The Antarctic analogy for ancient lakes at Gale Crater, Mars

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In place of the dual choice of “warm and wet” versus “cold and dry” Mars, we reconcile in this paper the notion of a cold Mars with the notion of wet Mars. Both the geological evidences at Gale's for the presence of liquid water during the Hesperian (Grotzinger et al., Science, 350 (6257), 2015) and the failure of climate models make Mars warm (Wordsworth, Review of Earth and Planetary Science, 44, 1-31, 2016) suggested that an alternative scenario could be envisioned.

The lake Untersee, Antarctica is an inspiring example of how an aqueous environment can survive for an extended period of the time in a place where the day average temperatures never, ever, each 273K. The key process which maintains a liquid, potentially habitable, environment under the ice is the subaqueous melting of a glacial dam in contact with the lake which provides a constant latent heat flux into the lake (McKay et al, in preparation) Our calculations showed that for certain range of pressures, temperatures and ice optical properties, a large body of water at Gale's will not freeze solid even if the surface temperatures are at all times well below freezing. The rather high sublimation rates of ice at Mars', the sunlight penetrating the ice and the geothermal flux contribute to stabilize the solid/liquid interface at a certain depth. We found that for a mean annual temperature of 245K ice thicknesses range from 3-10 meters which are comparable values to the range of those for the Antarctic lakes (2-7m). Thus, the ice potentially gets thin enough to let sediments penetrate the ice (Rivera-Hernandez et al., in preparation) and geological features associated with aqueous environments may still be possible with a perennially-covered lake, on cold, but wet planet. The Antarctic lakes model is engaging as it relaxes the requirement for a long-lived active hydrological cycle