RIMFAX GROUND PENETRATING RADAR OBSERVATIONS OF SUBSURFACE STRATIGRAPHY ALONG MARS 2020 PERSEVERANCE'S TRAVERSE. Patrick S. Russell[1], Svein-Erik Hamran[2], David A. Paige[1], Daniel C. Nunes[3], Hans Amundsen[2], and the M2020 RIMFAX Team. [1]Dept. Earth, Planetary & Space Sciences, Univ. California Los Angeles, Los Angeles, USA, [2]Inst. Technology Systems, Univ. Oslo, Oslo, Norway, [3]Jet Propulsion Laboratory, California Inst. Technology, Pasadena, USA.

Introduction: The Radar Imager for Mars' subsurface eXperiment (RIMFAX) ground penetrating radar (GPR) on the Mars 2020 Perseverance Rover [1] measures the shallow subsurface beneath the rover's path. The main goal of RIMFAX is to investigate the geology and geophysical properties of the subsurface, providing insight into stratigraphic relationships, links between surface outcroppings, structural features, regolith and bedrock densities, geologic context for samples and biosignature preservation potential, and rover strategic and tactical planning. Early results were given in 2, 3] Here we present a summary of types of subsurface materials and layers characterizing sections from around the rover's traverse so far. For geophysical properties of subsurface materials derived from RIMFAX data, see [4].

The RIMFAX radar uses a Gated Frequency Modulated Continuous Wave (FMCW) waveform operating from 150 MHz to 1200 MHz. The radar electronics are housed in a box mounted in the rover body in a temperature controlled zone. The antenna is a slot bow tie antenna mounted outside on the back of the rover. RIMFAX collects soundings every 10 cm along the rover traverse. At each location, three sounding modes are collected, each focusing on a different zone of the subsurface: Surface, Shallow, Deep. This partitioning is accomplished by varying the gating, time-delay, gain, and processing. For example, Deep mode data does not include the uppermost subsurface and uses higher gain to record fainter deeper returns, whereas the Surface mode is tuned to capture but not saturate the surface return. The Shallow mode has been the focus of most preliminary Rimfax data analysis, yielding exciting glimpses of layering, structures, and density variations.

Results. Within the crater floor fractured plains surrounding the edge of the Seitah geographical feature [4], data from RIMFAX reveals two general radar-types of materials (Fig. 2). One is characterized by moderate scattering and indications of intermittent layers and coherent structures, the other by very low scattering and weak returns of any kind. These are usually present as a sequence of up to a few apparently near-horizontal layers. Boundaries range from sharp to gradational. At some locations these dip up to ~5°, generally in a direction away from Seitah. Initial indications are that the low-return zones correspond to a layer(s) that are friable and degraded and typically form low surface slopes. However, rock outcrops are typically covered by regolith and aeolian materials, with only a few indications of competent material showing through. This may be an alternative expression equivalent to the smooth polygonal outcrops composing flat-surface instances of the Rubion unit [6]. It is also possible that it is similar to the more degraded materials of the overlying knobby Artuby unit [6], the base of which often disappears into the finer cover typically covering this zone along Seitah's S margin.

The upper/exterior portions of Seitah are characterized by prominent, bright reflectors indicative of roughly parallel, constant-thickness layering with dips 10-15 degrees, also generally away from Seitah, ranging from SW to SE. These are exemplified in the traverse down from the Artuby ridge into Seitah on Sols 201-202 (Fig 3), where they resemble foresets and cyclic steps within a subaqueous sedimentary environment [3]. Ridges of resistant surface outcrops dip consistently with the subsurface layers [7], exemplified at the rock Issole. The interior of Seitah also contains dipping reflectors but not of the same prominence as those of the exterior.
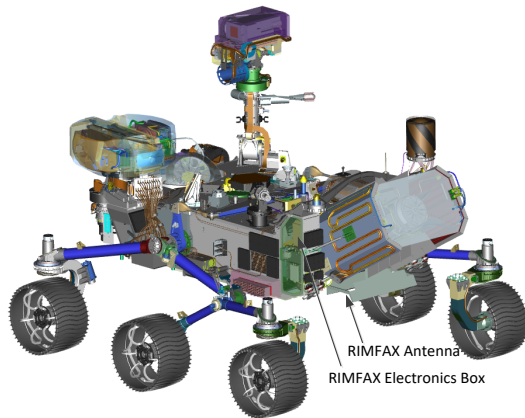
Fig. 1. Mars 2020 Rover with location of RIMFAX GPR instrument at back.

