Summary of Instruments and Sample Prep Needs Proposed for the SRF Ref. # Required Instrument Functionality Reference instrument Function	
Ref. # Required Instrument Functionality Reference instrument Function	Required for
	Curation Sample Safety Time-Sensitive Sterilization-
	Assessment Science Sensitive
	Science
Pre-Basic Characterization (n = 3)	
1 Stereo microscope (see note) [8:1 zoom], ; (possible multiple) Leica 216 APO; Leica DMS1000 Macroscope View/inspect/image all hardware by	before opening X
MOSDT1 P Cameras PTZ (pan/tilt/zonn) with 12x+ optical zoom (multiple) Axis G6074 PTZ 30x optical zoom View/inspect/mage all hardware t Plip Resolution X-ray Computed Tomography (RHXCT) (Risk or MTZ) ST with a 225 ST w	before opening X X X
a Nikon XTH 320 LC kV source - 4 Axis - PE 1620 w CFW	
with 225kV and 320kV)	
3 Magnetometer Mag-03MS100, Bartington Instruments measure sample tube in nano Teslas	X X
4 Magnetic Susceptometer no recommandation measure magnetic susceptability of the sample to	X X
Basic Characterization (n = 2) Analytical biance (see note) (may need multiple) Mettler XPR Automatic Balance <0.1 mg readability weigh samples	X
Analytica balance (see note) (may need multiple) Multispectral/hyperspectral image for 20 micron resolution) Multispectral/hyperspectral image samples in the UV to IR range Multispectral/hyperspectral image for 20 micron resolution)	X X
Multispectral/rryperspectral imager [Liv_Jumicron resolution] Steroo microscope (see note) [81, 2 comp.] (possible multiple) Leica 216 APO; Leica DMS1000 Macroscope View/inspect/image all sa	
MOSDT2 ; fully automated Materials reflective micrscope (long-working objectives 1.25X, Leica DM6 M View/inspect/image all sa	
5X, 10X, 20X, 50X) BF, DF, P, F; HR camera. (possible multiple)	
MOSDT3 IP Camera PTZ (pan/tilt/zoom) with 12x+ optical zoom (multiple) View/inspect/image all Sa	imples X .
Preliminary Examination (n = 8)	
7.1 Variable Pressure-Field Emission Scanning Electron Microscope with electron and PESS Sigma 300 VP with BSE, SE, EDS/EDX, CL, FIB, WDS Focused Ion Beam (Fib) columns and multiple detectors.	X X X Three instruments: a VP/FEG-SEM for non-prepared samples, a VP/FEG-SEM for prepared samples (PTS, etc.), and a FIB for sample preparation. The two VP/FEG-SEM instruments to
Focused ion Beam (FIB) columns and multiple detectors	sampies (r), set_d, and a r is for sample preparation. The two vr/reto-sex instruments to have additional detectors (CL, EDS, MDS, FIB, and EBS) to be determined later.
	Notionally, all will have BSE/SE imaging detectors (no additional footprint) and EDS
	detectors (small additional footprint). Detectors for CL, WDS, and EBSD require prepared
	samples and have small additional footprint.
8 Deep Ultraviolet Fluorescence Photon Systems Inc. DUV PL 200 Map distrubution of organic compounds.	X X X Deep UV and confocal Raman are typically separate instruments, with optics that might
	not be compatible. For the purpose of MOSDT, they are considered as not combined.
9 Confocal Raman Spectrometer HORIBA LabrAMHR Analysis of molecular structure, crystallinity, and	d molecular interactions X X X X X
in inorganic and organic phases (analysis of mine	
10.1 Fourier Transform-Infrared Spectrometer (FTIR) ThermoScientific icolet™ iSSO; ATR and DRIFT Analysis of functional groups (silicates, carobona	ates, phosphates, X X X X This duciplicate instrument is only needed when KBr or any other substance is added to the powder. There exist some FTIR that do not need to add KBR within the sample. When such
sulphates, etc.) and water in mineral phases. Ana hydration state and local abonding environment	powder. There exists some in this do not need to adult when which it is an interest of the control of the contr
11.1 Micro-X-ray diffractometer with total scattering and pair-distribution function Malvern Panalytical Empyrean powder X-ray Analysis of the phases and degree of chrystallinit	
(PDF) analysis capability diffractometer Crystal structure, major and non-volatile minor	
stoichiometric composition of minerals	
12 X-ray Fluorescence Bruker S2 Puma with light element detector and Analysis of bulk chemical composition	X
mapping stage	
13 Microscopy lab (see note) [Leica DM4 P & DM6 M*] View/inspect/image all sa	mples X X
Headspace Gas analysis	
23.1 High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Thermo Scientific TC/EA (which interfaces with any optimized for low molecular weight volatiles and	
Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) continuous flow IRMS and would be used for the analysis of headspace.	d their stables isotones X X
characterizes mineral-bound volatile concentrat	and other gas samples tions, speciation, and
characterizes mineral-bound volatile concentrat isotopic compositions (i.e., H2O, SO2, CO2, etc.)	and other gas samples tions, speciation, and Uses combustion and
characterizes mineral-bound volatile concentral isotopic compositions (i.e., P.20, SQ.), CQ.; Sq., Sq., Sq., Sq., Sq., Sq., Sq., Sq.,	and other gas samples tions, speciation, and Uses combustion and
characterizes mineral-bound volatile concentrat isotopic compositions (i.e., H2O, SO2, CO2, etc.)	and other gas samples tions, speciation, and Uses combustion and
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characteriase mineral-bound volatile concentration stooptoc compositions (i.e., PL20, SQC, Qct.), isotope ratio mass spectrometry to determine it compositions of components in bulk samples. 