THE ROCHECHOUART SIZE, SHAPE, AGE AND ENVIRONMENT. P. Lambert[1], [1]CIRIR, 2-4 Faubourg du Puy du Moulin, 87600 Rochechouart-France, lambertbdx@gmail.com

Résumé : Les récents travaux sur Rochechouart nous questionnent sans trouver pour l'instant de consensus sur sa taille initiale, sa forme (avec ou sans pic central), son environnement (continental ou marin), son âge (fin Trias ou début Jurassique). Cela promet du travail à venir sur Rochechouart pour les géologues et planétologues.

To date, there is no consensus regarding the initial size and shape of the Rochechouart impact crater. The 23 km appearing in the Earth Impact Database are not constrained by direct evidence [1] and a wide variety of sizes has been advocated in recent years both regarding much larger and much smaller sizes. We review and discuss the evidences that are used in support of these various estimates and the questions raised regarding the age of the impact and the environment of the Rochechouart area at the time of impact.

Geology-Paleogeography: Allochthonous breccias meeting all the petrologic characteristics of impact crater deposits are found over a 12 km wide zone [1]. This constrains the minimum possible size of the initial crater. Yet, the structure is deeply eroded and thus, it must have been originally larger. This can be addressed indirectly considering regional paleogeography and geology. The crater fill deposit is exclusively composed of basement material which indicates no or no significant sediment covered the basement at the time of impact.

Gravimetry by [2-4] indicates a -10 mgal Bouguer residual anomaly centered on the breccia deposit. Related to intense fracturing and porosity in the target below the crater floor, the anomaly expands well beyond the exposed breccia deposit (Fig. 1).

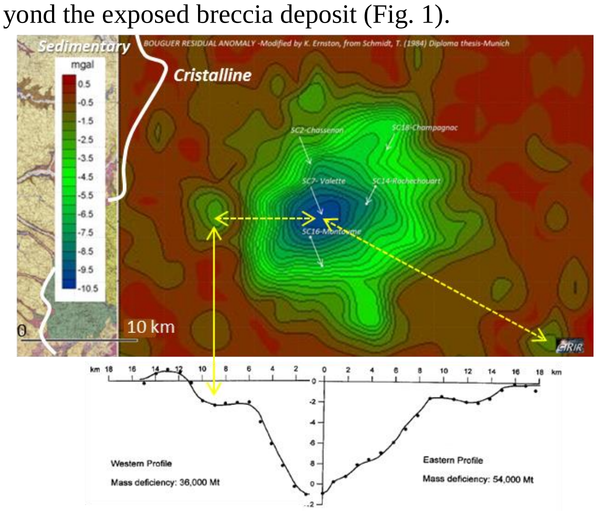

Fig.1-Residual Bouger anomaly after [2-4]on top of the geologic map of W part of the Hercynian Massif Cental

Beyond the central minimum corresponding to the Valette area, noticed an additional ringlike weak relative minimum at 10-14 km radial distance from the central low (Fig. 1). Overall, the anomaly affects an approximately 30 km wide sub-circular zone that may be regarded as the minimum imprint of the intial impact crater.

Shatter cone distribution was proposed by [5] to estimate the apparent diameter of eroded complex craters on Earth. This leads to a 32 km diameter estimate for the original crater.

Compared morphology: Impact craters on solid surfaces in the Solar System all fall into 3 major morphological categories, ranging from simple craters (SC) for the smallest, to central peak (CP), and then peak ring (PR) structures for the largest ones. The cut-off diameter in crystalline targets on Earth is approximately 2-4 km for SC-CP and 40-80 km? for CP-PR. While the crater floor of SC and PR is characterized by a "central low", CP craters are characterized by a central uplift that may provide a practical constraint on crater size/shape, when a crater floor is exposed. This is precisely the case at Rochechouart due to river drainage and drillings. The crater floor stands at 225 m +/- 75 m over the entire breccia deposit including at the center of the structure at the Valette butte (Fig. 2). This excludes Rochechouart as a CP crater, as if it represented such a structure, the floor at Valette would rise by 0.5-1 km above an anular depression. Being too large by far to be a SC, the only alternative left is a PR crater, of which the crater rim, the annular through and annular ring were removed by erosion, leaving at least in places, the bottom of the crater fill deposit in the central depression. This implies an intital crater at least 50-80 km in diameter.

