THE NICHOLSON LAKE IMPACT STRUCTURE, CANADA: SHOCK FEATURES AND AGE OF FORMATION. M. McGregor[1], C. R. M. McFarlane[2] and J. G. Spray[1], [1]Planetary and Space Science Centre, University of New Brunswick, Fredericton, NB E3B 5A3, Canada, mmcgrego@unb.ca, [2]Department of Earth Sciences, University of New Brunswick, Fredericton, NB E3B 5A3, Canada.

Introduction: As part of a concerted effort to better characterize and date Canadian impact structures (currently totalling 31), many of which have not been studied since their initial discovery, we present new data from the Nicholson Lake impact structure of the Northwest Territories of Canada, including the first higher precision age determination. The ages of most terrestrial impact structures remain poorly defined, save for a dozen or so well-dated exceptions (e.g., Sudbury, Manicouagan, Vredefort, Chicxulub). The challenge is identifying suitable mineral phases to date given the highly eroded state of many craters, as well as the paucity of impact-generated phases, especially in smaller structures where the thermal shock pulse is limited in time and space. New techniques are now facilitating the in situ micro-analysis of mineral phases, as well as the ability to discriminate partial resetting effects. Here we apply this approach to the Nicholson Lake structure using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS).

Geological Setting: The Nicholson Lake impact structure is an ~12 km diameter, eroded, complex crater located within the Rae Domain of the western Churchill Province, Canada (62°4 N; 102°4 W). This province has undergone a complex, polycyclic history spanning 3.4 to 1.8 Ga. At the regional scale, it comprises Neoarchean gneiss and greenstone belts of the Snow River Suite, intruded by biotite leucogranites of the Snow Island Suite and by Hudson granitoids [1]. Middle Ordovician limestones and associated sedimentary rocks overlay the Precambrian basement at the time of impact. Though now largely removed from the region by erosion, the sedimentary rocks can be found in situ and as fragments in breccias within the crater impactites. Previous age constraints, based on Ar-Ar geochronology, indicate a formation age for Nicholson of <400 Ma [2].

Impact Crater Geology: Previous work on the Nicholson Lake crater is limited to the original geological and geophysical studies undertaken by the Dominion Observatory in the 1960s [3], as well as local resource exploration initiatives in the same decade [4]. The crater morphology of Nicholson, unlike comparatively sized craters, such as the Deep Bay [3], does not have a characteristic circular surface expression due to deep glacial scour and other erosional effects. The crater has an average rim-to-rim diameter of 12.5 km with a central uplift region that rises approximately 52 m above lake level [3]. Monomict and polymict breccias (including suevites) are present, in addition to shocked gneiss and granitic basement rocks, some of which are shatter cone bearing. Due to erosion any more extensive impact melt sheet and overlying fallback material present has been removed. The melt-bearing breccias may represent the remains of the interface between fragmented basement and overlying impact melt sheet.

Age Constraints: Because the impact-generated glass-bearing lithologies were hot and melt-bearing at the time of their formation, we tested whether U-Pb resetting of basement apatite could be used to constrain the timing of impact-related heating. A total of 118 grains from 7 different thin sections were analyzed in situ with a 193 nm Excimer laser coupled to a quadrupole ICP-MS. Measurements were externally calibrated against the MAD apatite standard [5] and accuracy checked using in-house apatite from Phalabowra, South Africa. A semi-total Pb/U isochron yields a lower intercept age of 389 $\pm$ 6.7 Ma, which places it in the Middle Devonian (Givetian stage). This result is in keeping with its geological setting (i.e., having to be post-Middle Ordovician: <~470 Ma) and the previous Ar-Ar geochronology (<400 Ma).

We will conclude with presenting the results of petrography, analytical electron microscopy, bulk rock major-, trace- and rare earth-element analysis, and LA-ICP-MS for this previously poorly known terrestrial crater.

References: [1] T. D. Peterson, T. D., Van Breemen, O., H. Sandeman, H. and B. Cousens, B. (2002) *Precamb. Res.*, 119, 73–100. [2] Bottomley, R. J. (1982) Unpublished PhD thesis, University of Toronto, 103 p. [3] Dence, M., Innes, M. J. and Robertson, P. (1968) *Shock Metamorph. Nat. Mater*. 349-360. [4] Leask D. and Pyke, M. 1970. Canadian Delhi Oil Ltd Report, 65-L-10. [5] Thomson, S. N., Gehrels, G. E., Ruiz, J. and Buchwaldt, R. (2012) Geochem. Geophys. Geosyst. 13, Q0AA21 doi:10.1029/2011GC003928.