REVISITING THE DISTRIBUTION AND PROPERTIES OF SHATTER CONES AT THE SUDBURY IMPACT STRUCTURE, CANADA. G. R. Osinski[1], L. Ferrière[2], D. A. Kring[3], D. Anders[1], K. Armstrong[4], D. Baker[5], M. Bamberg[6], C. Beddingfield[7], T. Gaither[8], T. Harrison[1], M. S. Huber[2], D. Hurwitz[3], S. Jaret[9], G. Kramer[3], Y. Kuriyama[10], M. Lucas[7], C. L. Marion[1], C. Mercer[11], C. Mount[12], C. Neish[13], A. Nuhn[1], L. Ostrach[11], A. Pickersgill[1], E. Pilles[1], R. W. K. Potter[3], A. Ryan[11], M. Sharp[14], N. Swartz[15], O. Thomson[16], M. Veto[11], M. M. Wielicki[17] S. Wright[18], M. Zanetti[19], [1]Canadian Lunar Research Network/Centre for Planetary Exploration, University of Western Ontario, [2]Natural History Museum & University of Vienna, [3]Lunar and Planetary Institute, [4]Portland State University, [5]Brown University, [6]DLR, [7]University of Tennessee, [8]United States Geological Survey, Flagstaff, [9]Stoney Brook University, [10]Japan Aerospace Exploration Agency, [11]Arizona State University, [12]Northern Arizona University, [13]NASA Goddard Space Flight Center, [14]University of Maryland, [15]Temple University, [16]University of Puerto Rico Mayaguez, [17]UCLA, [18]Auburn University, [19]Washington University in St. Louis (gosinski@uwo.ca).

Introduction: Shatter cones are one of the most characteristic features of hypervelocity impact events and remain the only diagnostic shock metamorphic criterion recognizable in the field [1]. At Sudbury, shatter cones were first recognized in 1964 and provided the first definitive evidence for the impact origin of this structure [2, 3]. Since then, shatter cones have been used to confirm the existence of dozens of impact craters on Earth. However, several contrasting models for their origin exist [4–7] and the exact formation mechanism(s) remains unclear.

Despite being recognized at Sudbury almost 50 years ago, shatter cones have received relatively little attention. The original map of Guy-Bray published in 1966 [8] was updated slightly by Dressler in 1984 [9]. A recent compilation by Ames et al. [10] differs from these previous maps and includes new observations based on unpublished work by J.P. Golightly. Understanding shatter cones at Sudbury is important for several reasons, not least because they can help to infer the original size and geometry of this deformed structure based on knowledge of how shock attenuates away from the point of impact. At the same time, observations at Sudbury may shed light on the formation mechanism(s) of shatter cones.

Here, we present the first results of a new multi-year research program that aims to systematically map the distribution of shatter cones and their physical properties around the Sudbury structure. This effort was initiated by G.R.O. and L.F. in 2010 and took a major step forward in Fall 2012 as part of the “Impact Cratering Short Course and Field Training Program”, organized by the Canadian Lunar Research Network, the Centre for Planetary Science and Exploration, and the Lunar and Planetary Institute, through the auspices of the NASA Lunar Science Institute. The objectives are to: 1) determine the spatial distribution and radial extent of shatter cones around the Sudbury structure; 2) determine their orientation and identify if there are any systematic variations around the structure; and 3) investigate the morphology, morphometry, and microscopic shock effects of shatter cones around the Sudbury structure.

Methodology: The location of each outcrop was documented using Global Positioning System (GPS) units (provided). The following was recorded at each outcrop: basic description of the lithology in which shatter cones occur; size and how well developed (i.e. 3D full cones or only flat ones) of the cones; whether the apex of the shatter cones points downwards or upwards; trend and plunge of the shatter cone striations: strike and dip of the bedding. Cone measurements were plotted on a lower hemisphere equal area projection (Schmidt net) to determine cone orientation.

Results: Our initial results are broadly consistent with earlier studies of shatter cone distribution in the South Range of the Sudbury structure. In the North Range, however, the cluster of well developed shatter cones in the Milnet region identified by (8) could not be reproduced. In general, shatter cones appear more abundant in the South Range than the North Range. Many of the outcrops studied possessed shatter cones with apices pointing in multiple directions, often in completely opposite directions. This is in keeping with observations from other terrestrial craters (11, 12) and is not explained by current models for shatter cone formation (4–7). Other observations include a possible master cone (13) and intriguing relationships with Sudbury Breccia.

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