INVESTIGATION OF THE SOURCE OF VESICLES IN THE EUCRITIC FUSION CRUST

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Why is the mechanism of vesicles formation within the fusion crusts of eucritic meteorites important?

1) Explain fusion crust(177,273),(820,294) creation during atmospheric entry
   Fusion crust (FC) is the outermost part of meteorite, melted during the atmospheric passage of the meteorite.

2) Uncover micrometeorites origin - grain composition of their parent bodies and history discovery
   Micrometeorites are pieces smaller than 1500 µm, at least partially affected by high temperature due to atmospheric entry. They are 95% of 50 000 tons of cosmic bodies entering into the Earth atmosphere [1].

3) Understand evolution of planetary atmospheres both now and in the early Solar System, when the impact rate was higher
   During travel through the atmosphere, a significant portion of mass of cosmic object is ablated and vaporized, injecting volatiles and meteoric dust particles in the air. Those particles have probably delivered part of the volatiles to the inner planets and modified chemical and physical properties of atmospheres [2].

Methodology

Studied meteorites: QUE 97014, EET 92003, BTN 00300, PCA 91007 and GRA 98098 (achondritic stony meteorites of basaltic composition, probably from asteroid Vesta-4, selected because despite their similar chemical and petrological composition, they differ in terms of vesicles abundance in their FC).

Method: electron microprobe CAMECA SX 100 at the Polish Geological Institute in Warsaw (chemical composition of the bulk rock and fusion crust, identification of troilite crystals).

Is troilite the source of vesicles?

Achondritic fusion crust is characterised by spherical vesicles. According to Genge and Grady, the morphologies of these vesicles suggest that they grew by the exsolution of volatile components from a silicate melt [3]. In order to test this hypothesis we compared percentage of vesicles in the fusion crust with the troilite contents within the internal part of the meteorite. Sulfur from troilite is the only volatile element which contents in bulk rock is much higher than in FC suggesting significant degassing. However, percentage area of vesicles in the FC and troilite crystals does not show a significant correlation (Fig. 3).

Discussion

Troilite content does not seem to be the main parameter deciding about the vesicularity level of the fusion crust. There may be a correlation between the meteorite texture and how uniformly vesicles are spread out through the fusion crust. Figure 4 presents SEM images (in the same scale) that show the distribution of vesicles in fusion crusts and troilites in bulk rocks. QUE 97014, EET 92003, and PCA 91007 are characterised by: 1) uniformly distributed vesicles, 2) strongly shattered texture with high porosity, and 3) relatively uniform troilite distribution. On the other hand, BTN 00300 and GRA 98098 are characterised by: 2) vesicles arranged in clusters, 2) large, pristine minerals, 3) larger, unhomogenically distributed troilites.

We still can not explain differences in the percentages of vesicles in crust of eucritic meteorites. It is possible that our inability to untangle this issue is caused by the fact that the average percentage of vesicles in full thickness of FC is not a good indicator of vessicularity. The highest concentration of vesicles occurs in the internal part of the FC, just next to the boundary with the unmelted meteorite. In a thicker FC, the percentage area of vesicles decreases.

Beyond the uncertainty of the results, no other source of volatile element which could causes creating vesicles was perceived.

We will continue investigating this issue. Stay tuned!

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