Recent multiscale geoelectrical studies of the Rochechouart impact structure [6] concluded that all the target exposed beneath the 12 km impactite deposit corresponds to the collapsed central uplift of the Rochechouart crater. This also suggests a large crater interpreted as a transitional CP-PR structure [6].

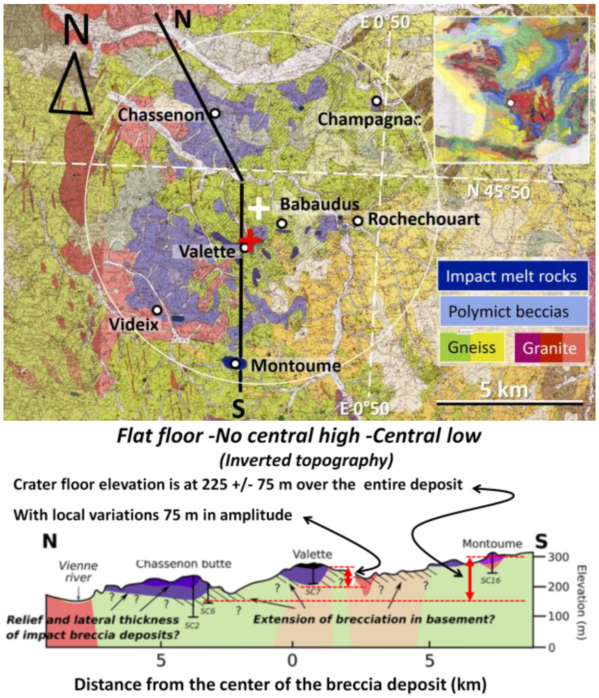

Fig.2-Geological map and cross section (modified after [1] and [6]. Crosses: center of symmetry of the breccia deposit (white)-of the Bouguer residual anomaly (red)

Impact breccia sedimentology: The SC2 drill core at Chassenon revealed a complex graded texture in the upper 80 m of the suevite deposit with rapid changes in granulometry in the first 40 m (Fig. 3). Using a visual line logging method developed to investigate impact deposits in several marine-target impact craters, [7] suggested a marine target setting for the Rochechouart impact, assesed the target water depth as ~200 m and the initial diameter of the crater as 12 km.

Discussion: Depending on the criteria used, the size estimates and even the shape estimates for the initial Rochechouart impact crater vary dramatically. Also the environment, considered until now to have been shoreline yet continental, has been questioned by the sedimentological features observed in the SC2 core. This in turn, raises questions about the generally accepted age of the impact, and the knowledge of the paleogeography of the area at the turn of the Jurassic. A marine impact with a minimum 200 m thick water cover is hardly reconcilable with a Rhaetian age, but might suggest an Early Jurassic age consistent with ~195 Ma ages given by some zircons recovered in impact melts rocks [8-10]. Nevertheless a 12 km diameter does not fit the apparent lack of central uplift. If we increase the size by a factor 2-4, this would require to increase the water depth by even more, which does not seem possible for the entire time span.

However, what could be tested is the possible environmental effect of an impact into the vicinity of a deep sea. It is our case (Fig 1). Could the impact have produced resurge and/or a refracted tsunami wave capable to mobilize enough water to explain the observed features in the SC2 drill core? Are we sure these features cannot be produced by an impact on land? Could the late excavation stage, and/or the rapid uplift followed by collapse of an enormous quantity of materials during the modification stage of cratering have been capable of stirring and transporting large sized blocks as a fluidized megabreccia? Could phreatomagmatic explosions have been able to reinforce the process or be a major contributor to complex deposition disturbances as observed in the SC2 drill core? Such explosions may be conceivable when considering a process where fracturing below the crater floor could have opened conduits for nearby seawater to interact with the hot deposits at the bottom of the crater? An aerial mechanism for the emplacement of impactoclastites and the upper SC2 suevite is debated in [11-12].

Conclusion: The above review leaves us with more questions than answers. It calls for more efforts and more studies to understand the Rochechouart event and the environment at the time of impact.

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