Analysis of $^{87}Rb/^{87}Sr$ and $^{143}Nd/^{144}Nd$ in Terrestrial Impact Melts: A mechanism for producing early felsic crust in the absence of plate tectonics J.P. Faltys[1], M. M. Wielicki[1], M. D. Wielicki[1] and H.H. Stowell[1], [1]University of Alabama, Department of Geological Sciences, (Jfaltys@crimson.ua.edu)

Introduction: Due to Earth's constant resurfacing, any presence of early crust during the Hadean has inevitably been recycled; leaving no trace of information regarding its composition or abundance. Although modern continental crust formation tends to be associated with plate tectonics, in the absence of a plate tectonic regime a different mechanism is required to produce an evolved crust (e.g., continental crust). One such possible mechanism on early Earth is the processing of the surface through impact melting. Investigating the Rb/Sr and Sm/Nd ratios within multiple portions of fractionated impact melt sheets from Morokweng and Sudbury, we can explore how the crust can be processed into more evolved compositions through impact events. This information can be modeled for an early bombardment history scaled from the lunar surface to investigate impact melting as a viable mechanism for producing abundant early felsic crust in the absence of plate tectonics.

Background: Considerable debate remains about the existence and abundance of continental crust during the Hadean, from a crust dominated by mafic compositions [1, 2, 3] to one with abundant felsic crust [4, 5, 6, 7, 8, 9]. Recently, apatite inclusions in Archean zircons from the Nuvvuagittuq supracrustal belt were analyzed using the Chicago Instrument for Laser Ionization to acquire a >1 Rb/Sr ratio suggestive of an abundant felsic crustal component during the Hadean [4]. $^{87}Sr/^{86}Sr$ ratios are higher in the crust and lower in the mantle due to the substitution of Rb into K-bearing minerals and Rb being incompatible within the mantle. The enrichment of ^{87}Rb in the crust lets it be used as a proxy for SiO_2 content; high $^{87}Rb/^{87}Sr$ ratios with increasing SiO_2**.** This isotopic characterization can therefore be used to distinguish felsic from mafic crust. $^{143}Nd/^{144}Nd$ ratios, unlike $^{87}Sr/^{86}Sr$, are lower in the crust and higher in the mantle due to the incompatibility of the radioactive isotope ^{147}Sm in the mantle. This leads to higher $^{143}Nd/^{144}Nd$ ratios in mafic rocks and lower $^{143}Nd/^{144}Nd$ ratios in felsic rocks. Although the Sm/Nd ratio acts as non-monotonic function when determining SiO_2 content, the Rb/Sr system acts as a unimodal function which is capable of interpreting wt.% SiO_2. Together the two isotopic ratios are capable of providing an estimate of SiO_2 content and examination of how impactors can process an evolved crust.

Methods: Isotopic ratios from the target rocks, amongst multiple portions of the fractionated impact melt sheets from Morokweng and Sudbury, were analyzed using a VG Sector 54 Thermal Ionization Mass Spectrometer (TIMS). Each sample was powdered and weighed via balance beam with UNC-G spike before dissolving in a combination of hydrofluoric and nitric acids (following procedures outlined by the University of Alabama Radiogenic Isotope lab). The remaining solution is then evaporated and centrifuged before pipetting into columns for isotope extraction and then mixed tantalum oxide before loading on a rhenium filament for TIMS analysis of Sm, Nd, and Sr, respectively. Values from TIMS analysis were normalized to 0.7219 for Nd and 0.51685 for Sm. These values were used to extract the spike from the samples and correct for oxide mass differences.

Preliminary Results: Initial TIMS results from sections of the M3 borehole at 156m (granophyric), 342m (norite), and 1063m (basement) of Morokweng present $^{87}Sr/^{86}Sr$ ratios of 0.729168, 0.7292734, and 0.7646331 alongside negative $\varepsilon Nd^{T=145}$ of -27.90, -27.80, and -20.07, respectively; indicating expected upper crustal and felsic signatures, with the strontium results showing an evolution throughout the fractionated impact melt sheet. Likewise, Sudbury samples from the granophyric, norite, and sublayer units display $^{87}Sr/^{86}Sr$ ratios of 0.7172273, 0.7131418, and 0.7096004 with $\varepsilon Nd^{T=1849}$ values of -8.74, -8.52, and -7.14. $^{143}Nd/^{144}Nd$ ratios from Morokweng (0.511022, 0.511027, and 0.511563) and Sudbury (0.509799, 0.509810, and 0.509881) plot within expected values for $^{143}Nd/^{144}Nd$ and $^{87}Sr/^{86}Sr$ ratios in Precambrian granitic rocks which validate these isotopic ratios as the target rocks from the Morokweng and Sudbury impact structures are Archean granitoids.

Future Work: TIMS analysis is incapable of measuring Rb concentrations, however, all samples will be processed and fused into glass beads in addition to pressed pellets for X-ray Fluorescence (XRF) analysis to characterize major and trace element abundances utilizing a Philips Analytical PW2400 XRF. Scaling the enrichment of Rb/Sr from these two terrestrial impact melts utilizing XRF trace element analysis for Rb concentration and applying estimated size frequency distribution of early impactors we will model the expected enrichment of a primitive early crust to further understand the role of impacts in pro-

ducing early felsic crust. This will allow for the determination of whether an impact can indeed generate an enriched Rb/Sr signature as seen in Archean apatite inclusions. and could provide a mechanism for the formation of a felsic crustal component during the Hadean in the absence of plate tectonics.

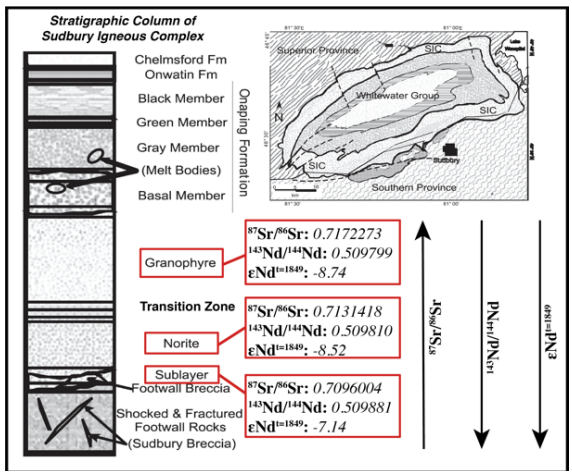

Figure 1: Map of Sudbury impact, Canada and cross section of Sudbury Igneous Complex [10]. $^{87}Sr/^{86}Sr$, $^{143}Nd/^{144}Nd$, and εNd values from the lower sublayer to upper granophyric unit of the Sudbury Igneous Complex. $^{87}Sr/^{86}Sr$ ratios increase as the $^{143}Nd/^{144}Nd$ ratios and $\varepsilon Nd^{t=1849}$ values decrease displaying enrichment of the isotopic evolution from the lower to upper units of the impact site.

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