Organic carbon in ice-bonded permafrost in the McMurdo Dry Valleys of Antarctica: a potential biotracer of microbial activity on Mars.

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The purpose of this study is to investigate the concentration of organic carbon in the uppermost 1 m of ice-bonded permafrost from the McMurdo Dry Valleys of Antarctica (figure 1). The core was collected in 2010 from University Valley (figures 2 and 3), situated at 1700 m above sea level, one of the coldest and driest environments on Earth. As such, University Valley represents a terrestrial analogue to study habitability of permafrost on Mars. By understanding the nature and cycling of the organic carbon found in the ice-bonded permafrost in relation to the origin of ground ice (liquid versus vapour formed ice), more refined sampling techniques and instruments can be devised for future landers sent to Mars, such as the proposed Icebreaker mission in 2018.

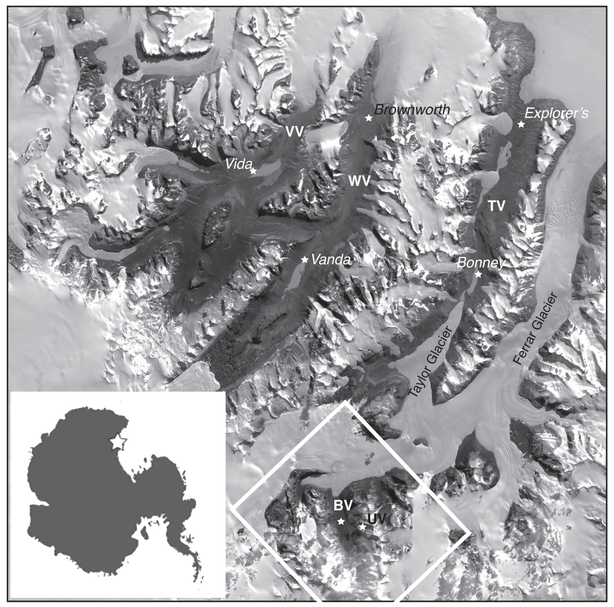

Figure 1: McMurdo Dry Valleys

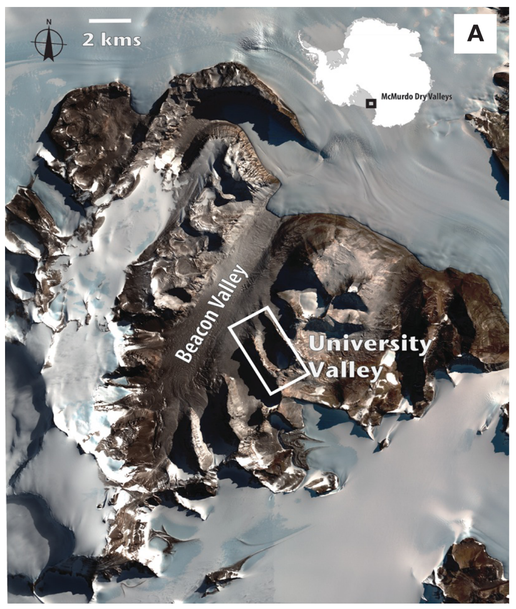

Figure 2: Southern end of the McMurdo Dry Valleys

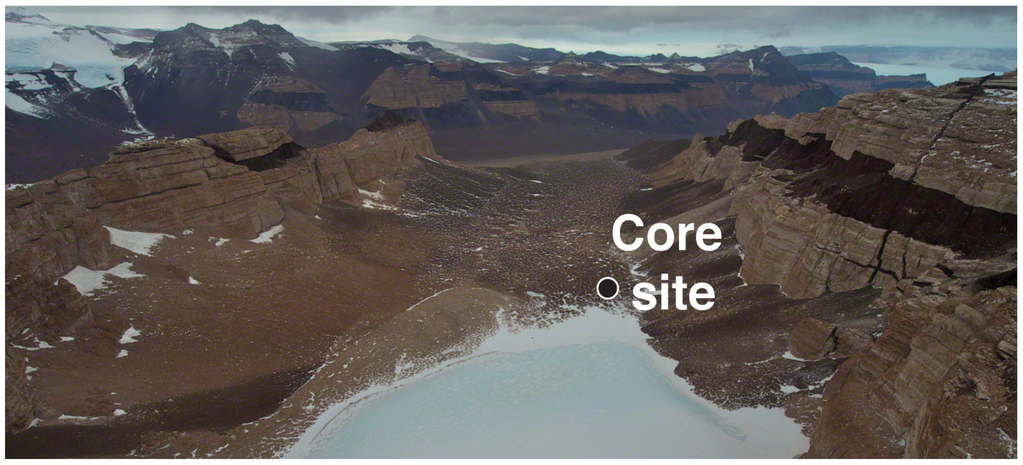

Figure 3: University Valley

METHODOLOGY

The 110 cm long core of frozen soil was sub-sampled using a circular rock saw into 48 vertical segments, each measuring ca. 2.3 cm. The volume of sediment and supernatant water was measured and the excess ice was calculated after the melted segments were transferred into graduated polypropylene vials. The mass of water was determined by subtracting the wet weight from the dry sediment weight and the gravimetric water content was calculated by dividing the mass of water by the mass of dry soil.

