# Elucidating the emplacement mechanisms of the Rochechouart suevite and impactoclastite sequence: high-resolution petrography and element mapping of the Chassenon drill cores.

Kaskes, Pim; Faucher, Juliette; Dehais, Thomas; Goderis, Steven; Lambert, Philippe; Spray, John; Claeys, Philippe

*Published in:*
ICF-CIRIR 2022 conference abstracts

*Publication date:*
2022

*Document Version:*
Final published version

# ELUCIDATING THE EMPLACEMENT MECHANISMS OF THE ROCHECHOUART SUEVITE AND IMPACTOCLASTITE SEQUENCE: HIGH-RESOLUTION PETROGRAPHY AND ELEMENT MAPPING OF THE CHASSENON DRILL CORES.

P. Kaskes[1,2], J. Faucher[1], T. Déhais[1,2], S. Goderis[1], Ph. Lambert[3], J. Spray[4], and Ph. Claeys[1]. [1]Analytical-, Environmental- and Geo-Chemistry, Vrije Universiteit Brussel, Brussels, Belgium (pim.kaskes@vub.be), [2]Laboratoire G-Time, Université Libre de Bruxelles, Brussels, Belgium, [3]Centre International de Recherche et de Restitution sur les Impacts et sur Rochechouart (CIRIR), France, [4]Planetary and Space Science Centre, University of New Brunswick, Fredericton, Canada.

**Résumé**: Les échantillons de Chassenon provenant de la structure d'impact de Rochechouart préservent une séquence unique de suevites et d'impactoclastites à grain fin. Pétrographie à haute résolution et la cartographie des éléments caractérisent les composants de la matrice clastique, ce qui permet de mieux comprendre le rôle de l'eau dans le dépôt des impactites.

**Introduction:** The Late Triassic Rochechouart impact structure in Central France has been drilled in 2017, allowing for a comprehensive study of the impact and target lithologies within this complex crater [1,2]. Here, we focus on the three Chassenon drill cores (SC1-3; Fig. 1), which form a near-continuous record of impactite emplacement and therefore provide a unique window into understanding the crater infill history at Rochechouart. Combined, the Chassenon drill cores have preserved a stratigraphy consisting of, from bottom to top, a 26 m thick gneiss unit, a 48.2 m thick melt-poor suevite/monomict breccia interval, a 39.8 m thick melt-rich suevite, and a 1.1-4.5 m thick impactoclastite unit [2]. The latter is an enigmatic, fine-grained, impact melt-bearing, layered unit that intercalates with and potentially partially overlies the suevite unit [2].

The deposition of this Rochechouart impactite sequence is not well understood, with especially the role of water and volatiles being poorly constrained [1]. Previous work on drill core SC2 suggested a forceful sea resurge within the crater in the immediate aftermath of the impact event, responsible for depositing a thick graded suevite unit [3]. This work was focusing on visual granulometric features on the outer drill core surfaces. Here, we use high-resolution petrographic and geochemical analyses of core samples to unravel the nature and emplacement of the suevite and impactoclastite sequence. These analyses are crucial to differentiate between matrix and clast types, to determine their particle parameters and to decipher the corresponding depositional processes, as previously shown for the suevite sequence in the Chicxulub impact structure [4].

**Materials & methods:** Eleven samples of the SC1-3 drill cores were collected during a sampling campaign in January 2021 [5]. High-resolution petrographic analysis (optical microscopy, SEM) and element mapping using µXRF and EDS at the VUB was performed on these samples. Due to a rather homogeneous major element composition [5], digital image analysis proved to be difficult on µXRF maps to segment clast types, so we performed image analysis on EDS maps and BSE images of the clastic matrix instead. Two representative thin sections were selected for this: SC1_3_5-7 (2.91 m depth), including a contact between impactoclastite and uppermost melt-rich suevite, and SC2_53_131-133 (85.5 m depth; Fig. 1), described as a melt-poor, poorly sorted suevite [2]. This digital image analysis determines modal abundances of components within the clastic matrix (Fig. 1), to quantify the particle sizes and shapes, and to infer the overall degree of sorting [6].

**Results:** The different suevite and impactoclastite samples show similar bulk geochemistry [5] and comparable felsic mineralogical components in the matrix, consisting predominantly of quartz, feldspar and phyllosilicates. Median grain-size of the clastic matrix is in the order of 15 µm and it shows a high angularity (median roundness of around 0.30). Petrographically, the impactoclastite is a polymict impact melt-bearing breccia with a clastic matrix and it can therefore be classified as a suevite [7]. However, with its dark crossbedded layers of imbricated grains dominated by phyllosilicaties, it clearly differs from the coarser grained and unorganized suevite below (Fig. 1). Strikingly, in both the impactoclastite and the upper suevite we found potential thermal sintering features surrounding (interlocking) quartz grains (Fig. 1). These features have recently been identified in suevites from the Steen River impact structure in Canada [8].

**Discussion:** The potential thermal sintering features in the clastic matrix implies that the Chassenon suevite units were relatively hot when they were deposited. The lack of vitric melt clasts, exotic target rock clasts and microfossils, clearly different from the Chicxulub peak ring suevite [4], also suggests that water-melt interactions were limited, even though a relatively proximal Late Triassic sea water body has been suggested [3, 9]. Based on the high angularity of the matrix and the general poorly sorted nature of the suevites, we alternatively propose a gravity driven mechanism as the driving force that could have been reponsible for local brecciating and comminution of target rock and minor transport of warm, relatively coherent melt bodies. The impactoclastite unit might represent a fine-grained variant of this process, potentially partly linked to ejecta fallback.

