

### EVIDENCE FOR A PUTATIVE IMPACT STRUCTURE IN PALM VALLEY, CENTRAL AUSTRALIA

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**Introduction:** We present evidence supporting the impact origin of a circular structure located in Palm Valley, Central Australia (24° 03' 06" S, 132° 42' 34" E). The ~280 m wide structure was discovered using a combination of Google Maps and a local Arrernte Aboriginal oral tradition regarding a star that fell into a waterhole called Puka in Palm Valley, Northern Territory [1][2] (see [3] for details of the discovery).

**Geophysical Evidence:** A survey of the structure in September 2009 collected magnetic, gravity and topographic data. Geophysical modeling of the data revealed the structure has a bowl-shaped subsurface morphology, as expected for a simple impact crater. Though the structure sits within the Finke Gorge system, the models do not support an erosional origin for the structure, as no buried channels are observed. Nor does the modeling fit a volcanic origin, as the density structure at depth is consistent with fractured sandstone/sediments.

**Geological Evidence:** One channel runs out of the crater to the south, consistent with outflow from crater-filling events, but again not with an erosional origin for the structure itself. The microstructure of rock samples collected from the site revealed the presence of planar deformation features in the quartz grains. The coincident angle of the fractures is consistent with the crystallographic fracture directions under mild-end shocks. These grains probably represent local focusing of stress as the shock wave moved through the heterogeneous grain matrix, suggesting the conditions were right for the shock pressure to locally exceed the ~7.5 GPa required to form the features, even though the bulk of the shock pressure was much less.

**Conclusion:** Based on the level of erosion and the absence of shatter cones and meteorite fragments, we estimate the structure's age to be in the millions of years. While the presence of shocked-quartz is a direct indicator of a cosmic impact, we cannot rule out that the quartz was transported from an older structure into the Hermannsburg sandstone as it was deposited. The ~22 km wide Gosse's Bluff impact structure, located ~40 km from Palm Valley, postdates the Hermannsburg sandstone, leaving a distal unidentified impact event as a possibility. However, the bowl shaped morphology of the Palm Valley structure, as well as the fractures on the structure's walls, support an impact origin.

**References:** [1] Austin-Broos, D., 2009, "Arrernte Past, Arrernte Present", University of Chicago Press, pp. 37-38. [2] Róheim, G., 1945, "The Eternal Ones of the Dream: a psychoanalytic interpretation of Australian myth and ritual", International Universities Press, New York, p. 183. [3] Hamacher, D.W. & Norris, R.P., 2010, Falling Star at Puka: using Aboriginal Oral Traditions to locate meteorite falls and impact craters. In *Ilgarijiri - things belonging to the sky*, edited by R.P. Norris, Proceedings of the symposium on Indigenous Astronomy held on 27 November 2009 at Australian Institute for Aboriginal and Torres Strait Islander Studies, Canberra, Australia (in press).