24 Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) 25 Science Investigations & SSAP 7.2 Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors 26 Sigma 300 VP with BSE, SE, EDS/EDX, CL, FIB, WDS] Analysis of samples (prepared) Analysis of functional groups (silicates, carobona sulphates, etc.) and water in mineral phases. Analysis of samples (prepared) 10.2 Fourier Transform-Infrared Spectrometer (FTIR) ThermoScientific icolet ** ISSO; ATR and DRIFT Analysis of functional groups (silicates, carobona sulphates, etc.) and water in mineral phases. Analysis of functional groups (silicates, carobona sulphates, etc.) and water in mineral phases. Analysis of the phases and degree of chrystallinity (PDF) analysis capability 11.2 Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability 25 Electron Paramagnetic Resonance (EPR) Spectroscopy— Bruker Magnettech ESRS000 bench-top EPR quantities species with unpaired electrons. These redocuments of the processing steps that sections sensitive minerals, prior to exposure to so humidity Against and the processing steps that sections are readed and care for the processing steps that sections are readed and care for the processing steps that sections are readed and care for the processing steps that sections are readed and care for the processing steps that sections are readed and care for the processing steps that sections are readed and care for the processing steps that sections. Technology of the processing steps that sections are readed and care for the processing steps that sections. Technology of the processing steps that sections are readed and care for the processing steps that sections. Technology of the processing steps that	JUses combustion and he stable isotopic X X X This instrument is recommended by the Time-Sensitive report, and for the scope of MOSD X X X Three instruments: a VP/FEG-SEM for non-prepared samples, a VP/FEG-SEM for prepared samples prepared in the stable isotopic samples prepared samples prepared samples prepared samples prepared samples prepared samples prepared in the sample prepared samples and have small additional footprint). Detectors for CL, WDS, and EBSD require prepared samples and have small additional footprint). Detectors for CL, WDS, and EBSD require prepared samples and have small additional footprint. X X X X X X X X X X X X X X X X X X X

Summary of Instru	ments and Sample Prep Needs Proposed for the SRF									
Ref. #	Required Instrument Functionality	Quick glance Size (handheld OR tabletop OR self-standing)	Is it possible to interface with	Org. cont.	Sample	Isolator Manual	Isolator Robotics/	Engineering Deta Vibration	Power Requirements (V/A)	Size
Ref. #	Required Instrument Functionality	Size (handheid Ok tabletop Uk sell-standing)	Is it possible to interface with isolator/DWI?	Org. cont. sensitive (Y/N)	Preparation (Y/N)	Isolator Manual Manipulation via gloves (Y/N)	Isolator Robotics/ RMS handling (Y/N)	Vibration Sensitive (Y/N)	Power Requirements (V/A)	Size
	Pre-Basic Characterization (n = 3)									
1	Stereo microscope (see note) [8:1 zoom], ; (possible multiple)	handheld	on isolator	N	N	N	Y	Y	USB 5V (5W)	
MOSDT1	IP Cameras PTZ (pan/tilt/zoom) with 12x+optical zoom (multiple)	handheld	on isolator	N	N	N	Y	Y	Power over Ethernet (PoE)	
2	High Resolution X-ray Computed Tomography (HR-XCT)	self-standing	Instument Box Interface (tbc)	N	N	N	Y	Y	230 VAC, 25 A, 50/60 Hz, 1 PHASE, TN-S	
3	Magnetometer Magnetic Susceptometer	tabletop	Instument Box Interface (tbc)	N N	N N	N	Y	?	110V (65mA)	
4	Basic Characterization (n = 2)	tabletop		IN	IN	IN .	1	·	·	
5	Analytical balance (see note) (may need multiple)	handheld	inside isolator	N	N	N	Υ	Υ	110VAC (Low amp)	
6	Multispectral/Hyperspectral Imager [10-20 micron resolution]	handheld	on isolator	N	N	N	Y	Y	110VAC (Low amp)	
MOSDT2	Stereo microscope (see note) [8:1 zoom]; (possible multiple); fully automated Materials reflective micrscope (long-working objectives 1.25X,	handheld handheld	on isolator on isolator	N N	N N	N N	Y	Y	USB 5V (5W) 110VAC	
MOSDT3	5X, 10X, 20X, 50X) BF, DF, P, F; HR camera. (possible multiple) IP Camera PTZ (pan/tilt/zoom) with 12x+ optical zoom (multiple)	handheld	on isolator	N	N	N	Y	Y	Power over Ethernet (PoE)	
	Preliminary Examination (n = 8)									
7.1	Variable Pressure-Field Emission Scanning Electron Microscope with electron and Focused Ion Beam (FiB) columns and multiple detectors	self-standing	Instument Box Interface (tbc)	Y	Y	N/A	N/A	Y	230V, 25A	
8	Deep Ultraviolet Fluorescence	tabletop	inside isolator	Y	N	N	Y	Y	110VAC / 100W	
9	Confocal Raman Spectrometer	self-standing	Instument Box Interface (tbc)	Y	N	N	Y	Y	110 VAC / 150 VA	
10.1	Fourier Transform-Infrared Spectrometer (FTIR)	tabletop	inside isolator/Instument Box Interface (tbc)	Y	Y	N	Y	Y	110VAC (15A)	
11.1	Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	self-standing	Instument Box Interface (tbc)	N	Y	N/A	N/A	Y	240 VAC / 4.6kVA	
12	X-ray Fluorescence	tabletop	inside isolator/Instument Box Interface (tbc)	N	N	N	Y	Y	110VAC / 600VA	
13	Microscopy lab (see note)	tabletop	on isolator	N	Υ	N	Y	Υ	110VAC	
	Headspace Gas analysis									
23.1	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	Tabletop or Stand-alone	Instrument Box Interface (tbc)	N	Y	N/A	N/A		230 V, single phase, 8 A.	45 x 70 x 50 cm (W x D x F
24	Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy)	Stand-alone but it can be quite extensive depending on the scope.	Instrument Box Interface (tbc)	Y	Y	N/A	N/A			
7.2	Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors	self-standing	Instument Box Interface (tbc)	Y	Y	N/A	N/A	Y	230V, 25A	
10.2	Fourier Transform-Infrared Spectrometer (FTIR)	tabletop	inside isolator/Instument Box Interface (tbc)	Y	Y	N	Y	Y	110VAC (15A)	
11.2	Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	self-standing	Instument Box Interface (tbc)	N	Y	N/A	N/A	Y	240 VAC / 4.6kVA	
25	Electron Paramagnetic Resonance (EPR) Spectroscopy –	tabletop	Inside isolator or Instrument Box Interface (tbc) or adjactent room	Y	N	N/A	N/A	N?	standard	397 x 262 x 192 mm
26	Brunauer-Emmett-Teller (BET) surface area analysis	tabletop	Instrument Box Interface (tbc)	N	Y	N/A	N/A			
24b	Optical laser spectrometer (Sample Analysis at Mars (SAM) instrument)	Tabletop	Inside isolator or Instrument Box	Y	Y	N/A	N/A			
L			Interface (tbc)	1		1		1	l	1

	ments and Sample Prep Needs Proposed for the SRF						
						Analysis requirements	
Ref. #	Required Instrument Functionality	Mass (kg)	Specialized Gas	Cooling Needs	Special infrastructure	Analysis under inert gas	Special Lighting
			Requirements		req		Needs
	Pre-Basic Characterization (n = 3)						
1	Stereo microscope (see note) [8:1 zoom], ; (possible multiple)	1.5	None	None	None	Yes, unopened tube	sample needs to be
						.,,.	illuminated
MOSDT1	IP Cameras PTZ (pan/tilt/zoom) with 12x+ optical zoom (multiple)	2.85	None	None	None	Yes, unopened tube	YES
2	High Resolution X-ray Computed Tomography (HR-XCT)	8000	None	YES; chiller	Radiation; electrical;	Yes, unopened tube	None
				.,	chiller	.,,.	
