Investigation of the form and age of the Bloody Creek Crater, southwestern Nova Scotia

Mariella Nalepa[1], Ian Spooner[1], and Peter Williams[2]

1. Department of Earth and Environmental Science, Acadia University, Wolfville, Nova Scotia B4P 2R6, Canada <090659n@acadiau.ca> ¶ 2. Department of Physics, Acadia University, Wolfville, Nova Scotia B4P 2R6, Canada

Virtually all terrestrial impact craters exhibit a circular geometry in plan-form; only three impact sites exhibiting non-circular, elongate forms have been identified on Earth. One of these exceptional sites is the Bloody Creek Crater located in southwestern Nova Scotia, an approximately 0.42 km long-axis elliptical crater first identified in 1987 during a regional air photo survey. It was confirmed as an impact crater in 2009 through integrated geomorphic, geophysical, and petrographic data. The structure's rare ellipticity, pristine definition, preservation through shock metamorphic features of anomalously high pressures at the rim, low depth-to-diameter ratio, as well as age remain ambiguous and complicate the interpretation of the origin and evolution of the crater.

The purpose of this study is to quantify the form of the feature in order to better understand the nature and age of impact. To achieve this objective, analytical software was used to assess the shape of the crater rim. An extensive review of the literature was also performed to understand the controls on crater formation as well as to synthesize a model for the geological evolution of the site which would aid in the interpretation of the age of the structure. Results demonstrate that the form of the crater rim is best approximated by an ellipse, as illustrated by comparison of the RMSE (Root-Mean-Square Error) calculated for various geometric models. This conclusion has resulted in the exclusion of a number of proposed impact models. Though elliptical craters can be formed by the erosion of circular impact features, the tectonic and/or geomorphic scenarios required to produce this outcome are inconsistent with models of evolution of the site. The Bloody Creek Crater was formed by very low-angle impact into a nearly horizontal, homogeneous medium. Impact occurred after peneplanation of the South Mountain Batholith and after Mesozoic sediment cover had been eroded constraining the age to Cenozoic. The pristine nature and near complete preservation of the rim structure likely indicate a much younger age.

The Bloody Creek Crater provides a unique opportunity

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to study shock deformation and structures associated with low-angle impact into a homogeneous crystalline target. Such research will add to the knowledge of how target geology influences the nature of observed shock effects, which may facilitate future identification of potential impact structures in similar geological environments. Moreover, continued identification of terrestrial impact craters contributes to the statistical data base for estimating past impact rates on Earth. The identification of low-angle impact craters in particular will contribute to discussions of the statistical probability of their occurrence on Earth, as well as the role of the terrestrial atmosphere in filtering such impact events.