HYDROTHERMAL ALTERATION FEATURES AT THE LAC COUTURE IMPACT STRUCTURE, CANADA. N. Shahi[1] and G. R. Osinski[2], [1]Department of Earth Sciences, Indian Institute of Technology Kanpur, Uttar Pradesh, India (nandinis@iitk.ac.in), [2]Department of Earth Sciences, University of Western Ontario, London, ON, Canada (gosinski@uwo.ca)

Introduction: Meteorite impacts are one of the mechanisms by which hydrothermal systems can be created [1–3]. In a rocky planetary body, the presence of an impact-generated heat source, H_2O, and fractures can lead to the formation of secondary minerals [1] and the creation of distinctive habitats favorable for the growth of thermophilic organisms [4]. The study of hydrothermal alteration features in impact craters on Earth can also be useful in identifying such systems on Mars [3, 5]. Here we present the findings from our study of hydrothermal alteration features in samples from the Lac Couture impact structure, Canada.

Background: The Lac Couture impact structure is situated in northern Quebec, and is wholly contained in the Lac Couture lake. No in situ outcrops of impactites have been documented, although Beals et al. [6] note that heavily fractured rocks are presented on some of the islands in the lake. The presence of the impact crater was confirmed by the examination of impact breccia boulders found in glacial deposits around the margin of the lake, which show the presence of planar deformation features in quartz individual crystals [6]. The size and age of the structure are estimated at ~8 km and ~425 Ma, respectively, although these metrics are poorly constrained. Overall, very little work has been done on the Lac Couture impact structure since its initial discovery in the 1960s. In this study, we report on the presence of hydrothermal alteration features in samples from the Lac Couture impact structure for the first time.

Method: Optical microscopy was performed on a total of 19 thin sections from the crater using a Nikon ECLIPSE LV100 POL petrographic microscope. Digital high resolution scans of the thin sections were obtained using an Olympus DSX500 opto-digital microscope in order to document the context and location of features of interest in the thin sections. Following this, electron microprobe analysis (EMPA) was conducted on a number of polished thin sections using a JEOL JXA-8530F field-emission electron microprobe. Backscattered electron (BSE) imagery and energy dispersive spectroscopy (EDS) were used to determine hydrothermal alteration textures and phases.

Results: We analysed thin sections from fine-grained, brecciated and inclusion-rich impact melt rocks from the crater. The inclusions were mostly that of shocked quartz. Multiple thin sections had plagioclase and anorthite mineral grains. We identified the presence of several alteration features in these thin sections. Quartz-rich amygdules were dominant (Fig.1). The diametrical size of the amygdules fell in the range of 0.3-2 mm. Oxides were present as clearly-defined grains in amygdules (Fig.1) as well as in the form of rims around other mineral grains. The oxides were mainly that of iron. Clays and zeolites were found to be present as part of the amygdules, surrounded by quartz crystals although some larger clay crystals also occurred outside the amygdules. Saponite, illite, scapolite, vermiculite, montmorillonite and nontronite were the most dominant forms of clays present in the amygdules. In many cases, multiple types of clays were present around one another, with no clear grain boundaries between the different types of clays. Possible zeolites present were clinoptilolite (Fig.2) and analcime. The zeolites also occurred in a pattern similar to the clays and were distributed around quartz and oxide grains in amygdules, often with other clays in adjacent regions (Fig.2).

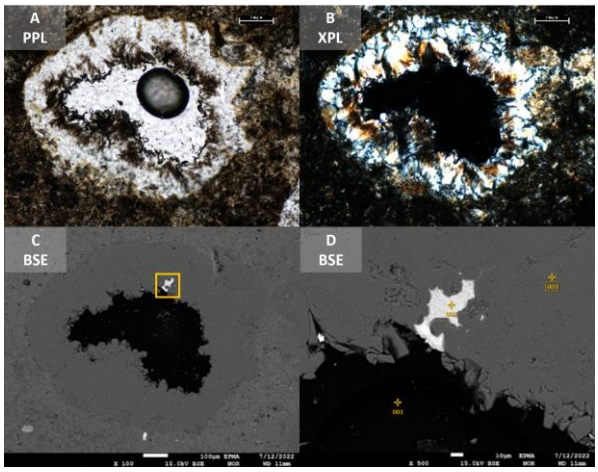

Fig.1. (A-C) Amygdule with predominantly quartz mineralization around the rim and iron oxide mineralization at the inner rim. **(D)** Backscattered electron image showing oxide surrounded by quartz at vesicle boundary. Scale bars are 100 μm in A-C and 10 μm in D.

Discussion and Conclusion: The existence of the above clays and zeolites suggests the occurrence of diagenetic changes in the fractured rocks of the crater as compared to similar rocks outside the crater. It also adds to our current understanding of the composition of secondary minerals which act as catalysts in organic reactions, bringing us closer to finding whether such impact crater systems may have been a habitat for life on Mars.

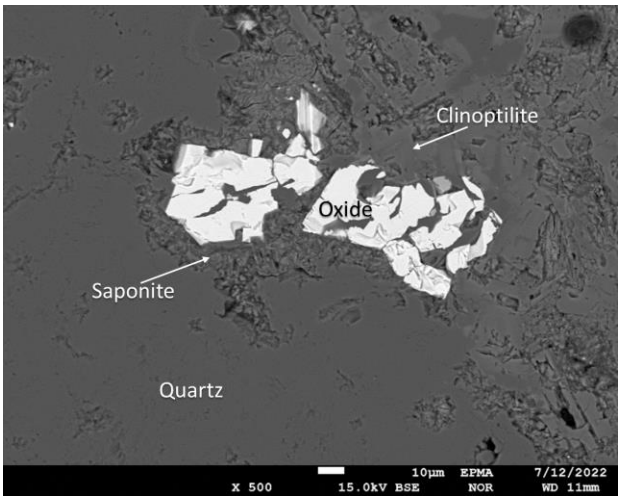

Fig.2. Backscattered electron image of an amygdule section showing oxide, clay and zeolite; iron oxide is white, saponite clay is rough-textured and dark grey, surrounding the oxide, clinoptilite zeolite is smooth-textured and dark grey, located above the right oxide grain, and quartz is the light grey filling throughout.

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