3	Magnetometer	1	None	None	Magnetic sheilding	Yes, unopened tube	None
4	Magnetic Susceptometer	7	None	None	Magnetic sheilding	Yes, unopened tube	None
	Basic Characterization (n = 2)						
5	Analytical balance (see note) (may need multiple)	1	None	None	None	Yes	None
6	Multispectral/Hyperspectral Imager [10-20 micron resolution]	1	None	None	None	Yes	Needs darkness
1	Stereo microscope (see note) [8:1 zoom]; (possible multiple)	1.5	None	None	None	Yes	YES
MOSDT2	; fully automated Materials reflective micrscope (long-working objectives 1.25X,	25??	None None	None None	None None	Yes	YES
WIUSDIZ	5X, 10X, 20X, 50X) BF, DF, P, F; HR camera. (possible multiple)	2311	INOTIE	None	None	162	163
MOSDT3	IP Camera PTZ (pan/tilt/zoom) with 12x+ optical zoom (multiple)	2.85	None	None	None	Yes	YES
IVIUSD13		2.85	ivone	ivone	ivone	Yes	YES
	Preliminary Examination (n = 8)						
7.1	Variable Pressure-Field Emission Scanning Electron Microscope with electron and	350	compressed air and	Maybe dependant	vacuum Pump; low		None
	Focused Ion Beam (FIB) columns and multiple detectors		GN2	on detector	magnetic field; low		
			1		vibration		
			1				
8	Deep Ultraviolet Fluorescence	12	None	None	Class 3B laser		Yes
9	Confocal Raman Spectrometer	95	Maybe	Yes and LN2	Class 3B laser, Liquid		YES
					Nitrogen		
10.1	Fourier Transform-Infrared Spectrometer (FTIR)	150	GN2 purge	LN2 detectors	Liquid Nitrogen		None
	, ,		p8-				
11.1	Micro-X-ray diffractometer with total scattering and pair-distribution function	1150	compressed air and	Cooling Water	Radiation; electrical;		None
	(PDF) analysis capability		GN2	Supply	chiller; gas		
	, , , , , , , , , , , , , , , , , , , ,		0.112	Supply	,		
12	X-ray Fluorescence	132	helium and GN2	None	radiation, gas		None
	Microscopy lab (see note)		None	None	None		VES
13	Microscopy lab (see note)	25??	None	None	None		YES
			None	None	None		YES
13	Headspace Gas analysis	25??		None	None		YES
	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas		None High purity helium (99.999% or	None	None		YES
13	Headspace Gas analysis	25??	High purity helium (99.999% or better).Reference gases	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99,999% or better).Reference gases (CO and H2) with pressure regulators.To use the TC/EA with CO	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To use the TC/EA with CO and H2/reference gas,	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99.999% or better). Reference gases (CO and H2) with pressure regulators. To use the TO/EA with CO and H2reference gas, the laboratory must be	None	None		YES
13	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To use the TO/EA with CO and H2reference gas, the laboratory must be equipped with CO and	None	None		YES
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	25??	High purity helium (99.999% or better). Reference gases (CO and H2) with pressure regulators. To use the TO/EA with CO and H2reference gas, the laboratory must be	None	None		YES
13	Meadspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To use the TO/EA with CO and H2reference gas, the laboratory must be equipped with CO and	None	None		YES
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To use the TO/EA with CO and H2reference gas, the laboratory must be equipped with CO and	None	None		YES
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy)	25??	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators.To use the TO/EA with CO and H2reference gas, the laboratory must be equipped with CO and	None	None		YES
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP	25?? i), 59 kg.	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators. To use the TC/EA with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.				
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	25??	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant	vacuum Pump; low		YES
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP	25?? i), 59 kg.	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators. To use the TC/EA with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.		vacuum Pump; low magnetic field; low		
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	25?? i), 59 kg.	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant	vacuum Pump; low		
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	25?? i), 59 kg.	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant	vacuum Pump; low magnetic field; low		
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	25?? i), 59 kg.	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant	vacuum Pump; low magnetic field; low		
24	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors	25?? i), 59 kg.	High purity helium (99.999% or better). Reference gases (CO and H2) with pressure regulators. To use the TCIE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant on detector	vacuum Pump; low magnetic field; low vibration		None
23.1	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	25?? i), 59 kg.	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant	vacuum Pump; low magnetic field; low		
24	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors	25?? i), 59 kg.	High purity helium (99.999% or better). Reference gases (CO and H2) with pressure regulators. To use the TCIE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors.	Maybe dependant on detector	vacuum Pump; low magnetic field; low vibration		None
23.1 24 7.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR)	25?? i), 59 kg. 350	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulators. To and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge	Maybe dependant on detector	vacuum Pump; low magnetic field; low vibration		None
24	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function	25?? i), 59 kg.	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2delectors. compressed air and GN2 GN2 purge compressed air and	Maybe dependant on detector LN2 detectors Cooling Water	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None
23.1 24 7.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR)	25?? i), 59 kg. 350	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulators. To and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge	Maybe dependant on detector	vacuum Pump; low magnetic field; low vibration		None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulations. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge compressed air and GN2	Maybe dependant on detector LN2 detectors Cooling Water Supply	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
23.1 24 7.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function	25?? i), 59 kg. 350	High purity helium (99.999% or betteri, Reference gases (CO and H2) with pressure regulations. To use the TOE4 with CO and H2reference gas, the laboratory must be equipped with CO and H2delectors. compressed air and GN2 GN2 purge compressed air and	Maybe dependant on detector LN2 detectors Cooling Water Supply None: Can use a	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulations. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge compressed air and GN2	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulations. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge compressed air and GN2	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulations. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge compressed air and GN2	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulations. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. compressed air and GN2 GN2 purge compressed air and GN2	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
13 23.1 24 7.2 10.2 11.2 25	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulators. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. Compressed air and GN2 GN2 purge compressed air and GN2 None	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
24 7.2 10.2	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	25?? i), 59 kg. 350 150	High purity helium (99.999% or better). Reference gases (CO and H2) with pressure regulators. To use the TOLEA with CO and H2/reference gas, the laboratory must be equipped with CO and H2/detectors. Compressed air and GN2 GN2 purge compressed air and GN2 None	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
