FORMATION OF VESICLES WITHIN THE FUSION CRUST OF EUCRITIC METEORITES

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Introduction: A fusion crust is one of the most characteristic features present on all meteorites. It is a glassy layer, usually between 100 um and 1000 um thick. It is developed on the outermost part of an object entering a planetary atmosphere by melting this object due to heating induced by hypervelocity collisions with air molecules. Up to now fusion crust has been a subject of only a few papers [1-9]. Vesicles are the most characteristic features of stony meteorites' fusion crust. There is a hypothesis that they are formed by "exsolution of volatile components from the silicate melts" due to high temperature [6]. However an element that gets volatilized and a source mineral phase have not been identified. It is also not sure under which pressure/temperature conditions this process takes place. The aim of this project is to explain the mechanism of vesicle formation within the fusion crust of eucritic meteorites (achondritic stony meteorites of basaltic composition, likely originating from asteroid Vesta-4).

Samples: All of the samples selected for this research come from eucrites of basaltic composition composed mostly of plagioclase and pyroxene, but with different textures, level of breeciation, type and amount of accesory minerals. As a result, despite similar bulk chemical composition, those meteorites are characterized by differently developed fussion crusts.

The following paragraph presents a short description of meteorites that will be analysed in this project: *BTN 00300* is probably a metamorphosed basaltic eucrite and may have come from a magnesian source region [10]. A fusion crust of this meteorite was showed to be heterogenous [9]. *GRA 98098* has coarse - and fine-grained granulitic regions containing low-Ca pyroxene, strongly zoned plagioclase with An_{85} cores, Ti-rich spinel and ilmenite. This meteorite is unique due to content of cm-length crisscrossing veins composed of elongated tridymite grains hosting grains of plagioclase and pyroxene. *GRA 98098* has also an unusual incompatible trace element pattern [10]. *EET92003* – no data in the literature is available. *LEW86001* - this basaltic achondrites is characterized by low terrestrial ages [11]. Pyroxenes in *LEW86001* contain larger and fewer opaque grains than pyroxenes in Juvinas do. The visible tiny needle-like or pellet-shaped opaques are oriented side by side. *PCA 91007* - the most unique feature of it is the presence of numerous, small, spherical vesicles that make up ~0.4 vol% of the meteorite. The spherical shape of these vesicles implies that they formed by exsolution of volatiles from a melt, which was later modeled as a mixed CO-CO_2 gas. *PCA91081* – 30% of this meteorite is covered with black fusion crust. The section shows a fine-grained ophtic intergroeth of pyroxene and plagioclase [12]. *QUE99006* - thin dark gray fusion crust covers 50% of this meteorite's exterior surface. The section consists of a granoblastic matrix of pyroxene (orthopyroxene, with fine lamellae of augite) and plagioclase with coarser basaltic clasts up to 2.5 mm [13]. *QUE97014* - 60% of this eucrite's exterior is covered with highly vesicular black fusion crust. The section consists of fine-grained pyroxene and plagioclase with minor SiO_2. Both Fe, Ti-oxide and iron metal occur in the unusually high level of a few volume percent combined [14].

Methods: We have carried out the analysis of thick sections of listed meteorites using scanning electron microscopy (SEM). Further analysis will be conducted using transmission electron microscopy (TEM) and secondary ion mass spectrometry (SIMS) techniques.

Future work: The project has began in March this year and is at a very initial level.

Studying the development of fusion crusts will allow for the determination of the extent to which re-processing during atmospheric passage is changing the initial material of both meteorites and micrometeorites. Learning more about meteorite fusion crust is important for determining the effect of the constant bombardment of micrometeorites evolution of planetary atmospheres both now and in the beginning of Solar System, [15-16].

Acknowledgments: The research leading to these results received funding from the polish National Science Centre under the Grant Agreement n° 2015/17/N/St10/03165.

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