SAMPLING THE MARGIN UNIT OF JEZERO CRATER, MARS FOR FUTURE MARS SAMPLE RETURN. S. Siljeström[1], K. A. Farley[2], T. Bosak[3], F. J. Calef III[2], A. D. Czaja[4], B. Garcynski[5], E. M. Hausrath[6], C. D. K. Herd[7], B. Horgan[8], L. E. Mayhew[9], N. Randazzo[6], S. Sholes[2], D. L. Shuster[10], J. I. Simon[11], K. M. Stack[2], B. P. Weiss[3], M.-P. Zorzano[12], A. C. Allwood[2], J. Bell[13], R. Bhartia[14], E. Clavé[15], J. Hurowitz[16], J. Johnson[17], Y. Liu[2], G. Lopez-Reyes[18], J. Maki[2], L. Mandon[19], E. N. Mansbach[3], E. Moreland[20], L. P. O'Neil[21], J. I. Núñez[17], A. C. Pascuzzo[22], E. Ravanis[23], P. S. Russell[24], S. Sharma[2], K. Siebach[25], A. Steele[26], M. M. Tice[19], , K. H. Williford[27], R. C. Wiens[28], A. Udry[29] and the Mars 2020 team [1]RISE Research Institutes of Sweden (sandra.siljestrom@ri.se), Stockholm, Sweden, [2]JPL, California Institute of Technology, Pasadena, CA [3]MIT, Cambridge, MA, [4]University of Cincinnati, Cincinnati, OH, [5]Western Washington University, WA, [6]University of Las Vegas, Las Vegas, NV, [7]University of Alberta, Edmonton, Canada, [8]Purdue University, West Lafayette, IN, [9]University of Boulder, Boulder, CO, [10]UC Berkeley, CA, [11]ARES, NASA JSC, Houston, TX, [12]Centro de Astrobiologia, INTA, Madrid, Spain, [13]Arizona State University, AZ [14]Photon Systems Inc., Covina, CA, [15]DLR-OS, Berlin, Germany [16]SUNY Stony Brook, Stony Brook, NY, [17]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [18]University of Valladolid, Spain [19]Caltech, Pasadena, CA, USA, [20]Rice University, Houston TX, [21]Texas A&M University, College Station, TX, [22]MMISS, [23]University of Hawai'i, Honolulu, [24]UCLA, LA, CA [25]Rice University, Houston TX, [26]Carnegie Institution of Washington, Washington DC, [27]Blue Marble Space Institute of Science, Seattle, WA, [28]LANL, NM, [29]University of Nevada, Las Vegas, NV.

Introduction: Mars 2020 Perseverance rover is currently exploring Jezero crater, which contains an ancient lake-delta system with a high potential for past habitability. One of Perseverance's primary science goals is to collect a set of scientifically return-worthy samples for return to Earth (Mars Sample Return; MSR) [1]. Between February 2021 and December 2023, Perseverance has sealed 23 tubes containing 20 rock cores, 2 regolith samples and one atmosphere sample. All rock and regolith samples are accompanied by a set of observations (Sample Threshold Observation Protocol, the STOP List) performed on abrasion patches or regolith near each sample collection site. These observations are documented in the Initial Reports and the Sample Dossier (https://pds-geosciences.wustl.edu/missions/mars2020/returned_sample_science.htm). Here we provide an overview of the samples collected during the Margin campaign.

The *Margin unit* is situated interior and adjacent to the western crater rim and exhibits a strong carbonate signal from orbital reflectance spectroscopy [2]. Stratigraphically the unit lies beneath the previously explored curvilinear and blocky units of the fan top and is therefore older than those units. Based on its position near the crater rim and the strong carbonate detections it has been proposed to be a shoreline deposit with possible lacustrine carbonates [2]. Alternative hypotheses include pyroclastic, fluviolacustrine and aeolian deposits. Based on rover observations a lacustrine shoreline deposit seems most likely [3-4]. The planning of the *Margin* campaign took place during the summer of 2023, and 3-5 samples were baselined to be collected [4].

