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SIGNALS FROM PAST LIFE IN ANTARCTIC PALEOLAKE SEDIMENTS AND RELEVANCE TO FUTURE MARTIAN FOSSIL HUNTS

Doran, P.T. and R.A. Wharton Jr.
Biological Sciences, Desert Research Institute, P.O. Box 60220,
Reno, NV 89506; fax 702-673-7469; e-mail: pdoran@maxey.unr.edu

Images of proposed fluvial systems on Mars suggest that there must have existed downstream locations where water pooled, and the sediment load deposited (i.e. lakes)(Carr *et al.*, 1987; Wharton *et al.*, 1995). As the Martian climate cooled, ice-covered lakes probably persisted as viable liquid water habitats until mean annual temperatures fell below -40°C (McKay *et al.*, 1985). For this reason, perennially ice-covered lakes of the McMurdo Dry Valleys are considered excellent analogs of potential past martian environments. Our research has recently focused on relating modern lake environments to the sediments being deposited, and using this relationship to make inference from paleolake deposits concerning the environment of the ancient lake. In the dry valleys there are two main types of paleolake deposit; perched deltas and lacustrine sand mounds. Both contain preserved (freeze-dried) organic matter and carbonates.

We have analyzed carbonate and organic matter in sediment cores from modern Lake Hoare, "perched" deltas remaining from Glacial Lake Washburn which occupied the Taylor Valley up to ~8000 years ago (Doran *et al.* 1994), and lacustrine sediment mounds near Lake Vida (perched deltas are also associated with the Vida mounds, but we have not yet sampled them). The lacustrine sand mounds and associated deltas were left by a Greater Lake Vida.

Strata in Lake Hoare sediments have a mean carbonate $\delta^{13}C$ value of 5.6‰, very close to the predicted value (5.4‰) for antarctic lakes precipitating carbonate near saturation (Doran *et al.*, 1995). Organic matter $\delta^{13}C$ is variable, but overall is isotopically light. Heavier organic $\delta^{13}C$ values are generally associated with coarse-grained material, suggesting the material originated in shallower waters or is allogenic. A depth transect of surface microbial mat samples in Lake Hoare clearly shows that $\delta^{13}C$ gets lighter with depth in the lake, at a much greater rate than does the DIC in the water column. These data suggest that $\delta^{13}C$ of microbial mat may be a useful indicator of paleohydrology (e.g. lake level, ice thickness, etc.), and in turn, paleoproductivity.

We find that $\delta^{13}C$ of modern deltas and shallow lacustrine mats are quite variable considering they are from the same lake at the same time. All of these samples are near a major inflow to the lake, and therefore are influenced by both lake and stream dynamics. Comparison of these results with the depth transect in Lake Hoare reported above leads us to suggest that lake bottom environments are more stable and predictable than lake edge deltaic environments, and therefore lake bottom deposits are more useful as paleoindicators.

Distinct authigenic (as opposed to detrital) carbonate is absent in the deltas, since the thermodynamics of the stream/lake system does not allow for saturation of calcite near stream inflows (i.e., where the deltas are forming). Lacustrine sand mounds, on the other hand, contain abundant and readily identifiable authigenic carbonate, since these deposits are characteristic of lake bottom environments. Identifying authigenic carbonate will be important for the Martian case, since carbonate is more likely to be preserved in the harsh ambient environment than organic matter, and it will contain isotopic signatures (e.g. $\delta^{13}C$, $\delta^{18}O$) indicative of the lake environment at the time of deposition. Our work in the dry valleys suggests further that the larger the delta, the less likely the chance of finding non-clastic material. This is presumably a result of the high energy environment that produces the larger deltas.

We conclude that deltas may not be ideal locations to look for evidence of past life on Mars. Nevertheless, large deltaic features visible in Viking imagery (e.g. in the Ma'adim Vallis/Gusev crater system), are useful in that they indicate a possible region of discovery for smaller-scaled features of potential, such as lacustrine sand mounds.

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