperature might have led to slight variations in viscosity of melted material which had an impact on expanding and escaping volatile elements. This could potentially explain the smaller volume taken by vesicles in thicker fusion crust (compare percentage of bubbles in FC and thickness of fusion crust for different meteorites in Table 3).

The source of vesicles in the fusion crust is still under investigation.

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References: [1] Greshake A et al. (1998) *Meteoritics & Planetary Science* 33: 267-290. [2] Nicolau-Kuklińska A. and Łosiak A. (2018) *MetSoc 2018*, Abstract #2067. [3] Genge M.J. and Grady M.M. (1999) *Meteoritics & Planetary Science* 34: 341-356. [4] Campbell-Brown M. D. and Koschny D. (2004) *A&A 418, 751–758.*