13 23.1 24 7.2 10.2 11.2 25	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulators. To use the TOE-R4 with CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. Compressed air and GN2 GN2 purge compressed air and GN2 None	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
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13 23.1 24 7.2 10.2 11.2 25	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	25?? i), 59 kg. 350 150	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators. To use the TOZEA with CO and H2/reference gas, the laboratory must be equipped with CO and H2/detectors. GN2 purge Compressed air and GN2 None Uses flowing gas method (N2 and He) to acquire adsorption and	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
13 23.1 24 7.2 10.2 11.2 25	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	25?? i), 59 kg. 350 150	High purity helium (99.999% or better, Reference gases (CO and H2) with pressure regulators. To use the TOZE Awith CO and H2reference gas, the laboratory must be equipped with CO and H2detectors. Compressed air and GN2 GN2 purge compressed air and GN2 None Uses flowing gas method (N2 and He) to	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None
13 23.1 24 7.2 10.2 11.2 25	Headspace Gas analysis High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	25?? i), 59 kg. 350 150	High purity helium (99.999% or better).Reference gases (CO and H2) with pressure regulators. To use the TOZEA with CO and H2/reference gas, the laboratory must be equipped with CO and H2/detectors. GN2 purge Compressed air and GN2 None Uses flowing gas method (N2 and He) to acquire adsorption and	Maybe dependant on detector LN2 detectors Cooling Water Supply None. Can use a temp controller for liquid nitrogen.	vacuum Pump; low magnetic field; low vibration Liquid Nitrogen Radiation; electrical;		None None

mmary of Instru	uments and Sample Prep Needs Proposed for the SRF				
		Sample prep			
Ref. #	Required Instrument Functionality	Detailed Sample Preparation Requirments	Sample Prep in sample prep area (separate) is the sample to be analyzed prepared in a general sample pre area? sample must be prepared following a certain protocol using capabilities and instruments identified in the Sample Prep section, and it doesn't need to be linked to the instrument, but can be transported to the instrument. N: sample preparation must occur in co-location with the targetted analytical instrument. N/A: no sample prep required	Level of pristinity before prep or analysis	Level of pristinity af prep or analysis (Pristine, Psub,Res Terminal
	Pre-Basic Characterization (n = 3)				
1	Stereo microscope (see note) [8:1 zoom], ; (possible multiple)	None	N/A		Pristine
MOSDT1	IP Cameras PTZ (pan/tilt/zoom) with 12x+optical zoom (multiple) High Resolution X-ray Computed Tomography (HR-XCT)	None None	N/A N/A		Pristine
2					Pristine
3	Magnetometer Magnetic Susceptometer	None None	N/A N/A		Pristine
4	Basic Characterization (n = 2)	None	N/A		Pristine
5	Analytical balance (see note) (may need multiple)	None	N/A		Pristine
6	Multispectral/Hyperspectral Imager [10-20 micron resolution]	None	N/A		Pristine
1	Stereo microscope (see note) [8:1 zoom]; (possible multiple)	None	N/A		Pristine
MOSDT2 MOSDT3	; fully automated Materials reflective micrscope (long-working objectives 1.25X, 5X, 10X, 20X, 50X) BF, DF, P, F; HR camera. (possible multiple) IP Camera PTZ (pan/tilt/zoom) with 12x+optical zoom (multiple)	None None	N/A N/A		Pristine Pristine
MOSD13	Preliminary Examination (n = 8)	None	N/A		Pristine
7.1	Variable Pressure-Field Emission Scanning Electron Microscope with electron and Focused Ion Beam (FIB) columns and multiple detectors	None to flat sample for low vacuum mode.	Y		Psub
8	Deep Ultraviolet Fluorescence	None to flat sample	Y		Psub
9	Confocal Raman Spectrometer	None to flat sample	Y		Psub
10.1	Fourier Transform-Infrared Spectrometer (FTIR)	samples are ground with KBr and pressed into pellets, or doubly polished thin section; ATR and DRIFT would reduce sample preparation	Y		Psub
11.1	Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample	Y		Psub
12	X-ray Fluorescence	None to flat sample	Y		Psub
13	Microscopy lab (see note)	None, flat sample, polished mount, or thin section	Y		Psub
	Headspace Gas analysis				
23.1	High Temperature Conversion Elemental Analyzer (TC/FA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	None	N/A		Terminal
24	Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down	None – Samples Placed in combustion tube	N/A		Terminal
	Spectroscopy)				
	Science Investigations & SSAP				
7.2	Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors	Flat sample, polished mount, or thin-section sample on glass slide with conductive coating (e.g. carbon, gold, etc.) for high vacuum mode.	Y		Rest
10.2	Fourier Transform-Infrared Spectrometer (FTIR)	samples are ground with KBr and pressed into pellets, or doubly polished thin section; ATR and DRIFT would reduce sample preparation	Y		Rest
10.2	Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability		Y Y		Rest
	Micro-X-ray diffractometer with total scattering and pair-distribution function	preparation	Y Y Yes	Pristine	
11.2	Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	preparation powders and thin-section	Y Yes	Pristine	Rest

Summary of Instru	ments and Sample Prep Needs Proposed for the SRF			
				Notes
Ref. #	Required Instrument Functionality	Sample Prep under inert gas	Sub Sample mass/volume needed in	
			sample prep	
	Pre-Basic Characterization (n = 3)			
	, , , ,			
1	Stereo microscope (see note) [8:1 zoom], ; (possible multiple)		N/A	
MOSDT1	IP Cameras PTZ (pan/tilt/zoom) with 12x+optical zoom (multiple)		N/A	
2	High Resolution X-ray Computed Tomography (HR-XCT)		None	
	M			
3 4	Magnetometer Magnetic Suscentameter		None	
4	Magnetic Susceptometer Basic Characterization (n = 2)		None	
5	Analytical balance (see note) (may need multiple)		None	
6	Multispectral/Hyperspectral Imager [10-20 micron resolution]		None	
1	Stereo microscope (see note) [8:1 zoom]; (possible multiple)		N/A	
MOSDT2	; fully automated Materials reflective micrscope (long-working objectives 1.25X,		N/A	
	5X, 10X, 20X, 50X) BF, DF, P, F; HR camera. (possible multiple)			
MOSDT3	IP Camera PTZ (pan/tilt/zoom) with 12x+optical zoom (multiple)		N/A	
	Preliminary Examination (n = 8)			
7.1	Variable Pressure-Field Emission Scanning Electron Microscope with electron and	None to flat sample for low vacuum	MAX: 0.5 cm thick sub samples to	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and
	Focused Ion Beam (FIB) columns and multiple detectors	mode.	generate thin sections of 30 microns	Focused Ion Beam capabilitythis is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray
			thick	Spectrometer (EDS). Tait et al., 2021 state the need for capability for both Field Emission- and Variable Pressur
				SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs
				,
8	Deep Ultraviolet Fluorescence		N/A	Ground-truthing SHERLOCK. Separate instrument from confocal Raman required. Likely require optical
ŭ			,	separation like the confocal Raman.
9	Confocal Raman Spectrometer		N/A	Should be placed either in a separate room, or with the ability to separate it from the other
				instruments (by optical curtain, for example)
10.1	Fourier Transform-Infrared Spectrometer (FTIR)		?	
11.1	Micro-X-ray diffractometer with total scattering and pair-distribution function		N/A	
	(PDF) analysis capability			
12	X-ray Fluorescence		N/A	Ground-truthing PIXL
12	x-ray Fluorescence		N/A	Ground-trutning MXL
13	Microscopy lab (see note)		N/A	
	William (Sections)		19/0	
	Headspace Gas analysis			
23.1	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas			to check the functions of different methods (IRMS, EA, TC/EA, Cavity Ring Down, GC-TC) for stable Isotope
	Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)			facility , go to http://www.uwyo.edu/sif/stable-isotopes/terms-and-definitions.html
				The Thermo Scientific TC/EA can be connected to any currentThermo Scientific Isotope Ratio MS equipped for
				continuous flowapplications. If hydrogen isotope ratios are to be analyzed, the IRMSmust be equipped with a
				energy filter to suppress 4He+ions on theDH collector (Thermo Scientific MAT 253, DELTA V Plus, and DELTA VAdvantage IRMS).
				vauvantage mivis).
