ORIGIN OF THE TIMOR SEA LATE EOCENE - PRE-MIOCENE STREWN CRATER FIELD.
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Since the majority of extraterrestrial impacts impinge on oceanic regimes, the identification of buried submarine impact structures from geophysical data, including 3D reflection seismic profiles, constitutes an essential step in unravelling the terrestrial impact record. However, the method suffers from severe difficulties inherent in the limitations on the amount of drilling and thus the on tests of candidate geophysical features and potential impact structures.

In the Timor Sea, north Bonaparte Gulf, Deep sea drilling and seismic reflection data encounter an at least 350 m-thick PGE-rich radioactive carbonate breccia lens at Fohn-1 exploration well (Gorter and Glikson, 2000). The data are interpreted in terms of a buried 4.8 km-diameter impact crater of late Eocene to pre-Miocene age. The crater displays the classic elements of impact structures, including a central uplift and ring syncline. The presence in the breccia of redeposited Campanian and Maastrichtian microfossils suggests rebound of strata from levels deeper than 1250 m below the pre-Langhian unconformity. Morphometric modelling suggests an original transient crater depth at least 1400 m deep, consistent with the excavation of Cretaceous strata. Stratigraphic and palaeontological evidence suggests that the impact occurred between 38 and 24 Ma. The breccia contains altered glass components enriched in the inert platinum group elements (PGE) (Ir, Ru) by factors of 5-12 above the values of common sediments. The more mobile PGE (Os, Pt, Pd) show a wide scatter and terrestrial-type values. Opposite geochemical/stratigraphic trends pertain to different PGE species - the relatively inert Ir-Ru group shows an overall concentration at the base of the section, whereas the more mobile Os shows peaks at median levels of the section - suggesting upward diagenetic leaching. The near-chondritic PGE patterns at the base of the breccia pile are accompanied by near chondritic Ni/Cr, Co/Cr, Ni/Ir, Ni/Pt, and Cu/Pd ratios. Departure from these values related to alteration at higher levels in the breccia pile is accompanied with high Sulphur levels (~1%).

Seismic reflection array studies of the North Bonaparte Basin (NBB), Timor Sea, disclose an ENE-striking 120x25 km-large swathe of more than 40 circular features excavated in the pre-Miocene - post-Eocene erosional surface and buried by Langhian sediments. Ten of the larger craters include central uplifts and circular troughs, display close similarities to the Fohn-1 impact structure and are considered as probable impact structures. The smaller circular features (D_C < 2.0 km) consist of crater-form and bulge-form structures, and may either represent deeply eroded impact structures or are of erosional origin. Limits on the degree of erosion are allowed at Fohn-1 impact structure from stratigraphic and morphometric estimates. The Timor Sea crater field may alternatively represent (1) high preservation rate of the 37.5-24 Ma impact flux; (2) a cometary fragmentation event similar to the Shoemaker-Levy-9 event on Jupiter, or (3) an atmospheric break-up of a low-angle asteroid.

In scenario (1), in so far as all the 40 circular features are considered of impact origin, their

incidence over an area delimited by a rectangle 7750 km^2 large during a maximum period of 13.5*10^6 years (37.5-24 Ma) yields an impact rate of 3.8*10^-10 km^-2yr^-1. Such a flux is higher by two orders of magnitude than the present-day flux of 100 m-scale asteroids, estimated as 2*10^-12 km^-2 yr^-1 by Chapman and Morrison (1994). Because scenario (2) would require global or large circle distribution of craters, scenario (3) is regarded as more likely on the basis of the limited spatial distribution of the craters (W. Bottke, pers. com., 1999).

References

Chapman, C.R. and Morrison, D., 1994. Impact on the Earth by asteroids and comets: assessing the hazard, Nature, 367, 33-37.

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