ELECTRICAL RESISTIVITY INVESTIGATIONS ON THE ROCHECHOUART IMPACT STRUCTURE.

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Summary: This study investigates the multiscale electrical signatures of the Rochechouart impact structure (France). Indeed, for the first time, core samples, downhole logging and surface electrical resistivity measurements were performed over an eroded impact structure. It unveils a significant contrast between the melt-rich and melt-poor impact breccia, which was then laterally and vertically mapped around the 2017 drilling holes. It also helps to image the bottom of the crater, which appears irregular at 1 to 50 m scale. Lastly, a magnetotelluric profile crossing the impact structure was started from the northwestern part in Chassenon, revealing the extent of the fracturing and brecciation in the basement, up to 200 m of depth.

In french: Cette étude présente les différentes signatures électriques multiéchelles associées à la structure d'impact de Rochechouart (France). En effet, pour la première fois, des mesures de résistivité électrique à l'échelle de l'échantillon de carottes de forage, dans les trous de forage, et en surface ont été réalisées sur cette structure érodées. Elles mettent en évidence un contraste électrique majeur entre une couche de brèches d'impact riche en résidus de roches fondues et un niveau plus pauvre. Ce contraste a été cartographiée latéralement et verticalement autour des forages réalisées en 2017. Ces mesures permettent aussi d'imager la base du cratère, qui semble irrégulière à plusieurs échelles (1 à 50 m au moins). Enfin, un profil d'observations magnétotelluriques coupant la structure a été initié à partir du nord-ouest de la structure, vers Chassenon, révélant l'étendue de la fracturation et de la bréchification dans le socle, jusqu'à plus de 200 m de profondeur.

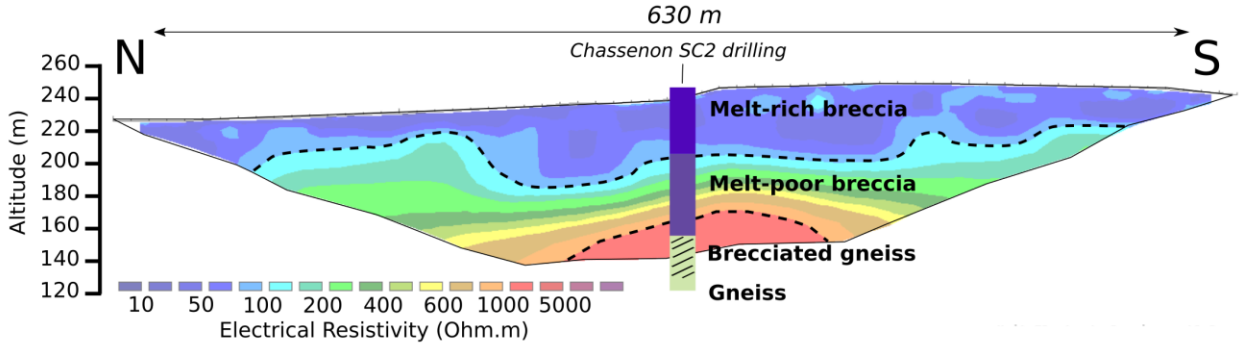

Figure 1: *electrical resistivity cross section over the Chassenon butte and the 120 m deep SC2 drilling, and associated geological interpretations.*

Introduction: Electrical resistivity investigations over impact craters are rare [1], but, in some cases, it can help to better image their deep geometry. For recent simple craters, it can be used to estimate the thickness of the post-impact sedimentary deposits, and/or the impactite formations overlying the target. For complex structures, the electrical resistivity contrasts may reflect uplifted and/or collapsed blocks. Syn-impact faults and/or alteration/mineralized zones can also be unveiled by electrical investigations. However, the characterization of these contrasts depends on the scale of the measurements, as well as on the climatic context (water table). On top of that, using the electrical methods only is often not sufficient to completely image the geological structures, especially without petrophysical constraints.

Context: The Rochechouart impact structure (France) was created about 205 Ma ago in the crystalline basement of the western Massif Central, part of the Hercynian Belt. It led to a 25-30 km diameter crater [2], but today no crater are visible: only thin (100 m max) deposits of impact breccia on the fractured basement are observed in a 10-12 km wide area. It offers the opportunity to access to the transition between impact melt rocks, impact breccia and the target. In 2017, a series of superficial drillings collected more than 540 m of fresh core samples covering all lithologies observed in the area (including basement). In parallel to this campaign, we performed several geophysical surveys in the area, which, surpisingly, was not really investigated until now.

Method: Multiscale electrical measurements were performed [3]. We first measured the electrical resistivity and porosity of core samples from different layers of several drilling holes. Downhole logging electrical resistivity were also acquired in some drilling holes, which can be compared to the core samples measurements. Then, electrical resistivity tomography (ERT) souding profiles were performed over each drilling site and in their vicinity, allowing to image the lateral and vertical extents of the drilled formations. Lastly, audio magnetotelluric (AMT) observations were acquired along a profile crossing the structure, starting from Chassenon in the northwestern part.

Results: The core sample analyses and the downhole logging data revealed a significant contrast between melt-rich (50-200 Ohm.m) and melt-poor (100-1000 Ohm.m) breccia layers (Figure 1). This allows us to clearly follow this transition at larger scale in the ERT profile, revealing a non-flat (relief of about 40 m in amplitude) interface at local scales (1 to 100 m). Similar contrasts and topography are observed between the impactites and the cristalline target (>500 Ohm.m), and between the brecciated and unbrecciated basement (>1000 Ohm.m). The AMT data seems to image significant reliefs (>100 m) and outward dippings (10-30°) of these different buried interfaces.

Discussion: This complete study of the electrical properties of the eroded Rochechouart impact structure shows that the melt content and porosity of the impactite formation are the most important parameters which influence the electrical resistivity, and which can be quantified and imaged by large-scale approaches. It also seems to confirm that Rochechouart may be a transitional mid-size complex impact structure, with a collapsed central uplift that we now characterize with the dipping of electrically-contrasting interfaces.

References: [1] Pilkington M. and Grieve RA.F (1992) *Rev. Geophys., 30*, 161-181. [2] Lambert P. (2010), *In* Gibson and Reimold, GSA Special Paper, *465*, 509-541. [3] Quesnel et al. (2021) *Geoch. Geophys. Geosyst., 22(9)*, e2021GC010036.

Acknowledgements: This work was supported by the Programme National de Planétologie (PNP) of CNRS/INSU, co-funded by CNES, as well as by A*Midex foundation from Aix-Marseille University. It is part of the CIRIR program and benefited from the field expertise and the logistical support of the CIRIR on site. The authors thank the Reserve Naturelle Nationale de l'Astroblème de Rochechouart Chassenon, for allowing the field work carried out on its territories. The authors also acknowledge ANR project EQUIPEX CRITEX (grant # ANR-11-EQPX-0011) for its financial support to the CS-AMT equipment. B. Célérier, G. Henry, L. Brun, and J. Paris are thanked for the downhole logs acquisition, while L. Hervieu, O. Cherait, G. Telansamou, who were students in training internships at the time of the surveys, F. Demory and J. Gattacceca, are warmly acknowledged too.