ACCRETIONARY LAPILLI FROM THE TOOKOONOOKA IMPACT EVENT, AUSTRALIA.

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Introduction: The lower Cretaceous Tookoonooka proven impact structure (27˚07'S, 142˚50'E) is a subsurface structure of the Eromanga Basin in Queensland, Australia. A Tookoonooka ejecta layer has now been identified in drillcore in the extensive sedimentary basin succession, [1]. The investigation of probable accretionary lapilli associated with the ejecta layer is discussed here.

Background - Accretionary Lapilli: Accretionary lapilli have been recognized in association with a number of impact events worldwide, including the Ries [2], Alamo [3], Popigai [4], Azuara [5], and Chicxulub [6,7,8] among others. Typical characteristics of impact-produced accretionary lapilli include internal concentric zonation, rims and nuclei, inclusions of rock fragments or grains (which may exhibit shock features), a fining outward texture, elemental anomalies suggesting a meteoritic input, and an original spherical to sub-spherical shape.

For clarification, this discussion will use the same terminology as [3], i.e. "crust" for the outer rim or shell, "mantle" for the main body of the lapilli comprising accreted particles, and "nucleus" where an inner core is present.

Observations and Discussion: Within the ejecta layer are unusual, light brown-tan clay-rich clasts. The apparent diameters of these clasts in core sample are commonly less than 1.5 cm, but may be up to 6 cm. Clast shapes are ellipsoidal, spherical, elongate, and irregular, and are consistently rounded (no angular or broken examples of these clasts have been observed). Clasts exhibit concentric zonation, a very fine-grained outer crust (possibly altered from a devitrified texture), and a relatively coarser-grained mantle with inclusions of quartz and partially-altered feldspar. Rare lithic nuclei are present. The clasts have been observed in a number of stratigraphic drillcores in the basin. Within 4 crater radii (proximal to the impact site), they may occur in clast-supported breccia layers which are interpreted to contain primary ejecta. More distal occurrences are reworked within tsunami deposits, often 'floating' within planar-bedded sandstone or in matrix-supported conglomerates.

Petrographic observations reveal that inclusions within the mantle of the clasts are complex. Minor feldspar (predominantly plagioclase, with some K-feldspar; both heavily altered) and quartz (some of which have a euhedral crystal shape) are enveloped in colourless, crystalline carbonate overgrowths. In some cases, pyritic overgrowths are also present. These complex mantle grains are set in a largely massive, brownish sideritic matrix exhibiting poikilotopic fabric under cross-polars. The carbonate and pyrite phases (and likely the euhedral quartz) are interpreted to be the result of post-depositional diagenesis; it is clear that these clasts have experienced extensive alteration although the primary zonation is still subtly apparent below the diagenetic overprint in many.

Conclusion: The clasts described are unusual within the context of the predominantly siliciclastic sedimentary basin. They exhibit many of the characteristics of previously described impact lapilli, [e.g. 2-8], even though they are pervasively altered and much of their original texture has been lost. These clasts are interpreted to be accretionary lapilli derived from the Tookoonooka impact event. Their presence provides evidence of impact provenance for the ejecta layer.

Ongoing work which will be presented includes geochemical studies and microscopic investigation of the primary crystal inclusions within the mantle of the lapilli for shock metamorphic features.

References: [1] Bron K., in prep. [2] Graup G. (1981) *EPSL, 55*, 407–418. [3] Warme J. et al. (2002) *GSA SP 356*, 489-504. [4] Masaitis V. (2003) *Impact Mark. in the Strat. Rec., Springer*, 137-162. [5] http://www.impact-structures.com/Archiv/archiv.html [6] Ocampo A. et al. (1996) *GSA SP 307*, 75-88. [7] Pope K.O. et al. (1999) *EPSL, 170*, 351–364. [8] Montanari A. (1990) *J. Sed. Petrol., 61*, 315–339.