THE LAWN HILL IMPACT STRUCTURE: A UNIQUE TERRESTRIAL CRATER?

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Introduction: The Lawn Hill Impact Structure (LHIS) is located 250 km North of Mt Isa in western Queensland. The structure consists of a central area ca. 8 km diameter which exposes Proterozoic metasedimentary rocks similar to those in the surrounding Mt Isa inlier, enclosed by a ca. 5 km annulus of the middle to late Cambrian Thorntonia limestone of the Georgina basin, which is also exposed undeformed just 5 km to the north of the structure. The Century Pb-Zn mine is located on the southern edge of the limestone annulus. The LHIS has been accepted as an impact structure since 1996 [1] and the discovery of shatter cones, melt, and PDFs [2].

The Limestone Annulus: The limestone annulus may be a unique structure for terrestrial impacts. It consists of beds that are tightly folded and faulted on a scale of several hundred meters, with little systematic structure apart from a generally circumferential orientation, and breccia dykes. The thickness of the annulus is locally four times greater than adjacent undisturbed sections of the limestone. The width of the annulus varies from 2 km in the west to over 5 km in the east, and the margins of the annulus are grossly polygonal.

Origin of the Limestone Annulus: The limestone annulus may have originated as sedimentary infill of a crater, ejecta around a rampart crater, or as an allochthonous deposit that occurred at the early crater modification stage within the transient crater. The deformed but partially coherent nature of the limestone and its volume argue strongly against the first two possibilities. In the latter case the total diameter of ca. 18 km to the edge of the limestone would mark the size of the transient crater, and the outer diameter of the structure would have been greater than 18 km, consistent with an interpretation of the central area as an uplift. The fragmentary preservation of bedding in the annulus may indicate that the limestone was semi-lithified at impact. The asymmetry of the width of the limestone annulus and the disposition of rocks within the central uplift may be due to pre-impact structure, and/or a component of oblique impact.

Age of Impact: The contorted nature of the Thorntonia limestone in the limestone annulus unequivocally constrains the impact age to syn-post middle to late Cambrian [2]. A number of other Australian craters (both surface and buried structures) have been dated also as middle to late Cambrian, with target material classified as sedimentary or meta-sedimentary [3]. Volatile release from water/sedimentary impacts has an increased capacity to carry more material into the atmosphere. It is therefore not unreasonable to make links between the cumulative effects of these impacts, into sedimentary targets, and one or more of the known Cambrian mass extinctions.

References: [1] Shoemaker E.M. and Shoemaker C.S. 1996.AGSO Journal of Australian Geology and Geophysics 16, 379-398.[2]Salisbury J.A.et al. 2008. *Australian Journal of Earth Sciences* 55(4), 587-603. [3] Haines P.W. 2005.*Australian Journal of Earth Sciences* 52(4-5), 481-507.