24	Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down	Yes		Mentioned as cavity ringdown in Time-sensitive report
24	Optical laser spectrometer (e.g., Tunable Laser Spectrometer or Cavity Ring Down Spectroscopy)	Yes		Mentioned as cavity ringdown in Time-sensitive report
24	Spectroscopy)	Yes		Mentioned as cavity ringdown in Time-sensitive report
	Spectroscopy) Science Investigations & SSAP			
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	None to flat sample for low vacuum	MAX: 0.5 cm thick sub samples to	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and
	Spectroscopy) Science Investigations & SSAP		generate thin sections of 30 microns	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al.,
	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	None to flat sample for low vacuum		The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability-this is an important sample prep step for other measurements. Gminke kt al., 2021 report calls for a Variable Pressure Scanning leteron Microscope with Energy Dispersive X-ray
	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	None to flat sample for low vacuum	generate thin sections of 30 microns	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	None to flat sample for low vacuum	generate thin sections of 30 microns	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability-this is an important sample prep step for other measurements. Gminke kt al., 2021 report calls for a Variable Pressure Scanning leteron Microscope with Energy Dispersive X-ray
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors	None to flat sample for low vacuum	generate thin sections of 30 microns	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron	None to flat sample for low vacuum	generate thin sections of 30 microns thick	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR)	None to flat sample for low vacuum	generate thin sections of 30 microns thick	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function	None to flat sample for low vacuum	generate thin sections of 30 microns thick	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR)	None to flat sample for low vacuum	generate thin sections of 30 microns thick	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2 10.2 11.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (F1IR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample for low vacuum	generate thin sections of 30 microns thick 7 N/A	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2 10.2 11.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (F1IR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample for low vacuum	generate thin sections of 30 microns thick 7 N/A	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2 10.2 11.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (F1IR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
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7.2 10.2 11.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (F1IR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2 10.2 11.2 25	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? // N/A Just requiring placing the sample in a tube.	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gimine ket al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray Spectrometer (EDS), Talt et al., 2021 state the need for capability for both Field Emission- and Variable Pressur SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs
7.2 10.2 11.2	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (F1IR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gminek et al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive-X-ray Spectrometre (EDS). Tall et al., 2021 state the need for capability for both field Emission—and Variable Pressure.
7.2 10.2 11.2 25	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a tube.	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gimine ket al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray Spectrometer (EDS), Talt et al., 2021 state the need for capability for both Field Emission- and Variable Pressur SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs
7.2 10.2 11.2 25	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a tube.	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gimine ket al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray Spectrometer (EDS), Talt et al., 2021 state the need for capability for both Field Emission- and Variable Pressur SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs
7.2 10.2 11.2 25	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy — Brunauer-Emmett-Teller (BET) surface area analysis	None to flat sample for low vacuum mode.	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a tube.	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FiB, and EBSD, and Focused on Beam capability—this is an important sample preps step for other measurements. Gimine ket al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray Spectrometer (EQS). Tart et al., 2021 state the need for capability for both Field Emission- and Variable Pressur SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs.
7.2 10.2 11.2 25	Spectroscopy) Science Investigations & SSAP Variable Pressure-Field Emission Scanning Electron Microscope with electron columns and multiple detectors Fourier Transform-Infrared Spectrometer (FTIR) Micro-X-ray diffractometer with total scattering and pair-distribution function (PDF) analysis capability Electron Paramagnetic Resonance (EPR) Spectroscopy—	None to flat sample for low vacuum	generate thin sections of 30 microns thick ? N/A Just requiring placing the sample in a tube.	The SEM will need to have ports for additional detectors, possibly including CL, EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important sample prep step for other measurements. Gimine ket al., 2021 report calls for a Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray Spectrometer (EDS), Talt et al., 2021 state the need for capability for both Field Emission- and Variable Pressur SEM, that could potentially be combined in one instrument but also state the benefits of having 2 SEMs

Summary of Instru	ments and Sample Prep Needs Proposed for the SRF							
						ired for		
Ref. #	Required Instrument Functionality	Reference instrument	Function	Curation	Sample Safety	Time-Sensitive	Sterilization-	Significant Instrument Comments
					Assessment	Science	Sensitive	
							Science	
23.2	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	Thermo Scientific TC/EA (which interfaces with any	characterizes mineral-bound volatile concentrations, speciation, and			х	х	
23.2	Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	continuous flow IRMS. GC-IRMS: 613C Analysis of PAHs	isotopic compositions (i.e., H2O, SO2, CO2, etc.) Uses combustion and			^	^	MOSDT is keeping #23 as separate from #24b (SAM) under the assumption that it can
15	Ultra-High Performance Liquid Chromatography Liquid Chromatography (UHPLC		Characterize macromolecular material of potential biological origin and		х	х	X	
	MS/MS) with tandem Mass Spectrometry		detect organic molecular biosignatures of extant and past/extinct life					
16	Capillary Electrophoresis–Mass Spectrometry (CE-MS)	7100 CE with 6550 QTOF	Equipment capable of carrying out extraction and sequencing of DNA		x	x	х	
17	DNA Sequencer and associated '-omics' equipment (see note)	Oxford Nanopore, MinION Mk1C	Equipment capable of carrying out extraction and sequencing of DNA		х	х	Х	
18	Real-time PCR machine, i.e. a thermal cycler with fluorescence reading capability							
19	Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) or Photon Transfer	https://www.srainstruments.com/p/sift-ms/	real-time quantification of several trace gases (e.g. VOCs) simultaneously					
	Reaction-Mass Spectrometry (PTR-MS)	https://www.ionicon.com/series/details/ptr-ms-	in air and breath. PTR-MS is real-time monitoring of volatile organic					
20	Electrospray ionization (ESI)-Mass Spectrometry AND/OR MALDI-ESI-MS		structural study or quantitative measurement of metabolites in a		X	X	X	#20 and #21 are kept as separate instruments, as described in Time-Sensitive report.
21	Matrix-assisted laser desorption/ionization time of flight (MALDI-TOF-MS)	Shimadzu MALDI-8020	Detection of extant indigenous life or contaminant life in Martian		х	х	x	Optimize and devlop protocole outside of containment on analogue and replica
			samples					instrument. If sample preparation is effectively sterilizing the sample, we strongly
14	Gas Chromatography (GC) Isotope Ratio Mass Spectrometer with quadrople mass spec and higher temperature conversion elemental analyzer (TC/EA) (see note)	Thermofisher GC-IRMS instrument; TRACE 1310 GC, a GC Isolink preparation device, a CONFLO IV ref. interface	Characterize macromolecular material of potential biological origin and detect organic molecular biosignatures of extant and past/extinct life		x	x	x	
22	Epifluorescence Microscope	isolitik preparation device, a convictorivier. Interface	detect organic morecular brossgracures or extant and pass/extinct me					
27	Ion chromatograph	[Dionex ICS-6000 Standard Bore and Microbore HPIC	measure concentration of inorganic anions and organic acids in aqueous			х		
28	Inductively coupled plasma - optical emission spectrometry (ICP-OES)	[Perkin Elmer AVIO 550 Max with cyclonic/concentric	used to measure concentrations of inorganic cations in aqueous solutions			х		
	Later Science Instruments	com ale introduction	as in whale seek diseate					
MOSDT4	Electron Probe Microanalysis (EPMA)							
MOSDT5	a.k.a. Electron Microprobe	1			1			These instruments were not researched in depth as they are outside of the scope of MOSDT.