References: [1] Hamran S.-E. et al. (2020) *Space Sci. Rev.*, 216(8). [2] Hamran S.-E. et al. (2021) *LPSC LII #1223*. [3] Hamran S.-E. et al. (2021) *AGU Fall Meet*. [4] Casademont T. et al. (2022) *LPSC LIII*. [5] Wogsland B. et al. (2021) *GSA Ann. Meet*. [6] Sun V. et al. (2022) *LPSC LIII*. [7] Tarnas J. et al. (2021) *GSA Ann. Meet*.
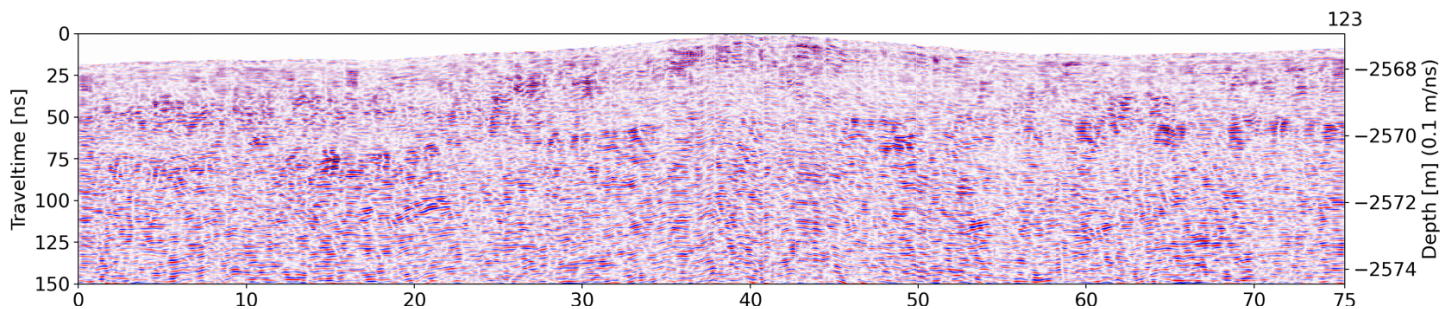

Fig 2. – Example of Fractured Crater Floor materials and layers, Shallow mode, from Sol 123; ~N to left, ~S to right; x-axis: along-traverse distance in meters, y-axis1: two-way travel time, y-axis2: depth in meters (estimated velocity ~0.1m/ns); vertical exaggeration 2x.
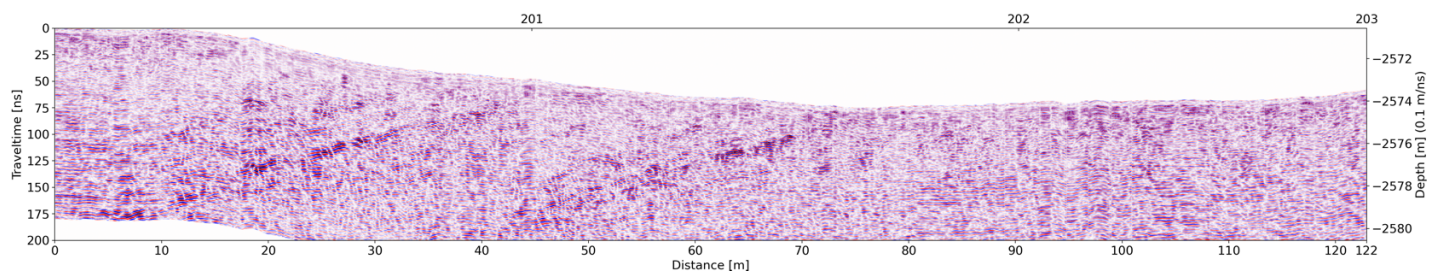

Fig 3. – Example of Seitah materials and layers with prominent layering towards exterior, Shallow mode, from Sols 201-202; ~SW to left, ~NE to right (turns present); x-axis: along-traverse distance in meters, y-axis1: two-way travel time, y-axis2: depth in meters (estimated velocity ~0.1m/ns); vertical exaggeration 2x.