RIMFAX GPR ON MARS 2020 INVESTIGATION AT JEZERO CRATER. Svein-Erik Hamran[1], David A. Paige[2], Hans E.F. Amundsen[3], Tor Berger[4], Sverre Brovoll[4], Lynn Carter[5], Leif Damsgård[4], Henning Dypvik[1], Sigurd Eide[1], Rebecca Ghent[6], Jack Kohler[7], Mike Mellon[8], Daniel C. Nunes[9], Dirk Plettemeier[10], Patrick Russell[2] and Mats Jørgen Øyan[4]. [1]University of Oslo, Kjeller and Oslo, Norway, [2]University of California, Los Angeles, CA, USA, [3]Vestfonna Geophysical, Trondheim, Norway, [4]Forsvarets forskningsinstitutt, Kjeller, Norway, [5]University of Arizona, Tucson, AZ, USA, Norway, [6]Planetary Science Institute, Tucson, AZ, USA, [7]Norwegian Polar Institute, Tromsø, Norway, [8]Cornell University, Ithaca, NY, USA, [9]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA, [10]Dresden Technische Universität, Dresden, Germany

Introduction: The Radar Imager for Mars' Subsurface Experiment (RIMFAX) is a Ground Penetrating Radar on the Mars 2020 mission's *Perseverance* rover [1], which is planned to land in Jezero crater on February 18, 2021 [2]. RIMFAX will add a new dimension to rover investigations of Mars by providing the capability to image the shallow subsurface beneath the rover [3]. The principal goals of the RIMFAX investigation are to image subsurface structure, and to provide information regarding subsurface composition. Data provided by RIMFAX will aid Perseverance's mission to explore the ancient habitability of its field area and to select a set of promising geologic samples for analysis, caching, and eventual return to Earth.

The RIMFAX Instrument: RIMFAX is a Frequency Modulated Continuous Wave (FMCW) radar that transmits a signal swept through a range of frequencies, rather than a single wide-band pulse that are used in commercial GPR's. The operating frequency range of 150 - 1200 MHz covers the typical frequencies of GPR used in geology. In general, the full bandwidth (with effective center frequency of 675 MHz) will be used for shallow imaging down to several meters, and a reduced bandwidth of the lower frequencies (center frequency 375 MHz) will be used for imaging deeper structures. The majority of data will be collected at regular distance intervals whenever the rover is driving, in each of the deep, shallow, and surface modes.

Field Tests: RIMFAX instrument prototypes have been field-tested in different geological setting to verify the performance of the different operating modes. RIMFAX has been used to sound polythermal glaciers imaging the internal structure of the glacier and the ice/rock interface down to more than 200 meters [3]. Imaging of subsurface structures in permafrost limestone down to 20 meters was demonstrated in Svalbard, Norway. Mapping of the cross bedding internal structure, down to 10 meters depth, of wind driven sand dunes was shown in data collected at the Coral Pink Sand Dunes, Utah.

Operations: RIMFAX can acquire data either while in motion during a rover traverse, or while stationary when the rover is standing still. When the rover is driving, RIMAFX will collect a group of soundings every 10 cm, each with different modes to optimize receiver dynamic, radar depth resolution and data volume. These measurements will give a two-dimensional radar profile image of the shallow subsurface along the rover traverse. Stationary radar soundings can also be collected at different time intervals to study diurnal changes in subsurface dielectric properties due to thermal variations and potential interactions between the atmosphere and the regolith.

Measurements: There is an extensive history of using ground penetrating radar systems to study both modern and ancient deltaic environments. Sedimentary processes in deltas can create lithofacies units that can be mapped over large distances. RIMFAX will reveal layering within the delta and may provide critical information about its evolution, including possibly its vertical extent, and the locations of buried channels.

The so-called dark-toned mafic crater floor is one of the most enigmatic aspects of the Jezero stratigraphy [2]. The dark-toned unit is thought to be ~ 10 m thick near the edges of the deposit [5], [6], which is most likely well within the penetration depth and resolution of RIMFAX.

First soundings on Mars: The first RIMFAX sounding data will be stationary aliveness tests acquired at the rover's landing site. The first RIMFAX traverse data will be acquired when the rover moves away from the landing zone. The results from these first measurements will be presented.

References:

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