PALEOLAKES AND LIFE ON EARLY MARS

M. A. Meyer, R. A. Wharton, Jr.*
Desert Research Institute
and
C. P. McKay
NASA Ames Research Center

Did life begin on early Mars, as it did on Earth, during the planets' first billion years after accretion? Early Mars had volcanism, an atmosphere, and liquid water - the essential ingredient for life as we know it. Knowing whether or not life existed on Mars is fundamental to our understanding of how life began in our solar system. During future Mars missions, the search for evidence of extinct life can be directed by research of terrestrial analogs of the possible conditions on Mars as the planet became cold and dry. The McMurdo Dry Valleys in Antarctica have a mean annual temperature of -20°C and less than 10 mm precipitation, yet within this barren land, perennially ice-covered lakes harbor rich communities of microbial mats, cold-water homologs of ancient stromatolitic communities. The translucent ice-cover insulates the subsurface liquid water from a frigid environment and permits photosynthetic microorganisms to proliferate. In addition, atmospheric gases are concentrated well above saturation by the exsolution of gases during freezing and the subsequent loss of water through sublimation. These results suggest that the purported Martian lakes, such as in Valles Marineris, may have harbored and extended the time period for life by providing light, liquid water, and concentrated gases as Mars cooled and its atmosphere thinned.

Two research directions have begun to elucidate key parameters in the search for extinct life on Mars. Carbonate sediments, deposited about 10,000 years ago in association with biological activity, have been sampled from the paleolake beds of Lake Vanda and Meirs in the McMurdo Dry Valleys. These samples are being analyzed for simple biological signatures that remain in cold and dry paleolake sediments, namely microfossils, percent carbonate, and total organic carbon. Our second initiative is the study of Colour Lake, in the Canadian Arctic, that periodically maintains a perennial ice-cover. Physical measurements started this year will be used to determine one end-point for ice-covered lake environments and will be compared to continuous measurements from Antarctic lakes started in November 1985. Interestingly, Colour Lake also supports benthic mat communities but the low pH precludes carbonate deposition. This research will broaden our knowledge base for what conditions are necessary for ice-covered lake formation and what biological signatures will remain in paleolake deposits.