Exploration of the *Margin unit* began in September 2023 and so far, two samples have been collected: the *Pelican Point* core at the *Hans Amundsen Memorial Workspace* in the *Mandu Wall region*, and the *Lefroy Bay* core at *Lake Newell* in the *Turquoise Bay* region (Fig. 1). The associated abrasion patches are *Amherst Point (Pelican Point)* and *Bills Bay (Lefroy Bay)*. *Mandu Wall* is interpreted to be stratigraphically lower than *Turquoise Bay* based on topography.

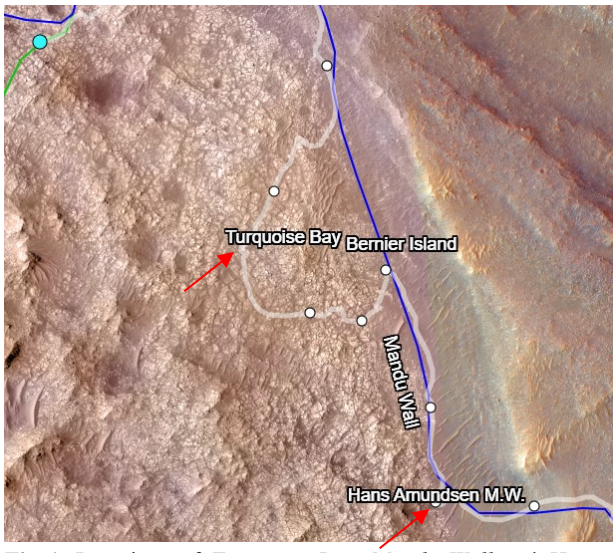

Fig 1. Locations of *Turquoise Bay, Mandu Wall* and *Hans Amundsen Memorial Workspace* in the Margin unit. Red arrows indicate locations of the *Pelican Point* and *Lefroy Bay* cores. Distance between TB and H.A.M.W is ~375 m.

Results: Images of the *Mandu Wall* and *Turquoise Bay* regions and their associated sampling sites show the presence of slabs of light-toned, dusty, granular, fractured and minimally layered rocks (Figs. 2-3) [5]. The *Turquoise Bay* area contains larger slabs of bedrock than *Mandu Wall*.

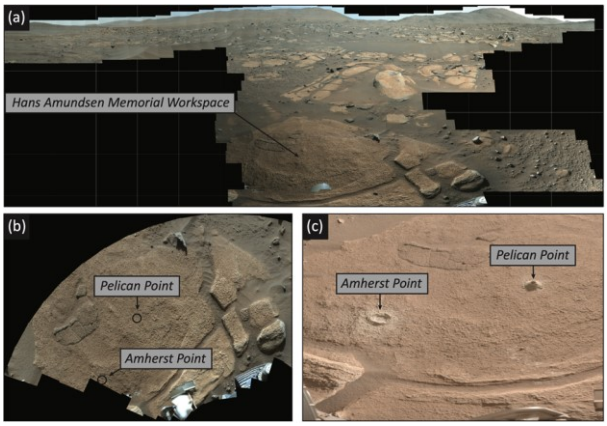

Fig. 2. Mastcam-Z (Sols 911, 912, 913, 914. 916; zcam08918, zcam08919,zcam08920,zcam08921,zcam08922, zcam08923) and Front Haz Cam Bayer of the sampling outcrop of *Hans Amundsen Memorial Workspace* in the *Mandu Wall* region showing the drill hole of *Pelican Point* and the abrasion patch *Amherst Point* (5cm across).