MOSDT5 MOSDT6	High-Resolution Transmission Electron Microscopy (TEM) (TEM-SAED-EDX) Nano-SIMS						Х	They are of significant size, and a specific area under containment can be sized and costed
MOSDT7	Mössbauer Spectroscopy							without more input from MOSDT.
MOSDT8	Added microbiological capabilities		In case of discovery of extant life					
	Sample Preparation		All instruments below are need for preparation of martian samples					Sample Preparation capabilities described in this section are the equipment needed to
								process and prepare subsets of samples to make them analyzable by the analytical
								instruments identified by MSPG2. The sample prep capabilities and instruments have been either recommended by MSPG2, or have been added when needed by MOSDT. The sample
								prep capabilities listed here can be used without being co-located with the instrument
								they are targetting. When a specific sample prep needs to be co-located with an instrument
								(add example here), it has been identified and described with said instrument.
29	Sterilization equipment for samples (see note)		Sterilization equipment for martian samples exclusively. Sterilization equipment for other material (waste, tools, etc) are treated separately.	х	х	х	x	
29.1	Heat chambers (1)		equipment for other material (waste, tools, etc) are treated separately.					We recommend to have one heat chamber. Adding extra heat chambers for redundancy
25.2	ricac chambers (2)							and timing would not change significantly the size of the rest of the SRF, but could be
								considered as an add-on. We recommend that all gases produced during sterilization
								should be captured and analyzed, or directly analysed by #23.1. A trade-off could be using #23.1 TC/EA chamber for heating steps and sterilization.
29.2	Radiation chamber (1)							Due to the size and cost of a shielded 60Co source, we recommend to have one source,
29.2	Radiation Chamber (1)							with possibly separate chambers irradiated by the same source. Adding extra sources for
								redundancy and timing would not change significantly the size of the rest of the SRF, but
								could be considered as an add-on. We recommend that all gases produced during
								sterilization should be captured and analyzed, or directly analysed by #23.1.
30	Rock sample prep capabilities (see note)			х	х	х	x	Use of a sonic bath between different steps of the sample prep is highly recommended in order to eliminate any material that can be stuck inside cracks or pores. This will lower the
								risk of contaminations from abraded material and especially from polishing pastes/fluids
								with diamonds/Al2O3 of different grain sizes (e.g. going from 6 to 3 and 1 µm).
30.SP1	Rock Sample Prep Space #1: cutting	Lance to the second sec						The ultramicrotome eeds to be kept separately from wire saw. MOSDT recommends a
30.SP1.1	Ultramicrotome	LEICA UC7 ultramicrotome or its upgraded version ARTOS 3D, (MOSDT Addition) with cryo capabilities						The ultramicrotome eeds to be kept separately from wire saw. MOSDT recommends a model slightly different to MSPG2 recommendation.
30.SP1.2	Dry Wire Saw	Wells 3500P wire saw: "Premium model" more			1		 	
55.57 1.2	S. y wife saw	adapted to MSRF operations						
7.3	FIB-SEM							
30.SP2	Rock Sample Prep Space #2 Embedding and Mounting							
30.SP2.1	Encapsulating and epoxy embedding							For best results with epoxy embedding would better to use a "pressure pot" rather than a
								"vacuum chamber" as there would be less bubbles forming during the process. The question is would it be possible to use a pressure pot within as isolator? This step can be
								moved across the preparation process as encapsulation can also happen at the beginning of
1								the entire process if the material is poorly consolidated.
30.SP.2.2	Thin Section Mounting							Recommendations on mounting resin for future work: high-purity and low-outgassing
								product
1								
30.SP3	Rock Sample Prep Space #3 Sample grinding and polishing							
30.SP3.1	Thin Section System (incl. vacuum pump)		For preparation of thin sections. Off cutting of excess material and					Finishing with lapping (see 30.SP3.2) is suggested.
		1	grinding to a thickness close to 30 μm.					
30.SP3.2	Grinding/lapping Samples:	Struers LaboSystem LaboPol-20 (smallest) with	polish samples					Use of a sonic bath between different steps of the sample prep is highly recommended in
		Laboforce 50 (to hold samples) . TegraPol (can be operated remotely when in isolator)						order to eliminate any material that can be stuck inside cracks or pores. This will allow lower the chance of contaminations from abraded material and especially from lapping
1		operated remotely when in isolator)						with fixed abrasive papers of different grit size.
30.SP3.3	Polishing Samples:	Struers LaboSystem LaboPol-20 (smallest) with	polish samples		1	1		Use of a sonic bath between different steps of the sample prep is highly recommended in
30.373.3	ronaning annipies.	Laboforce 50 (to hold samples) . TegraPol (can be	I was a second and					order to eliminate any material that can be stuck inside cracks or pores. This will allow
		operated remotely when in isolator)						lower the chance of contaminations from abraded material and especially from polishing
1								pastes/fluids with diamonds/Al2O3 of different grain sizes (e.g. going from 6 to 3 and 1
30.SP4	Rock Sample Prep Space #4: Sputtering							

Summary of instr	uments and Sample Prep Needs Proposed for the SRF	Quick glance						Engineering De	rtails	
Ref. #	Required Instrument Functionality	Size (handheld OR tabletop OR self-standing)	Is it possible to interface with	Org. cont.	Sample	Isolator Manual	Isolator Robotics/	Vibration	Power Requirements (V/A)	Size
		-	isolator/DWI?	sensitive (Y/N)	Preparation	Manipulation via gloves	RMS handling (Y/N)	Sensitive (Y/N)	
					(Y/N)	(Y/N)				
23.2	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	Tabletop or Stand-alone	Instrument Box Interface (tbc)	N	Y	N/A	N/A		230 V, single phase, 8 A.	45 x 70 x 50 cm (W x D x I
15	Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note) Ultra-High Performance Liquid Chromatography Liquid Chromatography (UHPLC-	self-standing	Instument Box Interface (tbc)	v	Y	N/A	N/A		UHPLC-FD: five 120V	UHPLC-FD: (L x W x H) =
15	MS/MS) with tandem Mass Spectrometry	sen-standing	installient Box interface (toc)	,	'	N/A	N/A			75 cm x 54 cm x 62 cm,
16	Capillary Electrophoresis-Mass Spectrometry (CE-MS)	tabletop	inside isolator/Instument Box			N/A	N/A		outlets , OTHER WIS. ONE	38 kg. W 35 cm, H 61 cm,
