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The geomorphology of two hyper-saline springs in the Canadian High Arctic

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On Axel Heiberg Island in the Canadian High Arctic, many low temperature perennial saline springs occur despite cold polar desert climate conditions marked by a mean annual air temperature of -18°C. Associated with 2 groups of hyper-saline springs are distinctive landforms resulting from winter deposition of salt minerals. These deposits resemble tufas structurally, but unlike true tufas which are composed of carbonate minerals, these landforms are formed mainly of salt. This study hypothesizes that the extreme cold winter air temperatures cool water temperatures triggering rapid precipitation of various salt minerals [mainly hydrohalite ($NaCl*2H_2O$)]. These newly formed salt minerals subsequently alter the flow hydrology by obstructing summer flow paths. The tufa-like appearance of these salt deposits reflects the interaction between changing water temperature, chemistry and flow.This research characterises the geomorphology and geochemistry of two hyper-saline springs on Axel Heiberg Island: the first is located at Wolf Diapir (79°07'23"N; 90°14'39"W), the deposit at this site resembles a large conical mound (2.5m tall x 3m diameter). The second is located at Stolz Diapir (79°04'30"N; 87°04'30"W). In this case a series of pool and barrage structures staircase down a narrow valley for approximately 300m (several pools are up to 10 m wide x 3 m deep). The springs have very different seasonal surface hydrologic regimes and topographic settings which influence the pattern of mineral precipitates. The accumulation of precipitates occurs during the winter and is dominated by the formation of hydrohalite. In the summer, the accumulated hydrohalite melts incongruently to form halite. In addition, spring water and snowmelt dissolve various parts of the accumulations, changing the morphology of the deposits. This presentation will focus on results from four periods of fieldwork (two in spring for winter conditions and two in summer) including results from time-lapse photography, air and ground monitoring, mineralogy and water chemistries. An interesting application of this research pertains to the search of liquid water on Mars. These features offer a potentially unique indication of groundwater activity in areas of cold permafrost and thus may aid in the site selection for future Mars missions. Axel Heiberg Island's cold and dry climate provides a Martian analogue setting that is a viable alternative to the costs and risks associated with full Mars missions.