

THE UNUSUAL FUSION CRUST OF TAMDAKHT (H5) FALL. L. Zennouri^{1,2}, H. Chennaoui Aoudjehane^{1,2}, A. Mazurier³, A. El Albani³. ¹Hassan II University of Casablanca, Faculty of Sciences Ain Chock, GAIA Laboratory, ²ATTARIK Foundation for meteoritics and planetary Science, km 8 Road to El Jadida 20150 Casablanca, Morocco (l.zennouri@gmail.com). ³IC2MP, UMR7285 CNRS, Université de Poitiers, 86073 Poitiers, France.

Introduction: Meteoroids enter Earth's atmosphere at cosmic speeds reaching up to tens of kilometers per second [1]. During this violent event, their surface is subjected to heating due to the friction with air molecules, which results in its rapid melting, leading to the formation of a usually black and thin layer, upon cooling, called fusion crust [2]. The study of meteoritic fusion crusts provides invaluable insight into the physical and compositional variations generated during this transitional stage, from the interplanetary space to the surface of Earth. Tamdakht is an H5 ordinary chondrite that fell in Morocco on December 20, 2008 [3]. It is an important fall, the TKW is up to 500 kg with numerous pieces and so far largest on was 82 kg [4]. Fusion crust of Tamdakht is interesting because of thickness of some specimens fusion crust [5]. Throughout this work, we aim to explore the physical characteristics, the textures and the mineralogical components of the fusion crust of numerous Tamdakht meteorite pieces, in order to establish a criterion that can be useful to understand the process of fusion crusts formation.

Methods: We performed mineralogical and petrographic analysis of several regions of the Tamdakht meteorite due to the marked heterogeneity of its fusion crust. We also examined artificially produced fusion crusts of this meteorite for comparison with natural samples. The analytical techniques used throughout this study are: optical microscopy, X-ray Microtomography in Poitiers, SEM in Pise and EPMA in Paris.

Results and discussion: Both primary and secondary fusion crusts have been identified in Tamdakht. The primary fusion crust is not homogenous, and is millimetric in some areas. X-ray tomography data showed that this layer has an uncommon evolution throughout the outer part of the meteorite (Figure 1). Based on SEM analysis, we noted the formation of new phases such as magnetite, and the gradual disappearance of other phases (such as pyroxene, feldspars and sulfides) from the substrate outwards. In some areas, we detected a mixing between partially and completely melted phases. We were able to distinguish three well-defined layers in mostly all examined regions: (1) an iron-oxide-rich outermost layer. (2) an intermediate layer composed of zoned Olivine with iron-rich rims. (3) a deep layer in close proximity of the substrate, composed of slightly melted silicates. Vesicles are also present, and come in different sizes

and forms. The secondary fusion crust also contains abundant vesicles; however, differently from those found in the primary crust, they exhibit a distinct forms. Other components and features detected in this layer are fractures and silicate minerals that come in the shape of rods. SEM images of the artificially generated fusion crusts of Tamdakht indicate that they comprise ferromagnesian and aluminous silicates, which are shaped like chopsticks, as well as magnetite and abundant vesicles.

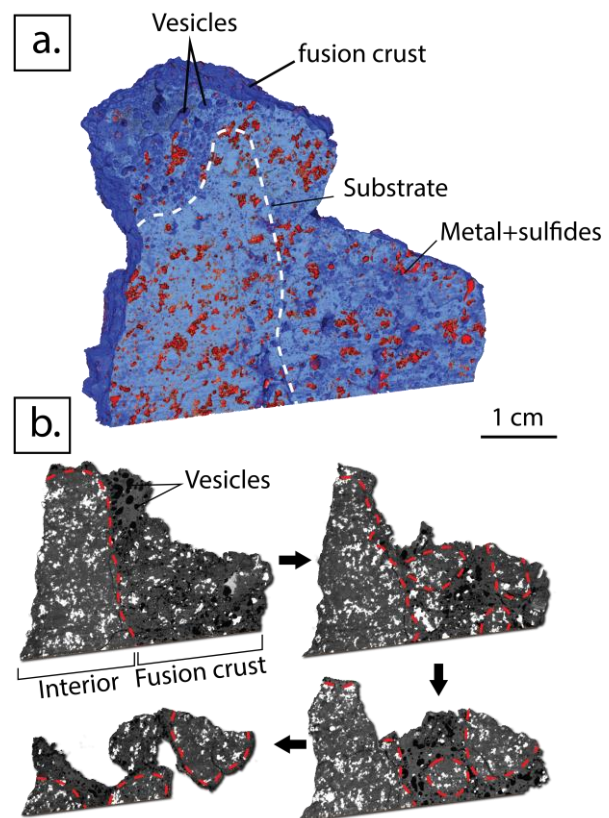


Figure 1: 3D and 2D X-ray microtomography images showing the evolution of the fusion crust of Tamdakht. (a) three-dimensional reconstruction of an end-cut of Tamdakht. Note the presence of abundant vesicles with various shapes and sizes within the fusion crust, which is irregular and vary in thickness. (b) Various 2D images showing the physical and the compositional changes of the fusion crust. Note the presence of mineral and meteoritic fragments, enclosed by the vesicular material within the crust.

Conclusion: based on our results from the analysis of different parts of the fusion crust of Tamdakht, we found that it displays considerable variations in thickness, texture and compositions, which mainly depend on the meteoroid entry conditions, its pre-entry size and chemical composition. We showed that the substrate compositions, the fragments incorporated into the melt, and the grains' size have considerable influence over the composition of the melted layer. We also demonstrated that using the elemental composition of fusion crusts to estimate the bulk composition of meteorites should be approached with extreme caution [6]. In future work, we are aiming to unveil the possible relationship between the total mass of this meteorite with the observed diversity in textures and compositions of its fusion crust.

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