IF TROILITE IS THE SOURCE OF BUBBLES FORMED IN THE FUSION CRUST?

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Introduction: When a meteoroid travels through the atmosphere, its outer-most part melts due to high friction between air particles and the cosmic body – this is how the fusion crust (FC) is formed. The morphology of the fusion crust depends on the type of the cosmic body and conditions in which the melting process has occurred (time, temperature). An understanding of the fusion crust formation process is required for to interpretat the properties of the 15 000 tons of cosmic material that reaches the Earth every year, since most of it (95%) is smaller than 1500 µm [1] and reaches Earth surface almost entirely melted.

Eucritic meteorites are achondritic stony meteorites of basaltic composition, likely originating from asteroid Vesta-4. They have relatively uniform chemical and petrologic composition. Despite that different specimens have fussion crusts with very variable amount of vesicles. There is a hypothesis that vesicles are formed by "exsolution of volatile components from the silicate melts" due to high temperature [2]. The aim of this study is to test this hypothesis by analysis of eucritic meteorites and laboratory experiments focused on recreating vesicles within the fussion crust.

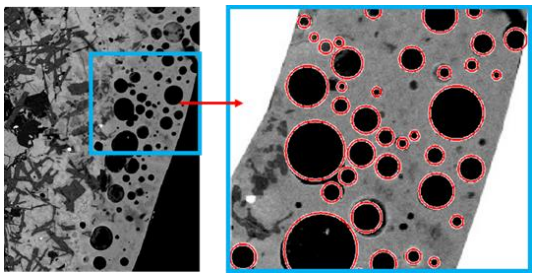

Fig. 1. Vesicles identified by our MATLAB program in the PCA 91007 meteorite.

Studied meteorites: QUE 97014, EET 92003, BTN 00300, PCA 91007, GRA 98098.

Methodology: Statistical parameters of vesicles in studied meteorites, determined by a custom-made Matlab code able to identify vesicles on the SEM images [Fig. 1], were correlated with sulfur contents in bulk rock and fusion crust.

Results: Basic parameters of vesicles within FC and sulfur content are presented in Tab. 1. There is no relationship between wt.% of S in bulk-rock composition and vesicles occuring. The SEM analysis showed a slight decrease in the sulfur content in the fusion crust compared to the interior of the meteorite. However, the max sulfur contents is 0.072 wt.%. Interestingly the sulfur contents increases with distance from the edge of the FC. It can be evidence of existence of point source of sulfur, which under high temperature expands to the form of bubbles. The source of sulfur probably is troilite. QUE 97014 meteorite is one with the highest number of vesicles and in its interior we can observe a big crystals of troilite. Furthermore GRA 98098 meteorite does not contain any significant troilite crystals and does not have almost no vesicles.

Tab. 1. Statistical parameters of vesicles in studied meteorites.

	QUE 97014	EET 92003	BTN 00300	PCA 91007	GRA 98098
percentage of bubles 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	158.5	161	156	170	255
S content in buk rock / wt.%	0.024	0.017	0.004	0.011	0.072
S content in fusion crust/wt.%	0.052	0.012	0.005	0.010	0.026

Further work: We are going to explain the physical phenomenomof creation vesicles from troilite. Simulations will be perform for different melting conditions and different chemical composition of meteorites as well. We are going to present how big amound of troilite is necessary to create specific amount of vesicles.

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References: [1] Greshake A et al. (1998) *Meteoritics & Planetary Science* 33: 267-290. [2] Genge MJ and Grady MM (1999) *Meteoritics & Planetary Science* 34: 341-356.