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Post-impact hydrothermal system geochemistry and mineralogy: Rochechouart impact structure, France.

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Hypervelocity impacts generate extreme temperatures and pressures in target rocks and may permanently alter them. The process of cratering is at the forefront of research involving the study of the evolution and origin of life, both on Mars and Earth, as conditions may be favourable for hydrothermal systems to form. Of the 170 known impact structures on Earth, over one-third are known to contain fossil hydrothermal systems [1]. The introduction of water to a system, when coupled with even small amounts of heat, has the potential to completely alter the target or host rock geochemistry. Often, the mineral assemblages produced in these environments are unique, and are useful indicators of post-impact conditions.

The Rochechouart impact structure in South-Central France is dated to 201 $\pm$ 2 Ma into a primarily granitic target [2]. Much of the original morphological features have been eroded and very little of the allochthonous impactites remain. This has, however, allowed researchers to study the shock effects on the lower and central areas of the structure, as well as any subsequent hydrothermal activity. Previous work has focused on detailed classification of the target and autochthonous and allochthonous impactites [3, 4], identification of the projectile [5], and dating the structure using Ar-isotope techniques [2]. Authors have also noted geochemical evidence of K-metasomatism, which is pronounced throughout all lithologies as enrichment in K2O and depletion in CaO and Na2O [3, 4, 5]. This indicates a pervasive hydrothermal system, whose effects throughout the structure have yet to be studied in detail, particularly in those parts at and below the transient floor. The purpose of this study is to classify the mineralogical and geochemical effects of the hydrothermal system. Samples were collected via permission from the Réserve Naturelle de l'Astroblème de Rochechouart-Chassenon [6]. Sample selection was based on the presence of secondary mineralization in hand sample and prepared for SEM/EDS and Raman analysis using the facilities available through the University of Glasgow. Oxygen and sulphur stable isotope work will begin in February at the SUERC facility in East Kilbride, Scotland.

Carbonate and sulphide mineral veining is restricted to below the transient crater floor, cross cutting brecciated basement rocks and pseudotachylites Melt-bearing lithologies display heavy argillization, particularly in the melt-rich, vesicular lithologies. Vesicles are lined with sulphates, sulphides and Fe and Ti oxides, and fractured granitic basement has been locally sericitized, particularly in samples containing mineral veins. In altered melt-rich impactites, there is an accumulation of REE's around the periphery of vesicles. Further results from this study will be used to constrain the conditions of the hydrothermal system, particularly temperature and chemistry of fluids, and levels of alteration with respect to location within the structure. As geologic processes and conditions are similar on the Martian surface to those on Earth, findings from this and similar studies may be used as analogues for impact hydrothermal systems on Mars [7].

[1] Osinski, G. R. and Tornabene, L. L. (2013) Icarus 224, 347–363 [2] Schmeider, M. et al. (2010) Meteoritics & Planetary Science 45, Nr 8, 1225–1242 [3] Lambert, P., (1977) Earth and Planetary Science Letters, 3, 258-268 [4] Lambert, P., (2010) The Geological Society of America Special Paper 465 [5] Tagle, R. and Schmitt, R. T., (2009) Geochimica et Cosmochimica Acta 73, 4891–4906 [6] Réserve Naturelle de l'Astroblème de Rochechouart-Chassenon, CCPM Mairie-Place-du-Chateau, 87600, Rochechouart, France [7] Schwenzer, S.P. et al., (2012) Earth and Planetary Science Letters 335–336, 9–17