17	DNA Sequencer and associated '-omics' equipment (see note)	handheld	inside isolator/Instument Box	Y	Y	N/A	N/A			11 kg; W 37 cm, H 22 cm,
						N/A	14/15			11 kg, w 37 cm, 11 22 cm,
18	Real-time PCR machine, i.e. a thermal cycler with fluorescence reading capability	tabletop	inside isolator/Instument Box							
19	Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) or Photon Transfer Reaction-Mass Spectrometry (PTR-MS)	self-standing	Instument Box Interface (tbc)							
20 21	Electrospray ionization (ESI)-Mass Spectrometry AND/OR MALDI-ESI-MS Matrix-assisted laser desorption/ionization time of flight (MALDI-TOF-MS)	Tabletop or integrated into MALDI stand alone.	inside isolator or Instrument Box Instrument Box Interface (tbc)	Y	Y	N/A N/A	N/A N/A			9.7 x 28.0 x 42.2" Weight:
21	Macrix-assisted laser description/formzation time of might (MALDI-TOF-MS)	Stario arone.	instrument Box interrace (tbc)	Y	Y	N/A	N/A			75 kg / 165.4 lb net
14	Gas Chromatography (GC) Isotope Ratio Mass Spectrometer with quadrople mass	tabletop or self-supported (depending on configuration)	Instrument Box Interface (tbc)	v	v	N/A	N/A	None	230V Power Supply	GC-QMS: (H x W x D) = 44
	spec and higher temperature conversion elemental analyzer (TC/EA) (see note) []	tabletop of self-supported (depending on configuration)	motivation box interface (toe)	· ·		1477	.,,,	Hone	(Electronics boards - 55 nd	cm x 94 cm x 68 cm, 100
22	Epifluorescence Microscope	Tabletop	on isolator or inside isolator							
27	Ion chromatograph	tabletop	Instrument Box Interface (tbc)	Y	Υ	N/A	N/A		1	(41Wx23Dx56H cm chart)
28	Inductively coupled plasma - optical emission spectrometry (ICP-OES)	tabletop	Instrument Box Interface (tbc)	N	Y	N/A	N/A		2800w; 2000w chiller;	76Wx84Dx87H cm
	Later Science Instruments								1000	
MOSDT4	Electron Probe Microanalysis (EPMA)	large stand alone	NC							
MOSDT5	a.k.a. Electron Microprobe High-Resolution Transmission Electron Microscopy (TEM) (TEM-SAED-EDX)	large stand alone	NC	+	1	1			+	
MOSDT6	Nano-SIMS	large stand alone	NC NC							
MOSDT7	Mössbauer Spectroscopy	handheld or small tabletop	NC (on isolator)							
MOSDT8	Added microbiological capabilities	·								
	Sample Preparation									
29	Sterilization equipment for samples (see note)			Y	Y					
29.1	Heat chambers (1)	standalone	NC							
29.1	near chambers (1)	standaione	NC							
29.2	Radiation chamber (1)	standalone	NC							
30	Rock sample prep capabilities (see note)			Y	Y			Y		
30.SP1	Rock Sample Prep Space #1: cutting									
30.SP1.1	Ultramicrotome	tabletop	in isolator		Y	Y	Y?	Y, equiped	100-240 V	
								with interna	I	
30.SP1.2	Dry Wire Saw	tabletop	in isolator							W x L x H: 410 mm x 345
	gr			1		1			1	mm x 460 mm,
7.3 30.SP2	FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting									
30.SP2.1	Encapsulating and epoxy embedding									
2001212	and chord chief									
30.SP.2.2	Thin Section Mounting				-		 			
50.SP.Z.Z	Thin Section Mounting									
30.SP3	Rock Sample Prep Space #3 Sample grinding and polishing									
30.SP3.1	Thin Section System (incl. vacuum pump)	tabletop	in isolator							
30.SP3.2	Grinding/lapping Samples:	In isolator (BUTmay be quite messy)		+	1	1			+	40 x 67 x 22 (58
30.373.2	Grinding/idpping Samples.	in isolator (DOTllay be quite lifessy)								Laboforce)
										222707007
30.SP3.3	Polishing Samples:	In isolator (BUTmay be quite messy)								40 x 67 x 22 (58
										Laboforce)
30.SP4	Rock Sample Prep Space #4: Sputtering									

	ments and Sample Prep Needs Proposed for the SRF						
		*****	5	T 6	Terrority 6	Analysis requirements	
Ref. #	Required Instrument Functionality	Mass (kg)	Specialized Gas	Cooling Needs	Special infrastructure	Analysis under inert gas	Special Lighting
			Requirements		req		Needs
23.2	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas	l), 59 kg.	High purity helium				
	Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	-,, 9-	High purity helium (99.999% or				
15	Ultra-High Performance Liquid Chromatography Liquid Chromatography (UHPLC-		ultrahigh purity				None
	MS/MS) with tandem Mass Spectrometry		compressed N2, mass				
16	Capillary Electrophoresis-Mass Spectrometry (CE-MS)						
17	DNA Sequencer and associated '-omics' equipment (see note)	11kg (depends on which	None	None	None		None
18	Real-time PCR machine, i.e. a thermal cycler with fluorescence reading capability						
19	Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) or Photon Transfer						
19	Reaction-Mass Spectrometry (PTR-MS)						
20	Electrospray ionization (ESI)-Mass Spectrometry AND/OR MALDI-ESI-MS						
21	Matrix-assisted laser desorption/ionization time of flight (MALDI-TOF-MS)		None	None	None		None
14	Gas Chromatography (GC) Isotope Ratio Mass Spectrometer with quadrople mass	See column O	High purity He, O2,	liquid N2 tank for			None
	spec and higher temperature conversion elemental analyzer (TC/EA) (see note) []		CO2, N2 (specifics in	oven cooling			
22	Epifluorescence Microscope	(20.4)			detected to		
27	Ion chromatograph	(20.4kg per slide) ~			deionized water		none
28	Inductively coupled plasma - optical emission spectrometry (ICP-OES)	163kg; 81kg chiller; 80kg	Argon, 80-120 psig 1-	Chiller needed	vent with damper to		none
	Later Science Instruments	"	20. ()		romana aa mhustian		
MOSDT4	Electron Probe Microanalysis (EPMA)						
	a.k.a. Electron Microprobe						
MOSDT5	High-Resolution Transmission Electron Microscopy (TEM) (TEM-SAED-EDX)						
MOSDT6	Nano-SIMS						
MOSDT7	Mössbauer Spectroscopy						
MOSDT8	Added microbiological capabilities						
	Sample Preparation						
29	Sterilization equipment for samples (see note)						
25	Stermation equipment for samples (see note)						
29.1	Heat chambers (1)						
29.2	Radiation chamber (1)						
30	Rock sample prep capabilities (see note)						
30	Rock sample prep capabilities (see note)						
30	Rock sample prep capabilities (see note)						
30	Rock sample prep capabilities (see note)						
30.SP1	Rock Sample Prep Space #1: cutting					v	
						У	
30.SP1 30.SP1.1	Rock Sample Prep Space #1: cutting Ultramicrotome	13.8 kg				у	
30.SP1	Rock-Sample Prep Space #1: cutting	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw	13.8 kg				y	
30.SP1 30.SP1.1 30.SP1.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM	13.8 kg				у	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting	13.8 kg				у	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding	13.8 kg				У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding	13.8 kg				Y	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting	13.8 kg				Y	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing	13.8 kg				У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting	13.8 kg				У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (Incl. vacuum pump)					У	
