WOODLEIGH - A NEW 120 KM-DIAMETER BURIED MULTI-RING IMPACT BASIN, CARNARVON BASIN, WESTERN AUSTRALIA, OF PRE-JURASSIC POST-EARLY PERMIAN AGE: EVIDENCE OF A METEORITIC COMPONENT INJECTED INTO SUB-CRATER BASEMENT.

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In 1981 petroleum exploration drilling in the Gascoyne Platform, south Carvarvon Basin, recovered quartzo-feldspathic cuttings showing penetrative lamella in quartz interpreted at the time as mechanical effects of the drilling. Subsequently Bouguer anomaly and airborne magnetic surveys by the Australian Geological Survey Organisation disclosed a near-perfectly circular multiring structure which abruptly truncates the Adjana and Wandagee NS-striking regional structure formed in Palaeozoic rocks (Iasky and Mory, 1999; Glikson, 1999). Subsequent drilling and coring by the Geological Survey of Western Australia in March, 1999, encountered direct evidence of shock metamorphism and impact breccia, including:

1. At the centre of the 25 km-diameter basement uplift the Woodleigh-1A drill hole intersected shock metamorphosed granitoid at a depth of 171 m - at least 1800 m higher than the gravity-modelled level of regional basement. The shocked granitoid features planar deformation lamella (PDF) in quartz and feldspar, penetrative pseudotachylite vein systems, and pervasive development of diaplectic glass in feldspars (Mory et al., 2000; Glikson, 2000).

2. An inner ring syncline drilled by Woodleigh-2A, 14 km off the centre of the multi-ring structure, contains a ~70 m thick thermally modified diamictite overlain by ~380 m of Lower Jurassic lacustrine deposits.

The Woodleigh structure is buried under thin regionally extensive Cretaceous cover and by lacustrine Lower Jurassic arenaceous sediments, representing crater fill. From drilling and gravity data the crater sediments thicken in ring synclines and overlap intervening circular ridges. An outermost diameter of 120 km for the Woodleigh impact structure is clearly defined by gravity, magnetic and surface drainage. The sharp intersection of the regional structure by the outer ring fault is analogous to relationships observed at Chicxulub and in the Shoemaker Impact Structure (formerly Teague Structure), Wiluna area, Western Australia (Pirajno and Glikson, 1998). At Woodleigh, Surface drainage area accord with late vertical isostatic readjustments of the lower density impact aureole.

Scanning electron microscopy (SEM), energy dispersive spectrometry (EDS), Laser Raman Spectroscopy and trace element analyses of samples from the shocked granitoid core indicate strong enrichment of the pseudotachylites in refractory elements (Mg, Al, Ca) and depletion in Si and K relative to host granitoid composition. Whole rock analyses indicate anomalous siderophile trace metals (Ni, Co, Cr, V, Cu) enrichments, mostly up to an order of magnitude higher than typical granitoids. There is a general, though inconsistent, agreement between chemical enrichment/depletion relations and boiling temperatures. Possible models include (1) shock-induced differential volatilisation and condensation effects, consistent with the results of

CO_2 laser experiments; (2) introduction of a ferromagnesian-rich component derived from the exploding projectile by melt transport and/or condensation from volatile phases. Preliminary ICPMS analyses indicate elevated PGE levels. Further testing of the second model, ie. a mass transfer of siderophile and magnesian trace elements, is currently under way.

The impact age of Woodleigh is constrained by overlying Lower Jurassic strata, reworked Early Permian palynomorphs in the Jurassic lacustrine section, and deformed Lower Devonian and older units. A regional thermal event identified by apatite fission track at 280–250 Ma hints at a possible Permian–Triassic boundary age for the impact, although the lack of Triassic fossils in the crater fill favours a late Triassic age. In view of its size, it is likely that Woodleigh, by analogy with other mega-impacts (Manicouagan - late Triassic; Morokweng - J-K boundary; Chicxulub - K-T boundary; Popigai and Chesapeake Bay - late Eocene) was associated with extinction. The pre-lower Jurassic post mid-Permian age of Woodleigh therefore suggest it may either belong to the late Triassic impact cluster, or alternatively represent a Permian-Triassic boundary impact. A hint supporting the latter possibility may be provided by a thermal high at 280-250 Ma indicated by apatite fission tracks.

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