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Geophysical evaluation of the proposed Bedout impact structure, northwest shelf of Australia

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The offshore Canning Basin on the northwest shelf of Australia includes the unusual Bedout High, which has recently been controversially interpreted as an end-Permian impact structure similar in size to the K-T boundary Chicxulub crater. We present a geophysical point of view of the associated debate, based on deep seismic reflection, refraction and well data. The Bedout High is associated with a Moho uplift of 7-8 km, and is about 40-50 km wide, with the centre of the Moho uplift offset from the centre of the high by about 30 km landwards. Unlike central uplifts of other known impact craters, the Bedout consists of two separate highs separated by a fault zone. Neither gravity data nor a basement topography map clearly outline a circular depression around the Bedout High. The high is not surrounded by a circular annular basin, but is bounded by the linearly shaped Rowley Sub-Basin to the west, which extends for at least 400 km along the continental shelf, from the Lambert Shelf to the Leveque Platform. The Bedout Sub-Basin on the southeast of the Bedout High is a localized Basin, which does not appear to be connected to the Rowley Sub-Basin. Neither free-air gravity data nor an isostatic residual gravity map exhibit a clear circular feature around the Bedout High. In the available multi-channel seismic reflection data the Permo-Triassic unconformity displays a reflection amplitude similar to that of an overlying intra-Triassic unconformity. If the end-Permian unconformity represented the boundary between an impact-breccia and overlying Triassic sediments, we would expect a substantially stronger impedance contrast as compared with an unconformity within marine sediments, associated with a higher-amplitude reflection, as for example seen in the annular basin of the Mjølnir impact structure in the Barents Sea. Reflections both above and below the Permo-Triassic unconformity exhibit sub-horizontal layering, not expected for an impact breccia. Both velocity modeling

of seismic refraction data as well as thermal modelling based on data from well La Grange-1 are consistent with Triassic-Jurassic rifting above mantle with an elevated temperature. Refraction data provide evidence for lower crustal flow from the rift edge towards its center, which typically occurs when the strength ratio between the upper and lower crust is large, associated with rifting above anomalously hot mantle. In summary, we do not find unambiguous evidence in the existing geophysical and well data to support the idea that the Bedout High represents an impact structure. Instead, the currently available data favor the interpretation of the Bedout High as a basement high, formed by consecutive episodes of rifting which were orthogonal to each other, and topped with a thin layer of volcanics associated with Triassic-Jurassic rifting above anomalously hot mantle.