THE TOOKOONOOKA-TALUNDILLY TSUNAMI SEQUENCE: CONSTRAINING MARINE IMPACT STRATIGRAPHY. K. Bron, Australian School of Petroleum, The University of Adelaide, Adelaide, SA 5005, Australia (tbron@asp.adelaide.edu.au).

Introduction: The Tookoonooka and Talundilly Impact Structures, 66km and 84km diameter respectively, are among the largest impact structures on Earth. They are located in the subsurface of central Australia. A biostratigraphically-dated impact horizon in their host sedimentary basin constrained them as an ancient marine impact event of approximately Barremian-Aptian boundary age [1-3]. The impact horizon spans a vast area of the Australian continent and is overlain by complex strata representing a geologically brief timeframe within near-continuous basin sedimentation.

Marine Impact Cratering: Marine cratering processes are less understood and more variable than their subaerial counterparts within Earth's cratering record, with water cover and target material saturation adding to the complexity of impact-related deposition and crater formation [4-7]. The nominal water depth required to form a marine crater and control cratering processes and crater morphology have been modelled, as has impact tsunami propagation [e.g. 8-9]. A large crater radius to water depth ratio [10] applies to large craters formed in a shallow sea. In these scenarios, violent resurge and tsunamis are associated with crater rim collapse, strong sediment mixing and significant seabed erosion [4,8].

Tsunamiites in the Geological Record: Tsunami deposits in the ancient rock record are rare. Tsunami or resurge sedimentation known to originate from ancient marine impact events is even less common [4,11,12]. However, tsunami deposits have been associated with a subset of marine impacts, with Chicxulub's being well-documented and recognized in a variety of depositional environments [e.g. 13,14].

Methodology: Interpretation of Tookoonooka's and Talundilly's post-impact sedimentation was accomplished with the analyses of 51 drill cores, 12 geological outcrops and 158 additional subsurface petroleum exploration well datasets. Data represent >805,000 km^2 of the depositional basin and 931m of logged section. Analyses of core and outcrop were supplemented with formation evaluation data to aid in stratigraphic interpretation, isopach mapping and evaluating the distribution of the impact-related sedimentation.

Tookoonooka-Talundilly Tsunamiite Sedimentology: Detailed logging confirmed that the ambient low-energy basin sedimentation was interrupted by an unusual geological event of short duration. The impact horizon is a widespread scour surface overlain by a sedimentary sequence with entrained impactoclasts, breccia-conglomerates, rip-up clasts of unusual size, large-scale couplets, highly polymictic clasts in high flow regime bedforms, as well as widely varying bed thicknesses correlative to crater proximity. Trends in stratification throughout the study area can be resolved from flow regime indications, grainsize, matrix style, grading and bioturbation. Individually, the bedforms and facies observed reflect normal marine sedimentary processes, but collectively, the high velocity bedforms, coarse sedimentary fabrics, cyclicity and stacking reflect an unusual event of extraordinary magnitude. This sedimentary sequence, beyond the crater rims, is interpreted to be a Tookoonooka-Talundilly tsunami sequence.

Depositional Realms Interpretation and Mapping: Distribution patterns of the sediments were assessed by correlation and mapping. Geological logs from core and field observations were correlated to show the lateral character of the tsunami sequence. The tsunami deposits were classified based on depositional character, cyclicity, stacking pattern, interpreted processes of deposition and paleoenvironments. Five depositional realms with respect to crater proximity have been identified.

Isopach maps were constructed, utilizing extensive subsurface drilling data calibrated from lithological log observations. A sheet-like tsunami deposit is interpreted to span the paleo-basin. The widespread scour surface at the base of the impact sequence is attributed to impact-related excavation and tsunami scour mechanisms proximal to the crater structures. Removal of at least 30% of pre-impact strata beyond the crater rims is indicated. The tsunamiite exhibits complex stratigraphic architecture that is interpreted to vary with crater proximity, paleoenvironment, and paleo-water depth.

Conclusions: Detailed core-logging, correlation and mapping, over an area of >805,000 km^2, of an interpreted impact tsunamiite has been accomplished. Impact tsunami deposits are well-preserved due to burial, excepting erosion by successive tsunami waves and distal basin margin exposure. This study improves the current understanding of the depositional processes and impact sediment distribution following marine impacts. Tookoonooka-Talundilly provides an important model for marine impact sedimentation in shallow marine settings.

References: [1] Bron K. and Gostin V. (2012) *MAPS, 47,* 296-318. [2] Bron K. (2010) *GSA SP 465,* 219-244. [3] Bron K. (2015), *in review*. [4] Dypvik H. and Jansa L.F. (2003) *Sed. Geol.*, *161*, 309-337. [5] Ormö J. and Lindström M. (2000) *Geol. Mag.*, *137*, 67-80. [6] Gault D.E. and Sonett C.P. (1982) *GSA SP 190*, 69-92. [7] Baldwin E.C. et al. (2007) *MAPS*, *42*, 1905-1914. [8] Glimsdal S. et al. (2010) *The Mjølnir Impact Event: Springer*, 257-271. [9] Matsui T. et al. (2002) *GSA SP 356*, 69-77. [10] Shuvalov V. et al. (2008) *Cat. Events caused by Cosmic Obj: Springer*, 291-311. [11] Dawson A.G. and Stewart I. (2007) *Sed. Geol.*, *200*, 166-183. [12] Scheffers A. and Kelletat D. (2003) *Earth Sci. Rev.*, *63*, 83-92. [13] Smit J. (1999) *Ann. Rev. Earth Planet. Sci.*, *27*, 75-113. [14] Goto K. (2008) *Tsunamiites – Feat. & Imp.: Elsevier*, 277-297.