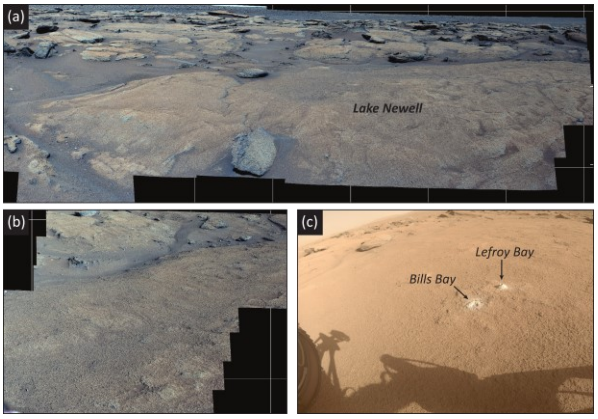

Fig 3**.** Mastcam-Z (Sol 933, zcam08945; Sol 943, zcam08959) and Front Haz Cam Bayer filter images of the sampling outcrop of *Lake Newell* in the *Turquoise Bay* region showing the drill hole of *Lefroy Bay* and the abrasion patch *Bills Bay* (5cm across).

The abrasion patches associated with the cores *Pelican Point* and *Lefroy Bay* show they are moderately to poorly sorted medium to coarse sandstones with *Lefroy Bay* being slightly coarser grained than *Pelican Point* (Fig. 4).

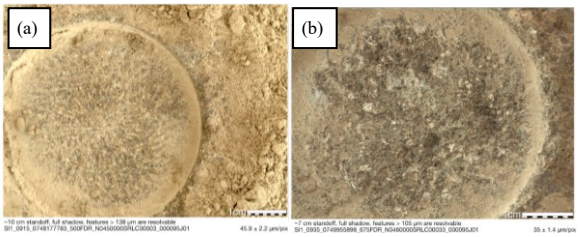

Fig. 4. WATSON images of the abrasion patches: a) *Amherst Point* and b) *Bills Bay*. Scale bars in right lower corners 1 cm.

Bulk composition is consistent with that of an altered basalt. PIXL shows that the clastic components of the rocks consist of olivine, pyroxene, feldspar, Fe-Cr-Ti oxides and altered silicates. Major alteration phases include silica and Mg/Fe-carbonates with silica as a possible cement. Hydrated sulfates, similar to previously detected sulfates in Jezero crater, and chlorides are also present. SuperCam's observations of the *Margin* show that the unit has similar chemistry and mineralogy to the curvilinear unit but with more prevalent carbonate and silica signatures [6]. Overall, the two samples are similar to each other [6] except *Pelican Point* contains hydrated carbonates while *Lefroy Bay* contains more abundant carbonates, and hydrated/hydroxylated silica and potential perchlorates as detected by SHERLOC. The *Margin unit* samples exhibit minimal fluorescence which together with the lack of Raman signal indicate only minor amount of organic matter present if at all.

Examination of the samples upon their return to Earth would address multiple scientific questions including constraining the history of Jezero lake and the age of deposition of the *Margin unit*. Study of silica cements and carbonates would constrain the fluid chemistry (pH, Eh, salinity etc.) and potential fluid sources. Together with studies of other samples from the fan these samples will enable studies of source to sink sedimentary processes on Mars.

Due to its potential as an ancient shoreline and presence of minerals deposited by water the *Margin unit* might represent a habitable environment [3-4]. The presence of carbonates and silica in these rocks as cements make them targets for biosignature investigations.

Conclusion: Two sandstone samples have been collected at the *Margin unit* which consist of olivine, feldspar, altered silicates, Fe-Cr-Ti oxide, carbonate, sulfate, chlorides, with silica as a possible cement. The current plan is to potentially collect another 1-2 samples of the *Margin* and rocks exposed within *Neretva Vallis* channel before climbing the rim of Jezero crater. The samples could include a representative of proximal *Margin*, a possible hydrated silica deposit (if found [7]) and a sample of a light-toned unit at *Bright Angel,* within *Neretva Vallis.*

References: [1] Farley K. et al. (2020) *Space Science reviews, 216,* 142. [2] Horgan H, et al. (2020) *Icarus, 339,* 113536. [3] Randazzo R. et al., this meeting. [4] Horgan H. et al., this meeting. [5] Garczynski B. et al. this meeting. [6] Wiens R. et al., this meeting. [7] Beck P. et al., this meeting.