THE ROCHECHOUART 2017-CORES RESCALED: MAJOR FEATURES.

P. Lambert[1] , C. Alwmark, D. Baratoux, S. Bouley, A. Brack, P. Bruneton, E. Buchner, P. Claeys, M.R. Dence, A.Courtin Nomade, I. Duhamel Achin, J.P. Floch, B.M. French, C. Fudge, J. Gattacceca, R.L. Gibson, S. Goderis, R.A.F. Grieve, N. Hauser, K.V. Hodges, F. Hörz, M. Humayun, F. Jourdan, S.P. Kelley, T. Kenkmann, D.A. Kring, F. Langenhorst, J.P. Lebreton, M.R. Lee, P. Lindgren, J. Lofi, J.P. Lorand, B. Luais, V. Masaitis, A. Meunier, C.B. Moore, J. Ormö, G.R. Osinski, S. Petit, P.A. Pezard, M. Poelchau, J. Pohl, Y. Quesnel, C. Ramboz, H. Reeves, U.W. Reimold, P. Rochette, H.M. Sapers, M. Schmieder, P.H. Schultz, S.P. Schwenzer, T. Sharp, C.S. Shoemaker, S.L. Simpson, D. Stöffler, E. Sturkell, H. Trumel, E. Walton, F. Westall, A. Wittmann and K. Wünnemann. [1]*CIRIR-Center for International Research and Restitution on Impacts and on Rochechouart-87600 Rochechouart-France, lambertbdx@gmail.com*

Introduction: Eighteen core holes distributed along two 10-12 km traverses (N-S and NE-SW) across the central breccia deposit of the Rochechouart impact structure (France) were drilled at 8 sites in the "Reserve Naturelle Nationale de l'Astroblème de Rochechouart-Chassenon" [1]. We present and discuss the rescaled and correlated core/borehole wall observations after the CNRS (Geosciences Montpellier) acquired oriented optical images of the deepest holes using an OBI manufactured by ALT / Mount Sopris.

Results: The main lithological units and details on the various facies, structural-textural features, thickness, depths relative to surface and absolute elevations are given in Table 1 and Fig. 1, both provided full-scale at https://ciriredu.files.wordpress.com/2019/01/lpsc-50-lambert-al.pdf. The final rescaled cumulative depth drilled is 544 m (6% deeper than initially reported [1]). The comparison between the borehole wall images and the cores confirms that 1 m of yellow, massive, clast-poor impact melt rock is missing at -12 m in SC11, and 20 cm of clay are missing at -14 m in SC18. The remaining 542.8 m were recovered and are available for studies.

As expected [2], the holes intercept both crater fill materials and/or underlying rocks. The clast size is small (10 cm or less) in the upper part of the cores in the crater fill. Clast size increases and breccia clast population decresases in variety with depth. At least at SC2 and SC7, probably at SC11 and possibly at SC16 and SC 18, the bottom of the crater fill deposit is quasi monomict and dominated by large meter/multimeter brecciated blocks of the underlying target. When they are intercalated with thin layers of polymict breccia and/or impact melt rock (SC2/U3-SC11/U2-SC16/U2-3-SC18/U1), it is not clear if these monomict units and breccia blocks belong to the bottom of the crater fill or to the top of the parautochthonous target. This results in an uncertainty of 117.2 m for the cumulative thickness estimate for the crater fill as given in Table 1 (260.2-377.5 m). The elevation of the crater floor is the same over the whole drilled area (ca. 200 m). It is slightly lower at the northernmost hole (SC2-152 m) and slightly higher at the southernmost hole (SC16-258 m), in agreement with a 1% inclination towards the north of the entire impact structure already noted by [3]. No sedimentary rocks are observed in the cores. With the exception of graphite, found as loose "chewing gum"-like deformed clasts and as clasts of graphitic gneiss, all the target lithologies represented in the drillings have previously been reported from surface exposures [3]. They are characteristic of the granitic-gneissic metamorphic rocks of the western edge of the Variscan Massif Central.

