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.

![Figure 1a](image1.png)

Figure 1a. 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 %o 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 $p$CO$_2$ 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 $p$CO$_2$, which is consistent with the occurrence of glaciation at the time.

References: