**SEDIMENTOLOGICAL EVIDENCE FOR A FORCEFUL RESURGE AT THE ROCHECHOUART IMPACT CRATER, FRANCE: IMPLICATIONS FOR TARGET ENVIRONMENT.** Jens Ormö[1], Erik Sturkell[2], Philippe Lambert[3], [1]Centro de Astrobiologia INTA-CSIC, Torrejon de Ardoz, Spain (ormoj@cab.inta-csic.es). [2]Earth Sciences Center, Gothenburg University, Sweden. [3]Center for International Research & Restitution on Impacts and on Rochechouart (CIRIR), France.

**Introduction:** The 24km wide, Late Triassic, Rochechouart impact structure is one of the largest impact structures in western Europe. Notwithstanding the apparently deep erosional level, the crater infill sequence is remarkably complete at Chassenon (north-central part of the structure) where a fine-grained, impactoclastic layer is lying horizontally over the suevite, landmarking the top of the sequence [1]. To obtain a better view three holes were cored as part of the 2017 drilling program [2]. Unlike the two shallow cores SC1 & SC3 (respectively 1 and 4.5m deep) developed in two vertical impactoclastite dikes similar to that described in [1], the 121.7m deep SC2 hole, 1.2 m apart from SC1, intersects 88m of suevite and 25m of monomict breccia before reaching a locally brecciated gneissic basement [2]. The upper 40m of the suevite is melt rich and further characterized by successive layers with graded texture raising the question of the possible influence of water during deposition [2, 3]. The location of the impact relative to the sea is currently unknown as no sediments are known to cover the Variscan crystalline basement in the area. However, sedimentological studies of graded impact deposits within craters such as Lockne, Tvären, Chesapeake Bay, Flynn Creek, Wetumpka, and Chicxulub have shown that such deposits can be used to prove the presence of a target sea and even hint on its depth [4, 5, 6, 7, 8].

**Methods:** We have on the upper 66m of SC2 applied the same sedimentological techniques as used on the aforementioned craters to obtain more information on the paleoenvironment at the Rochechouart impact site. A line is drawn along the core, and the granulometry and lithology of every clast ≥5mm that touches the line are described. In this study we note clast size, sorting, roundness, and frequency, both general and lithology-specific. Thanks to the relatively high number of clasts in the SC2 core compared with similar deposits [4, 5, 6, 7, 8], we average the data on a 1/2m elementary line basis, instead of 1m. A total of 3679 clasts were logged and first separated into 19 distinctive classes. For simplicity, these classes were then grouped into four main classes: 1) Melt (includes brown, green, and white), 2) Gneiss (includes various lithologies determined to be part of the gneiss-suite of the area), 3) Granite, and 4) a small, but possibly significant, group of well-rounded lithic clasts that we, in lack of a better name, choose to call "conglomerate" with quotation marks as we do not yet know its genesis.

**Results and discussion:** The results from the line-logging and statistical analysis are presented in Figs. 1 and 2. There are clear trends in the data, which allows comparisons with published data from other craters with similar deposits. Of the 3679 logged clasts 33.3% are melt, 59.3% are gneiss, 7% are granite, and 0.4% "conglomerate". The average melt content among the clasts is high, 45%, in the upper 40m and sharply drops to 17.5% at 40 m depth, supporting the division by [3] of the suevite into an upper and a lower unit based on melt content. In the interval 40-66m there is a slight decrease in number of clasts towards the top. As this is not accompanied with an increase in clast size it is instead more likely a consequence of increased matrix (i.e., mud) content. The sorting is fluctuating around a mean of about 1, i.e., moderately to poorly sorted [9], and shows only a slight improvement in the top five meters of the interval (40-45m). This interval holds a relatively low amount of melt (mainly green). Instead basement material like gneiss and granite dominates. A similar combination of trends is seen in the relatively deep-marine resurge deposits at Lockne (target water depth ~500m) at a stage of collapse of a central water plume (CWP) and initiation of an anti-resurge [4]. A mud-rich deposit carrying a high amount of basement rip-up clasts is dumped rapidly when the transport energy temporarily drops.

The following interval 5-39m begins with a drastic increase in clast size, but is then showing a normal graded sequence. The size-sorting is also gradually increasing upwards. This interval also sees a much higher amount of melt that now includes an increased amount of white and brown. This is typical for a suspension deposit related to water-rich, and strong flow, e.g. Lockne, Tvären, and Chicxulub [4, 8]. In the case of a CWP then this interval of the core was deposited during the anti-resurge. In any case it is deposited from a forceful flow capable of keeping a huge amount of material in suspension.

