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BIOGEOCHEMICAL ANATOMY OF THE ACRAMAN BOLIDE IMPACT

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The Dey Dey Mudstone is a lithologically monotonous unit up to 300 m thick in the late Neoproterozopic succession of the eastern Officer Basin, South Australia. Deposited on the floor to lower slope of the anoxic to suboxic Ediacaran ocean, this organically-lean formation (TOC mostly <0.2%) would be unremarkable except for the fact that it contains sedimentological, palynological, isotopic and biomarker evidence of the impact of a large asteroid (~4.8 km diameter) at the site of present-day Lake Acraman on the nearby Gawler Craton at ca. 570 Ma [1-3]. New biomarker and C-isotopic data on core samples from the Munta-1 and Observatory Hill-1 drill holes strengthen the case for this impact being the cause of a classic extinction-radiation event [4].

A recently discovered thin horizon of acid volcanic fragments at 1884.36 m depth in Munta-1 appears to comprise ejecta from the Acraman impact. Although not necessarily *in situ*, it permits the stratigraphic level of the impact to be more precisely established in the lower Dey Dey at this locality than was hitherto possible (Fig. 1). The previously reported first appearance of large spinose acritarchs (acanthomorphs) [2] and an ethylcholestane excursion [3], both reflecting the opportunistic proliferation of new chlorophyte taxa following the impact, are now shown to be preceded by another biomarker anomaly, this one short-lived and attributable to the absence of key microbial heterotrophs.

Highly branched alkanes (HBA) of the C_{3n} series E and F [5] are particularly prominent in the lower Dey Dey Mudstone. Their source organisms are most likely fermenting bacteria [6], which are dependent on the production of organic compounds by other organisms, and which thrive in anoxic conditions. HBA abundance (relative to *n*-heptadecane) rises steadily through the basal 70 m of the formation in Munta-1, reaching its acme during the maximum flooding stage of the highstand, before declining into the lower slope facies of the upper Dey Dey Mudstone which hosted a more diverse microbial community (as evidenced by complex assemblages of monomethyl alkanes). Superimposed on the HBA excursion is an abrupt drop in their abundance over ~10 m of lithologically uniform mudstone, and their virtual absence from the biomarker record through the next 22 m of section. These two features together comprise the HBA anomaly which has an estimated duration of ~0.5 m.y. [6]. HBAs reappear

some 5 m below the start of the ethylcholestane anomaly, followed shortly thereafter by the first recognisable acanthomorph acritarchs that signal the onset of a chlorophyte-led recovery of the marine biosphere (Fig. 1).

Thus there are two biomarker anomalies temporally linked to the Acraman impact event. The first reflects the initial collapse of the biosphere and hence the food supply for benthic fermenting bacteria (a prokaryotic signal) whereas the latter marks the appearance and radiation of encysting chlorophyte algae (a eukaryotic signal).

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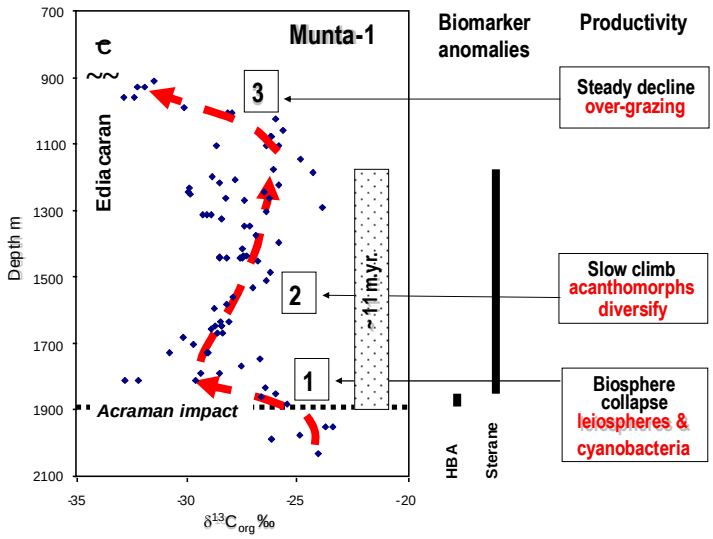

Figure 1. Secular variation in C-isotopic composition of organic matter in Late Ediacaran succession penetrated by Munta-1, eastern Officer Basin. Based mostly on raw data of C.R. Calver referenced in [2] & [3].