Final Report for

"Investigation of Isotopic and Geochemical Evidence for an Active Planktonic Biota in the Precambrian"

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Submitted by

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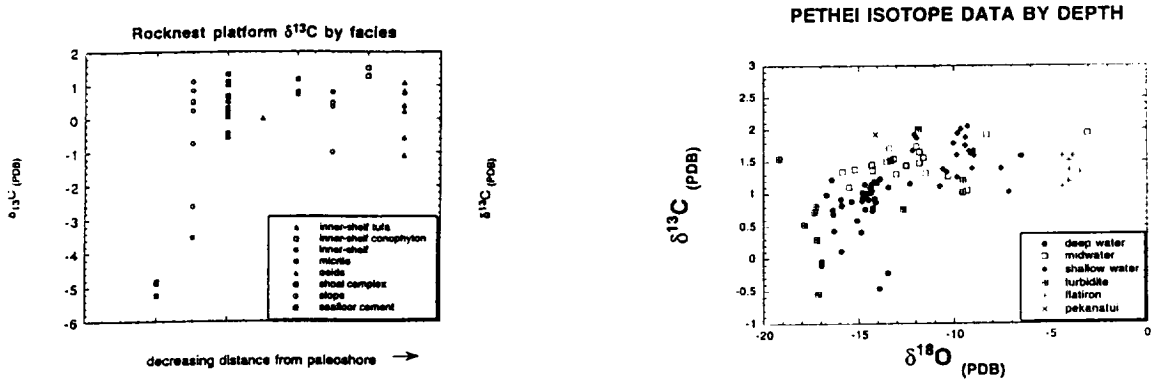
Report Narrative:

The funded research was motivated by the earlier study of Burdett *et al.* (1990), who collected carbon and oxygen isotopic data from Paleoproterozoic rocks of the Northwest Territories from deep- and shallow-water facies of the Rocknest Platform. Their results (Fig. 1a) displayed a possible decrease in $\delta^{13}C$ with depth when arranged by increasing distance from the paleoshore. The most ^{13}C-depleted samples were seafloor cements and fans from the underlying siliciclastic Odjick Formation, and slope carbonates of the Rocknest platform..



a **b**

Figure 1. Preliminary data on the carbon and oxygen isotopic composition of carbonates from the Rocknest (**a**; Burdett *et al.*, 1990) and Pethei (**b**; this study) Platforms.

Intrigued by these data, and in collaboration with John Grotzinger and Michael Pope (MIT), Roberta Hotinski (Penn State Graduate student) and I collected samples in the summer of 1996 from the Pethei platform (with funding from this project). The isotopic data we generated represent seafloor and/or early diagenetic cements from shallow (filled diamonds) and deep water (filled circles) facies (Fig. 1b). The $\delta^{18}O$ values of our shallow water carbonates agree with previous estimates of a lighter ocean composition of about -7 to -10 ‰ in the Precambrian (Burdett et al, 1990; Veizer et al., 1992). The data do, however, show a wide spread in $\delta^{18}O$ which might be the result of differential diagenesis of the deep-water facies. Deeper water samples likely have experienced a decrease rather than an increase in $\delta^{13}C$ due to diagenesis, so we tentatively conclude that the water column in the vicinity of the Pethei platform had a carbon isotopic gradient of at most 1‰.

We presented a paper at the CSPG-SEPM Joint Convention (Hotinski and Kump, 1997) in which we argued that this small gradient is consistent with the idea that atmospheric pCO_2 was elevated in the Paleoproterozoic, compensating for a less luminous sun. As a result, oceanic inorganic carbon contents were high, and the ability of organisms to stratify the isotopic composition of the oceans was diminished. Large inferred gradients in the Neoproterozoic indicate low atmospheric pCO_2, which is consistent with the occurrence of glaciation at the time.

References:

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Veizer, J., Plumb, K.A., Clayton, R.N., Hinton, R.W., and Grotzinger, J.P., 1992. Geochemistry of Precambrian carbonates: V. Late Paleoproterozoic seawater. *Geochim. Cosmochim. Acta*, 56: 2487-2501.