GEOPHYSICAL MAPPING AND MODELLING OF THE CHARITY SHOAL STRUCTURE, LAKE ONTARIO, CANADA. P. A. Suttak[1], J. I. Boyce[1] and D. Hrvoic[1], [1]School of Geography and Earth Sciences, McMaster University, Hamilton, ON L8S 4L8, suttakp@mcmaster.ca

Introduction: The Charity Shoal structure (CSS) is an enigmatic, crater-like depression located in eastern Lake Ontario, about 25 km south of Kingston. The CSS is defined by a raised bedrock rim, 1200-1400 m in diameter, enclosing a 19.5 m deep circular depression (Fig. 1A). The origin of the CSS is uncertain but it has been interpreted as a (Ordovician age?) meteorite impact [1]. A detailed geophysical survey was performed over the structure and 2-D magnetic forward modeling was conducted to evaluate its origin.

Methods: Magnetic, seismic and bathymetric surveys were conducted across a 9-km^2 grid over Charity Shoal in July, 2012. Sub-bottom seismic profiles were acquired with a 12-24 kHz chirp profiling system (Fig. 1C). 2-D forward modeling was conducted using GM-SYS^{TM} to evaluate three geological scenarios: 1) a meteorite impact in Precambrian basement, 2) a diatreme (Jurassic-age) and 3) a synclinal structure (depression) within the Precambrian basement.

Results: The CSS is defined by a ring-like magnetic high and central magnetic low (Fig. 1B). The total field magnetic anomaly is large (> 1500 nT) and cannot be accounted for by the 19.5 m deep basin within the Paleozoic bedrock.The anomalies large magnitude indicates a deep basin and/or demagnetization effects in the Precambrian basement rocks below the structure. Demagnetization effects are associated with meteorite impacts due to shock melting of target rocks but can also be produced by intrusive bodies with remanence directions that oppose the modern main field.

Forward modelling results verify that the observed total field anomaly requires a deep depression in Precambrian or a remanence opposing the main field. A volcanic intrusive origin is also unlikely, as the modelled diatreme produces complex, short wavelength anomalies not present in the observed signal. A simple structural depression (syncline) in the Precambrian basement can be fitted to the observed data but requires a magnetic susceptibility ($4x10^{-1}$ SI) larger than the mean value for Precambrian basement rocks in the region. The impact crater model best reproduces the observed anomaly when the basin is modeled as a 450 m deep parabolic impact crater in the Precambrian basement. The modeling results exclude the origin of the CSS as a shallow erosional feature and are most consistent with a meteorite impact or structural depression (syncline) within the Precambrian basement.

References [1] Holcombe T. L. et al., (2013) *Geo. Mar. Lett.*, DOI 10.1007.

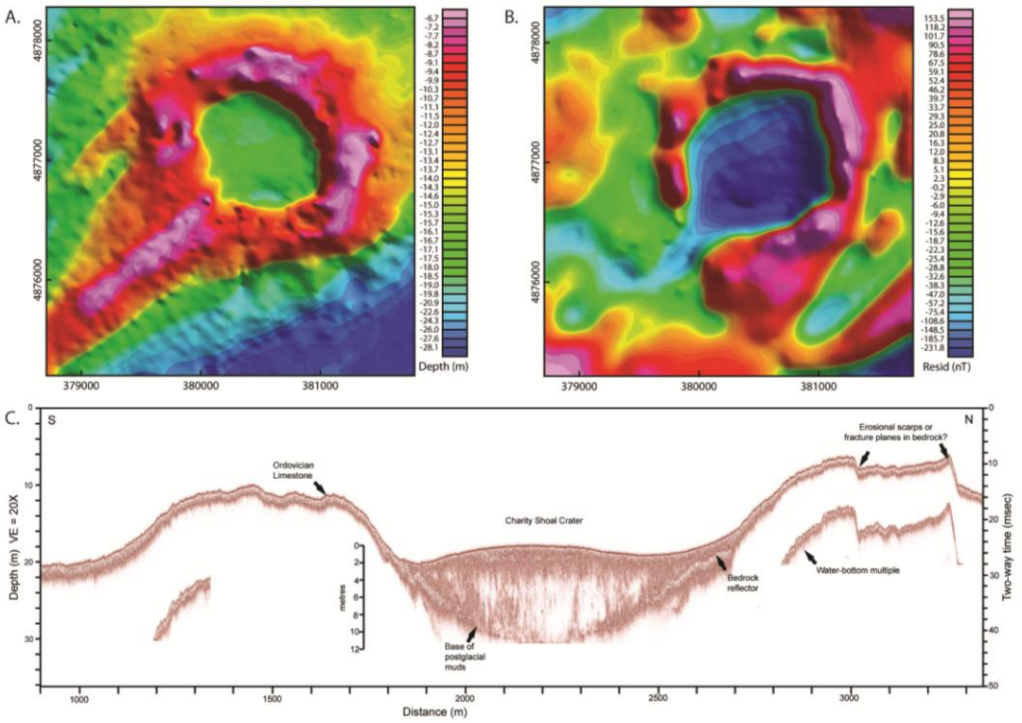

Figure 1. A. 200 kHz single-beam bathymetry. B. Residual magnetic field. C. N-S chirp seismic profile