The uppermost 5m of the core is characterized by normal grading, increased sorting, increased matrix content, more angularity of clasts, increased melt content, and more of white and brown melt. This is distinctively different from that of the impactoclastite layer described in [1] as "…ash-like horizontal deposit of very glass-poor, fine-grained, lithic debris derived from basement rocks". Instead it is more likely a very mud-charged suspension flow with angular, more distal (i.e., higher shocked), ejecta. It is common that the finer grained top

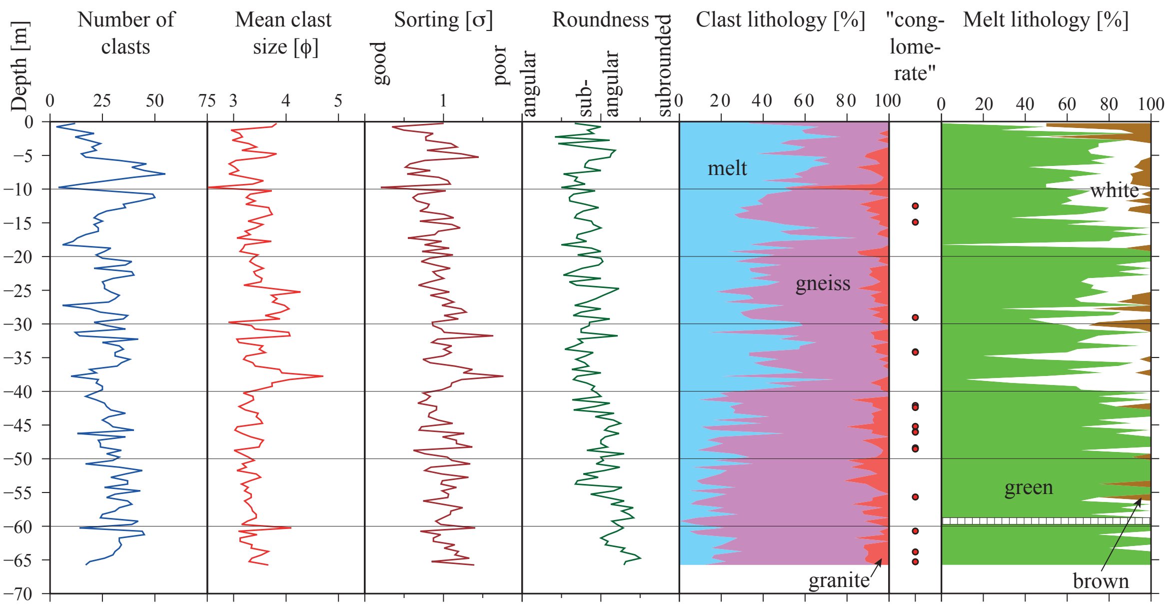


Figure 1. Granulometry and clast lithology distribution of the suevite.

parts of resurge deposits have a higher content of melt and shocked quartz [10]. At Chicxulub increased angularity is coupled with an increased amount of melt fragments, possibly forming shards after rapid quenching in contact with seawater [8]. The circle diagrams in Fig. 2 show that also at Rochechoart the melt clasts express a high angularity. Likewise, the granite clasts show an a higher angularity than that of the gneiss (possibly an effect of rheology), but they are relatively few and evenly distributed along the core, thus not affecting the general roundness graph to the same degree.

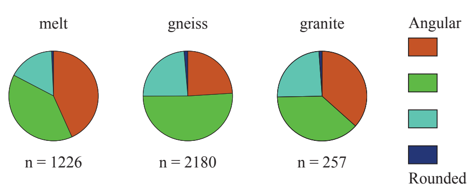


Figure 2. Pie diagrams showing the roundness of the three main lithologies.

A mudcharged, hyperconcentrated flow may hold 20-40%vol of debris, which in the case the whole 88m is a resurge deposit would mean a water depth of the flow of about 120-300m. However, a separation of the resurge deposit into a lower part possibly formed by a collapsing CWP and an upper, more clear suspension deposit, may suggest a water depth of not more than 80-200m depth. Numerical simulations of resurge flows at Lockne and Tvären indicate that the depth of the target sea would be in the same order. These are very rough estimates, but it is clear from the sedimentology of the suevite deposits that there was much water available for the transport. Less water would have generated a complex set of debris flows similar to relatively shallow-water impacts such as Wetumpka [7].

**Conclusions:** Sedimentological analysis of the suevite deposits at the SC2 core near Chassenon suggests a shallow marine target environment for the Rochechouart impact. More generally the Rochechouart impact can be used to further constrain the paleotopography and the erosional history of the Western edge of the French Massif Central

**References:** [1] Lambert P. (2010) Geol. Soc. Am. Spec. Pap. 465, 509–541. [2] Lambert P. et al. (2018) Lunar Planet. Sci. XLIX, #1954. [3] Lambert P. et al. (2019) This conference. [4] Ormö J. et al. (2007) Meteorit. Planet. Sci. 42, 1929-1943. [5] Ormö J. et al. (2009) Geol. Soc. Am. Spec. Pap. 458, 617-632. [6] De Marchi L. et al. (2018) Lunar Planet. Sci. XLIX, #6278. [7] King D. et al. (2014) Lunar Planet. Sci. XLV, #2139. [8] Ormö J. et al. (2018) Lunar Planet. Sci. XLIX, #1221. [9] Folk R. L. (1974) Petrology of sedimentary rocks. Austin, Texas: Hemphill Pub. Co. 182 pp. [10] Therriault A.M. and Lindström M. (1995) Meteorit. Planet. Sci. 30, 700-703.

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