MICROSCOPIC EFFECTS OF SHOCK METAMORPHISM IN ZIRCON FROM THE HAUGHTON IMPACT STRUCTURE, ARCTIC CANADA. A. C. Singleton[1], G. R. Osinski[1,2], [1] Centre for Planetary Science and Exploration/Dept. of Earth Sciences, University of Western Ontario, 1151 Richmond St., London, ON, N6A 5B7, Canada (asingle2@uwo.ca), [2]Dept. of Physics and Astronomy, University of Western Ontario, 1151 Richmond St., London, ON, N6A 5B7, Canada

Introduction: The features that result from the extreme conditions involved in an impact event are diagnostic of these events and can sometimes be related to specific pressure and temperature conditions [1, 2]. Zircon is recognized to be a highly refractory and resilient mineral, which has advantages over quartz, feldspar and other rock-forming minerals. Indeed, zircon is increasingly being seen as a useful indicator of shock metamorphism in the study of impact structures and impactites in general [2, 3]. The aim of this study is to investigate shock metamorphic effects in zircon from the Haughton impact structure, Canada, for the first time.

Geological Setting and Methodology: The Haughton impact structure is a 23 km, ~39 Ma, well-preserved complex crater situated near the western end of Devon Island, Nunavut, in the Canadian High Arctic (75°22'N, 89°41′W) [4, 5]. Over 300 samples of precambrian gneiss samples were collected from 36 sites within the clast-rich impact melt rock unit of this structure and from one site outside the structure. Fifty-two representative samples were selected and polished thin sections were made and investigated in transmitted and reflected light with a petrographic microscope. Select grains were then imaged using an SEM (scanning electron microscope) to provide more detailed information on the microstructures and zoning within the grains.

Results and Discussion: Shock effects identified in the sample set range from level 0 to level 7 indicating shock pressures ranging from 2 to 80 GPa. These shock levels were assigned using the methodology outlined by Singleton et al. [6].

A total of 255 zircon grains from seven representative samples were located, photographed and described using an optical microscope. In the description of each zircon, key descriptors were recorded, including the presence of fractures (linear, sub-linear, or non-linear), zoning, displacements, and granular texture. The percent of grains per sample containing each feature was then determined and the resulting data was represented using a bar graph. From examining this data some general trends may be noted. First, oscillatory zoning steadily decreases as the shock level increases. There does not appear to be a trend in the presence of non-linear and sub-linear fractures but it should be noted that the most highly shocked samples do not display linear fractures. Conversely, granular textures are only observed in samples that are shocked to level 5 or higher. The lack of linear fractures seems to correlate well with samples that show the so-called granular texture. This texture has been described by Wittmann et al. [3] as recrystallized amorphous $ZrSiO_2$ and redite that reverted to zircon.

This is likely do to the fact that the recrystallization that causes this granular texture disrupts the zircon's original crystallinity thus changing its cleavage surfaces. Displacement is present in all samples with the exception of the unshocked sample, suggesting that this is a shock-related feature.

A small number of zircons at shock level of 6 exhibited an unusual "microporous" texture. These grains are rare in this sample set and are found in sections along with fully recrystallized zircon grains. They appear to consist of smooth regions of recrystallized zircon and regions of the aforementioned texture (Fig 1). To the knowledge of the authors, this is the first recorded instance of it. In an attempt to explain the internal variations in texture of these grains, trace element maps were collected.

It is clear from this study that zircons have the potential to play an important role in the identification and understanding of impact structures. This study is the most extensive investigation of its type at Haughton and the focus on zircons adds to previous investigations on main phase shock metamorphism.

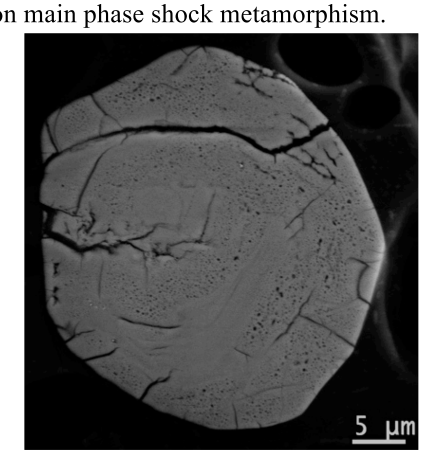

Figure 1. SEM image of recrystallized zircon showing microporosity texture.

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