CHIXCULUB IMPACT CRATER'S PEAK RING: CARACTERISING POROSITY AND FLUID CONDUCTIVITY

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Résumé : De nouvelle propritété pétrophysiques des roches du cratère de Chixculub ont permis de caractériser la nature de la porosité de son anneau central. Ce dernier, composé principalement de roches granitiques, injectées et drappées par des suévites et roches fondues, présente des hétérogénéités en fonction des lithologies. Les granites choqués sont globalement plus poreux et perméables que des granites frais ou altérés, et se comportent davantage comme des roches sédimentaires cimentées que comme des roches cristallines. Les hétérogénités observées entre ces granites choqués et les roches fondues ont des implications sur la circulation des fluides dans l'anneau central. Des données sont également présentées sur la nature des fluides présents dans l'espace poreux de l'anneau central, fluides dont la conductivité est jusqu'à six fois supérieur à celle de l'eau de mer.

A set of physical property measurements was recently published, investigating the nature of the porosity in Chicxulub's impact crater peak ring [1]. The study looks at 29 peak-ring samples from the IODP-ICDP Expedition 364. Among the studied lithologies, the dominant one recovered in the peak ring consists of shocked granitoid rocks (19 samples). Porosity measurements with two independent methods (triple weight and 14C-PMMA porosity mapping) concur and bring new observations on the intensity and distribution of fracturing and porosity in these shocked target rocks. Characterization of the porous network is taken a step further with two other independent methods (electrical and permeability measurements). In order to illustrate how these granitoid rocks have been affected, they are compared with intact and altered granites from the literature. Electrical properties such as the cementation exponent and the formation factor do not compare with other granites; they point at a type of porosity closer to clastic sedimentary rocks than to crystalline rocks. Permeability data also show that unlike other fresh to deformed and altered granitoid rocks from the literature, Chicxulub shocked samples appear to be relatively insensitive to increasing stress (up to ~40 MPa). This observation has implications for the nature of the porous network and the structure of the matrix, again, behaving more like cemented clastic rocks than fractured crystalline rocks. Other analysed lithologies include suevite and impact melt rocks. Relatively low permeability measured in melt-rich facies suggest that, at the matrix scale, these lithologies cutting through more permeable peak-ring granitoid rocks may have been a barrier to fluid flow, with implications for hydrothermal systems.

Looking *in situ*, initial expedition downhole measurements suggested that borehole fluid conductivity was increasing with depth [2]. Corrected at 25°C, borehole fluid conductivities are up to twice as high (~10 S/m at 25°C) as seawater conductivity (~5 S/m at 25°C). Electrical properties (formation factor) measured on core samples [1]; combined with expedition *in situ* downhole logging data (formation conductivity) allow calculating the conductivity of the fluid present in the porous network of the formation. These conductivities appear to be up to six times higher than seawater, notably in melt-rich intervals found at the top, and cutting through the shocked target rocks. A candidate for these high conductivities could be the occurrence of brines, as reported in other impact craters [3, 4]. Further investigations should help understanding the nature and origin of the fluids present in Chicxulub's peak ring.

[1] Le Ber, E. et al. (in press) *JGR Solid Earth*. [2] Morgan, J. et al. (2017) *Proceedings of the International Ocean Discovery Program*, 364. [3] Sanford, W. et al. (2013) *Nature*, 503, 252–256. [4] Scully, J.E.C. et al.(2020) *Nat Commun,* 11, 3680.