TOOKOONOOKA IMPACT SEDIMENTATION: EVIDENCE FOR RESURGE CYCLICITY WITHIN THE CRATER FILL.

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Introduction: The buried Tookoonooka 66-km diameter complex impact structure [1, 2] in central Australia has recently been interpreted as being the product of a marine impact event [3-5]. Thargomindah-3, a well drilled into the outer zone of the structure in 1987 to assess seismically-defined channel features, was originally interpreted to intersect a diamictite-filled 'canyon' [6, 7]. This work was done prior to a full knowledge of the impact origin of the structure. Recent studies have prompted the re-interpretation of the intersected 'canyon-fill' as a marine impact resurge sequence capped with debris flow deposits and finally the normal basin marine transgressive sequence.

Depositional processes that accompany marine impacts are not well understood, in part relating to the variability of known marine impact structures. Recent work on a handful [e.g. 8-10] has helped to better characterize the mechanisms and sedimentation styles related to these events.

Results: Detailed core logging of Thargomindah-3 has been done for the purpose of re-interpreting the 'diamictite' sequence intersected in the context of Tookoonooka's impact origin.

Almost 200 meters (thicker than originally defined) of stratified deposits overlie the autochthonous sedimentary basin rocks, and can be divided into three types. The lowermost unit is comprised of very poorly sorted polymict breccia within a sandstone matrix. The proportions of the larger clasts cannot be well-ascertained in core, though lithic clasts of up to several meters in height can be differentiated. Melt clasts are also present (clasts exhibiting flow structures or contact-metamorphosed rims). Overall, the matrix of this unit fines upward from coarse- to fine-grained. Cyclicity can be distinguished on the basis of varying matrix type: the matrix switches between primarily light-beige-grey coloured sandstone and chiefly fine-grained, dark grey sandstone. At least three cycles can be differentiated within this unit. Cycles thin upward.

A middle unit is made up of poorly-sorted, dark grey, matrix-supported sandstone interbedded with siltstone. The siltstone to sandstone ratio is about 1:3. The sandstone includes common pebble-sized, polymict, lithic clasts of varied shapes. The matrix is fine-grained.

An upper unit resembles the middle unit, but does not contain siltstone interbeds. Within this unit, the fraction of lithic clasts fines upward.

Both the upper and lower contacts of the whole deposit appear sharp. Various types of deformation such as soft-sediment deformation structures, fractures, and injectites are pervasive throughout the underlying in-situ rock types as well as within the sequence.

Discussion & Conclusions: It is interpreted that marine impact resurge sedimentation and post-impact debris flow deposits are preserved in this location. The three types of deposits observed are likely formed by different processes. The lowermost unit is interpreted to be a resurge deposit incorporating megabreccia-scale clasts. At least three cycles of resurge-runout sedimentation are suggested by the periodic shifts in matrix. The lighter-coloured matrix is thought to represent the resurge into the crater, whereas the dark-grey sandstone matrix is thought to signal the runout phase of deposition. The upward-thinning character of the unit corresponds to waning flow energies. This depositional phase would have occurred immediately post-impact.

The middle and upper units within the sequence suggest that at least two phases of slumping or slope failure likely occurred in this part of the crater. These units are interpreted as post-impact debris flow deposits. Palynological analyses [11] concur with this interpretation.

Rather than a 'canyon' as proposed in the original descriptions of this well, the stratified deposits presumably occupy a concentric slump scar caused by listric faulting of the peak ring. Likely resurge processes and peak ring slumping were contemporaneous. This re-interpretation of the stratigraphy at Thargomindah-3 furthers the understanding of Tookoonooka post-impact mechanisms and marine impact processes.

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