The dried sediment underwent a treatment of 10% hydrochloric acid to dissolve any inorganic carbon present in the samples. For analysis of organic carbon and nitrogen concentration, approximately 10 mg of oven dried soils (105°C) was placed into a tin capsule with 20 mg of tungstic oxide and flash combusted at 1800°C. The resulting gases were carried using ultra pure helium through reducing/oxidizing gas chromatographic columns to separate the CO_2 and N_2 gases. The concentrations of the gases were measured with an elemental analyzer (VarioEl III) and then plotted with depth within the soil column, which revealed trends in organic carbon and excess water content.

RESULTS

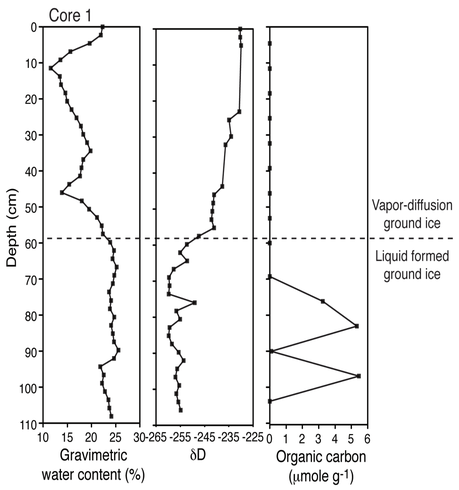

Figure 4: Depth vs gravimetric water content (%), δD and organic carbon for core 1.

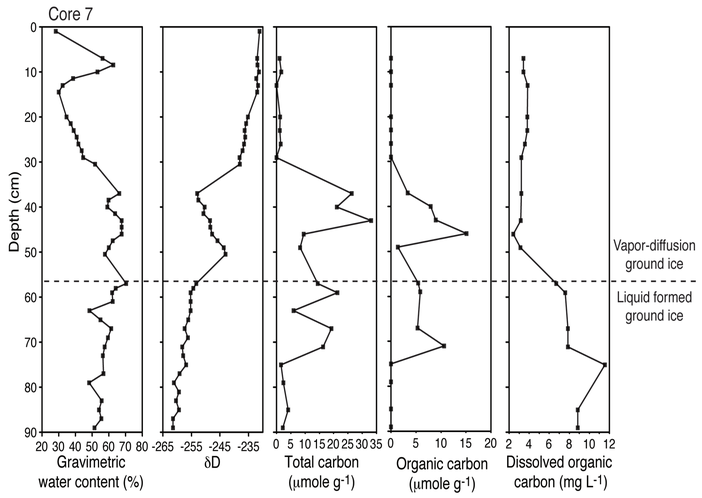

Figure 5: Depth vs gravimetric water content (%), δD, total carbon, organic carbon and dissolved organic carbon for core 7.

CONCLUSION

These trends show that the highest concentration of organic carbon is found at depths in which ice content is formed by freezing water (figures 4 and 5). The origin of the organic carbon has yet to be determined. Was it transported by water, or was it produced *in situ* by microbes and bacteria who were able to survive due to a source of water?

ACKNOWLEDGEMENTS

This work was supported by the University of Ottawa's Undergraduate Research Opportunity Program (UROP). We would like to thank Paul Middlestead (G.G. Hatch laboratory) for his guidance in preparing samples for elemental analysis.