ALASKAN ANALOGS FOR ICY SOILS ON MARS: THE PERMAFROST TUNNEL AND THE JUNEAU ICEFIELD: J. M. Lorenzo[1], T. A. Douglas[2], S. Campbell[3], H. Haviland[4], M. Zanetti[4], R. C. Weber[4], C. Fassett[4], D. A. Patterson[1], A. Bates[1], S. Karunatillake[1],[1]Dept. Geology & Geophysics, Louisiana State University, Cnr. Tower and S. Campus Drives, Baton Rouge, LA 70803, USA, gllore@lsu.edu; [2]U.S. Army Cold Regions Research & Engineering Laboratory, 9th Avenue, Building 4070 Fort Wainwright, AK, USA, thomas.a.douglas@usace.army.mil; [3]School of Earth & Climate Sciences & Climate Change Institute, University of Maine, 119 Sawyer Hall, Orono, ME 04469-5790, USA, scampb64@maine.edu; [4] NASA Marshall Space Flight Center, 320 Sparkman Drive, Huntsville, AL 35820, heidi.haviland@nasa.gov.

Introduction: Water ice on Mars is an essential resource for fuel and water to support future human explorers. The distribution of shallowly buried ice (< 10 m) can also help constrain the relative roles of precipitation, brines, and obliquity cycles on Mars [1]. Recent, Martian, mid-latitudinal ice discoveries emphasize these areas as key to future exploration [2]. Remote sensing suggests compaction resembling terrestrial glaciers, but with limited evidence for flow. Cold, dry-based glacier conditions currently dominate, as evident from both scarp activity and collapsed boulder fields [3]. However, analyses of Martian valley networks indicate provenance from subglacial meltwater instead of rainfall on ancient Mars [4]. Increasingly mature, compact nuclear spectroscopy, ground penetrating radar (e.g., dielectric properties) and seismic methods increase the capacity to effectively explore of mid-latitudinal sites in situ [5].

Non-invasive in-situ characterization can be the key to modeling the geology of ground ice and advancing prior, remote and in situ observations (Figure 1). An integrated sensing and analytical approach is needed to constrain autonomous, real-time interpretations, e.g., simultaneous measurement of chemical (e.g., gamma-ray-neutron spectrometer), seismic and dielectric properties**.** A multi-sensor approach reduces uncertainty in key properties such as the spatial distribution, depth, density, nature of overburden, and distinct stratigraphy of ice deposits within an area of interest.

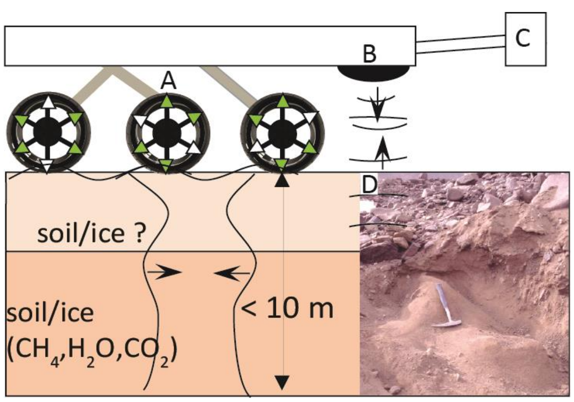

Figure 1. A. Alternating seismic sensors (green) and sources (white) receive and send seismic waves. B. Ground-penetrating radar transceiver detects pore-space substituted with ice. C. A long-arm gamma-neutron spectrometer. Sensor collects nuclear spectra away from influence of rover. D. As a specific example for Mars, the Antarctic Dry Valleys analog [2] implies a potentially complex soil-ice mixture for Mars that requires an integrated suite of geophysical and geochemical tools.

Alaskan Analog Sites

By cross-calibrating seismic and nuclear spectroscopy data, ground-truthing increases the precision of geophysical and compositional interpretations at high resolution to decimeter depths (comparable to orbital nuclear spectroscopy on Mars and mechanical sampling depths of past in situ missions). Two sites in Alaska present optimal analogs to cryospheric processes on Mars over geologic time.

*Juneau Icefield***:** The Juneau Icefield is the site of the longest operating glaciological research and education program in North America with field stations placed across 4000 km^2 of temperate glacier, permafrost, and periglacial terrain. The icefield provides easy access to snow, firn, ice, recently exposed subglacial environments, glacial geology, and undisturbed sporadic permafrost.

*Permafrost Tunnel***:** The U.S. Army Cold Regions Research and Engineering Laboratory's Permafrost Tunnel near Fairbanks is a unique [6] 500 m-long underground research facility excavated since the mid-1960s through intact syngenetic ice-rich permafrost. The site is readily accessible and allows access to a full range of intact permafrost structures as well as a 50-year sublimation record [7] through massive ice and undisturbed loess.

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