HOLE			LOCATION			FEATURES (from top to bottom)			
						CRATER FILL		UNDERLYING TARGET	
REF.	Depth driller (m)	DEPTH (m)	SITES	Latitude	Longitude	Thickness (m)	Lithology	Thickness (m)	Lithology
SC1	4.5	4.5	No.1: Chassenon	45°50'36.87"N	0°46'10.18"E	4.5	Vertical impactoclastite dyke		
SC2	121.7	121.4		45°50'36.86"N	0°46'10.06"E	39.8	Melt-rich, graded suevite with impactoclastite intercalations		
						48.2	Melt-poor suevite		
						26	Brecciated gneiss blocks densely piled at the bottom of the crater fill	26	Monomict breccia (Gneiss)
								7.4	Gneiss locally brecciated
SC3	1.1	1.1		45°50'37.60"N	0°46'9.43"E	1.1	Vertical impactoclastite dyke		
SC4	10.5	10.5	No.2: Champonger	45°50'8.20"N	0°46'15.04"E	7	Melt-poor suevite		
								3.5	Gneiss and microgranite dyke
SC5	3.2	3.2		45°50'9.86"N	0°46'15.12"E	3.2	Gneiss blocks in monomict breccia		
SC6	3.2	3.2		45°50'9.84"N	0°46'15.72"E	3.2	Monomict breccia (gneiss)		
SC7	60.9	64.6	No.3: Valette	45°48'45.01"N	0°46'9.24"E	16	Impact melt rock including vesicular clasts	0	Not reached by the drilling
						48.6	Suevite or very clast-rich impact melt rock		
SC8	1.1	1.1		45°48'45.09"N	0°46'9.23"E	1.1	Impact melt rock including vesicular clasts		
SC9	1.1	1.1		45°48'44.92"N	0°46'8.50"E	1.1			
SC10	1	1		45°48'46.87"N	0°46'10.75"E	1	Red, clast-rich impact melt rock		
SC11	61.6	66.5	No.4: Puy Chiraud (Videix)	45°47'20.20"N	0°44'55.01"E	16	Red, clast-rich impact melt rock		
						16	Granite dominant clast-rich impact melt rock		
						27	Granite dominant clast-rich impact melt rock, wit bearing multi-meter sized blocks	27	Granite severely deformed, pervaded by melt veins and intersected by impact breccia layers
						7.6	Polymict lithic breccia	7.6	Breccia layer in the target
SC12	1	1		45°47'20.12"N	0°44'54.96"E	1	Red, clast-rich impact melt rock		
SC13	1	1		45°47'20.09"N	0°44'55.90"E	1	Red, clast-rich impact melt rock		
SC14	60.8	65.1	No.5: Rochechouart (castle)	45°49'11.79"N	0°49'4.19"E	1.5	Altered polymict breccia (some melt clasts?)		
								63.6	Gneiss severely deformed (cataclasite, monomict breccia, schliren) intersected by polymict breccias and by impact melt veins
SC15	1	1		45°49'18.35"N	0°49'8.92"E	1	Massive yellow impact melt rock		
SC16	60.5	65.6	No.6: Montoume	45°46'32.24"N	0°46'30.01"E	26	Red ,clast-rich impact melt rock		
						29	Granite dominant clast-rich impact melt rock bearing multi-meter sized blocks	29	Granite severely deformed pervaded by melt veins and cut by m-thick breccia dykes
						10.6	Gneiss dominant clast-rich impact melt rock bearing multi-meter sized blocks	10.6	Gneiss severely deformed pervaded by melt veins and cut by m-thick breccia dykes
SC17	60.2	65	No.7: Recoudert	45°48'15.98"N	0°46'59.15"E	23	Red, vesicular, impact melt rock with a 2m thich massive yellow melt at 12m		
								21.1	Fractured gneiss
								2.5	Breccia dyke (melt-bearing polymict breccia (suevite))
								18.5	Felsic gneiss severely deformed intercepted by breccia dykes
SC18	62.4	67.1	No.8: Champagnac	45°51'20.81"N	0°49'52.15"E	17	Brecciated gneiss blocks densely piled at the bottom of the crater fill	17	Monomict breccia (Gneiss)
								30	Gneiss, fractured locally brecciated
								20.1	Gneiss, fractured and brecciated locally
TOTAL	516.8	544.0				377.5	MAXIMUM	283.9	
						117.2	UNCERTAIN	117.2	
						260.3	MINIMUM	166.7	

Table 1. The Rochechouart 2017-drillings (full size online)

The cores obtained at the center of the structure (SC7, 11 and 17) and the southernmost one (SC16) all start with a red, clast-rich, seemingly horizontal impact melt layer that covers various melt-bearing breccias (Table 1, Fig.1). The northernmost drilling (SC2) did not intercept an impact melt layer but instead an 88 m thick melt-clast bearing breccia, with two distinct units according to texture and melt-clast content. The upper melt-rich unit (SC2/U1) is 40 m thick and displays a series of layers with distinct and sharp variation in granulometry and matrix content, contrasting with the underlying unsorted/ungraded melt-poor suevite unit (SC2/U2-Fig. 1). SC2/U1 also features impactoclastite dykes, some of which are separating the coarse/matrix-poor and fine/matrix-rich intervals in this suevite package (Fig.1) (for more details see the study by [4] dedicated to the upper 66 m of SC2).

Discussion/Conclusions: The widespread "Chassenon polymict lithic breccia" seen on the geological map [5] corresponds to the 48 m thick SC2/U2 unit. This unit is now recognized as a melt-poor suevite. The same possibly applies to the historical "Rochechouart breccia" formation at the foot of the castle, and possibly to part or all breccias mapped as polymict lithic breccias throughout the structure. In Rochechouart, this unit occupies the same position as U2 at SC2 and is underlain by a unit very similar to SC2/U3 (SC14/U2). Our field observation shows some intriguing arrays of vesicles and melt coated clasts in a newly cleared outcrop about 100 m from the SC14 location. This, together with the thick layers of impact melt rock encountered in the drilling (Table 1), leads to the conclusion that the amount of melt preserved in the current remains of the Rochechouart crater fill is higher than previously thought ([3] and refs therein). The sharp variations of textures in SC2/U1 suggest reworking of the top of the crater fill, probably by high-energy water flows, which is also supported by [4]. This raises the question of the nature and origin of the water, either a shallow sea covering the area, and/or a transient resurge overflowing the crater rim due to an impact-generated tsunami in the nearby sea [2-3]. If water did cover the target at the time of impact, it was shallow and there was not a significant rock-forming sedimentary cover as confirmed by the strictly crystalline target composition of the lithic clasts observed in the cores.

Despite of the limited abundance of graphite bearing material in the drillings, it opens the potential for searching and discoving impact diamonds associated with the Rochechouart impact. Graphite bearing rocks are not reported in the central breccia deposit zone but do outcrop 25 km west of Rochechouart as part of the lower gneiss unit of the Hercynian orogeny. The drillings confirm that the central breccia deposit is filling a flat-floored central depression and confirm the lack of central peak [3]. This, combined with the crystalline character of the target (possibly under a thin water layer), could indicate that Rochechouart is a deeply eroded peak ring crater whose now eroded peak ring formed beyond the 12 km diameter central deposit zone. Located even further away from the center and standing higher in elevation (100 m or more), the annular depression would now be entirely eroded.

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Fig.1-Rochechouart drillings 2017-Schematic logs (full size and details online)