**Conclusions:** Based on this first high-resolution petrographic and geochemical investigation, we did not find compelling evidence suggesting that water was a major driving factor behind the suevite (and potentially also the impactoclastite) deposition at Rochechouart. Additional Chassenon core samples of suevite and impactoclastite intervals, accompanied with detailed halfcore photos, will aid in fully elucidating the formational history of the Rochechouart impactites.


**References:** [1] Lambert P. (2010) *GSA SP. 46,* 509–541. [2] Lambert P. (2018) *LPSC XXXIX*, Abstract #1954. [3] Ormö J. et al. (2019) *LPSC L,* Abstract 2132. [4] Kaskes P. et al. (2022) *GSA Bulletin*, *134*, 895-927. [5] Fauchier J. et al. (2021) *GSA LIII*, Abstract 109-10. [6] Kaskes P. et al. (2021) *GSA SP, 550,* 171-206 [7] Stöffler D. & Grieve R.A.F. (2007) *IUGS*, 82-242. [8] McGregor, M. et al. (2020) *GCA*, *274*, 136-156. [9] Simpson, S.L. et al. (2017) *EPSL*, *460*, 192-200.



**Acknowledgements:** We thank Research Foundation Flanders (FWO; project 11E6621N) and the Barringer Family Fund for Meteorite Impact Research for funding, and CIRIR and the National Natural Reserve for providing samples.


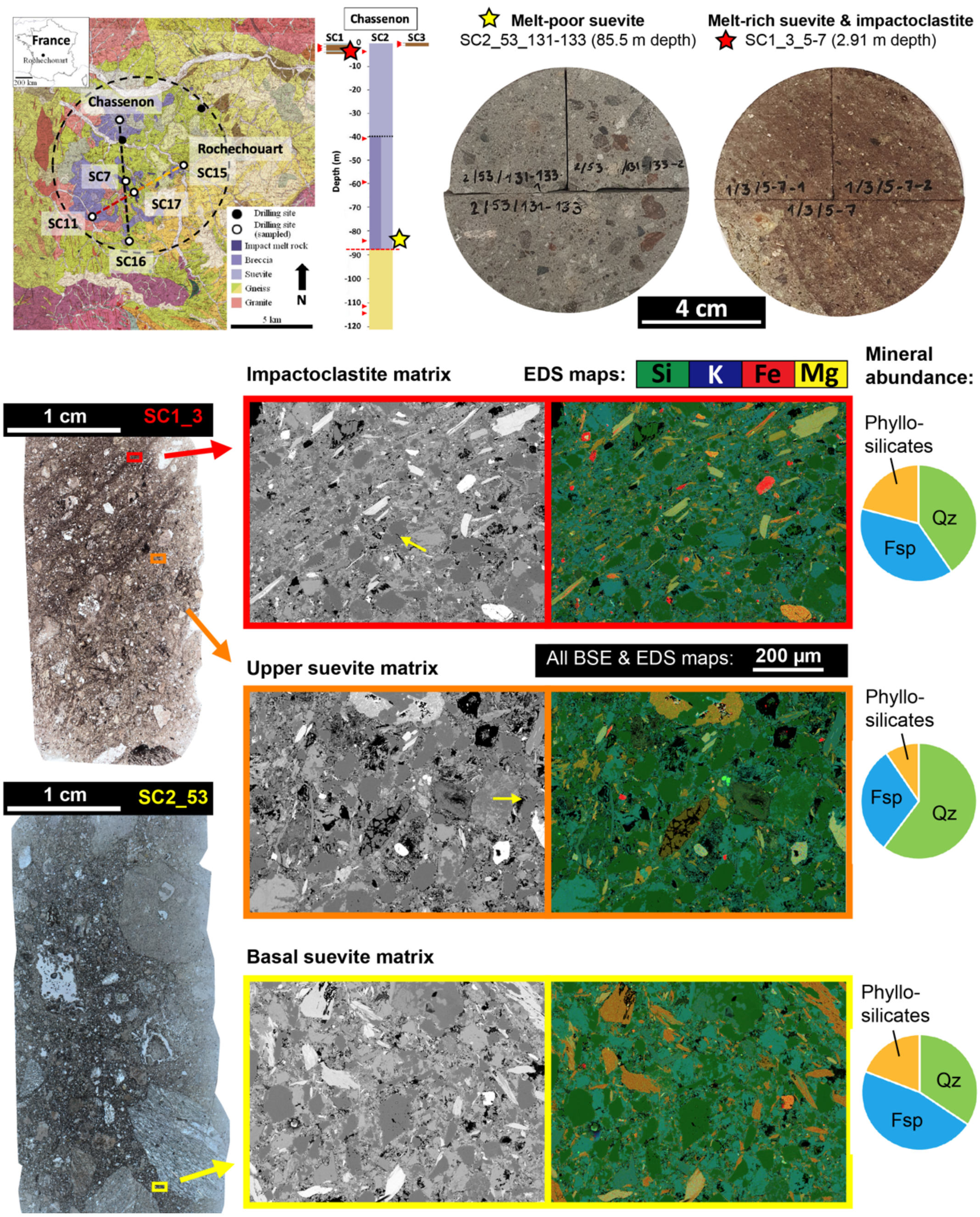


**Fig. 1.** The 2017-Chassenon drill cores shown on the geological map of the Rochechouart impact structure [2,5]. Next to the lithostratigraphy, two core overviews are displayed with a basal suevite and a sharp contact between the upper suevite and impactoclastite. The lower panels show thin section data, highlighting BSE images of the matrix, EDS mappings and modal abundance data based on image analysis [6]. Yellow arrows on the BSE images indicate potential thermal sintering features in between quartz mineral grains [8].