30.SP1 30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing	22kg (36, 5 kg			interface with water,	Y	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (Incl. vacuum pump)				interface with water ,	У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (Incl. vacuum pump)	22kg (36, 5 kg				y	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2.2 30.5P2.1 30.5P2.1 30.5P2.1 30.5P3.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:	22kg (36, 5 kg laboforce)			"air" supply.	У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2 30.5P2.1 30.5P2.1	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (Incl. vacuum pump)	22kg (36, 5 kg laboforce) 22kg (36, 5 kg			"air" supply. Interface with water ,	У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2.2 30.5P2.1 30.5P2.1 30.5P2.1 30.5P3.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:	22kg (36, 5 kg laboforce)			"air" supply.	У	
30.5P1 30.5P1.1 30.5P1.2 7.3 30.5P2.2 30.5P2.1 30.5P2.1 30.5P2.1 30.5P3.2	Rock Sample Prep Space #1: cutting Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:	22kg (36, 5 kg laboforce) 22kg (36, 5 kg			"air" supply. Interface with water ,	У	

Ref. #	Required Instrument Functionality	Sample prep Detailed Sample Preparation Requirments	Sample Prep in sample prep area (separate): is the sample to be	Level of pristinity before prep or	Level of pristinity af
			analyzed prepared in a general sample pre a rea? Y: sample must be prepared following a certain protocol using capabilities and isntruments identified in the Sample Prep section, and it doesn't need to be linked to the instrument, but can be trasnported to the instrument.	analysis	prep or analysis (Pristine, Psub,Re Terminal
			N: sample preparation must occur in co-location with the targetted analytical instrument N/A: no sample prep required		
23.2	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)	Destructive sample preparation: Pyrolysis of solid (powders) and liquid samples to characterize volatiles hosted in mineral phases. Getting a representative sample of larger samples usually requires grinding and homogenizing. Soils should be ground	Y		Terminal
15	Ultra-High Performance Liquid Chromatography Liquid Chromatography (UHPLC-MS/MS) with tandem Mass Spectrometry	Unprepared samples or Powders and Solvents (in same instrument, with different input) (acid-hydrolyzed to inactivate any biopolymers for analysis of free amino acid molecules)	Y		Terminal
16	Capillary Electrophoresis-Mass Spectrometry (CE-MS)				Terminal
17	DNA Sequencer and associated '-omics' equipment (see note)	Outlier Dt. 18 Ct. atta7FDTA 7U2O and C OC a Trickers in 200 mil distilled water Add CO mil 10% Twees 70 calcular and F0 mil 10% Tribes V	Y		Terminal
18 19	Real-time PCR machine, i.e. a thermal cycler with fluorescence reading capability Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) or Photon Transfer Reaction-Mass Spectrometry (PTR-MS)		Y		Terminal Terminal
20	Electrospray ionization (ESI)-Mass Spectrometry AND/OR MALDI-ESI-MS	Acetonitrile-methanol-water (1:1:1) with 0.1% formic acid and 0.01 M 18-crown-6. Multistep sample preparation, very sensitive			Terminal
21	Matrix-assisted laser desorption/ionization time of flight (MALDI-TOF-MS)	Acetonitrile-methanol-water (1:1:1) with 0.1% formic acid and 0.01 M 18-crown-6. Multistep sample preparation, very sensitive to contamination (interferes with crystallization and ionization), need pure water, inert gas to dry plates. Choice of matrices and			Terminal
14	Gas Chromatography (GC) Isotope Ratio Mass Spectrometer with quadrople mass spec and higher temperature conversion elemental analyzer (TC/EA) (see note) []	Powders and Solvents [acid-hydrolyzed to inactivate any biopolymers for analysis of free amino acid molecules]			Terminal
22 27	Epifluorescence Microscope Ion chromatograph	Sample type – aqueous solutions	Yes		Terminal
28	Inductively coupled plasma - optical emission spectrometry (ICP-OES)	aqueous solutions or in whole rock digests (acid digestion or fusion). Acid digestion: dissolution of a sample in a hot acid, or a	Yes		Terminal
20		squeezes sometens or in minor rock digests facile digestion of rusion). Acid digestion, dissolution of a sample in a not acid, or a	1 feet		i Ci i i i i i i i i i i i i i i i i i
MOSDT4	Later Science Instruments Electron Probe Microanalysis (EPMA)				
WO3D14	a.k.a. Electron Microprobe				
MOSDT5	High-Resolution Transmission Electron Microscopy (TEM) (TEM-SAED-EDX)				1
MOSDT6	Nano-SIMS				1
MOSDT7 MOSDT8	Mössbauer Spectroscopy Added microbiological capabilities	special radiation shielding accomodation for glove box might be needed			
29	Sterilization equipment for samples (see note)				
29.1	Heat chambers (1)				n/a
29.2	Radiation chamber (1)				n/a
30	Rock sample prep capabilities (see note)				
	Rock Sample Prep Space #1: cutting				
30.SP1 30.SP1.1	NOCK Sample Prep Space #1: Cutting Ultramicrotome	If sample is not hard enough, need embedding in epoxy			Rest
30.SP1.2	Dry Wire Saw				Psub
7.3	FIB-SEM				Rest
30.SP2 30.SP2.1	Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding				Rest
30.SP.2.2	Thin Section Mounting				Rest
30.SP3	Rock Sample Prep Space #3 Sample grinding and polishing				
30.SP3.1	Thin Section System (incl. vacuum pump)				Rest
30.SP3.2	Grinding/lapping Samples:	Need Water, or liquid on lapping paper. Despite the antisplash system, it could be quite a dirty operation.			Rest
30.SP3.3	Polishing Samples:	Need Water, or liquid on polishing plates. Despite the antisplash system, it could be quite a dirty operation.			Rest

ummary of Instrur	ments and Sample Prep Needs Proposed for the SRF			
				Notes
Ref. #	Required Instrument Functionality	Sample Prep under inert gas	Sub Sample mass/volume needed in	
			sample prep	
23.2	High Temperature Conversion Elemental Analyzer (TC/EA) with Gas		To measure the isotopic ratio of water	must be kept in containment for time-sensitive measurement of non-igneous rocks
	Chromatograph Isotope Ratio Mass Spectrometer (IRMS) (see note)		samples 0.5-1 µl of liquid is needed. For	
15	Ultra-High Performance Liquid Chromatography Liquid Chromatography (UHPLC-MS/MS) with tandem Mass Spectrometry	Powders can be measured in DWI to preserve pristinity. Should not be an	https://www.nature.com/articles/srep06	As a note, ultrahigh-performance liquid chromatography tandem mass spectrometry with electrospray ionization (UHPLC-ESI-MS/MS) is available. https://pubs.acs.org/doi/10.1021/acs.analchem.8b05884
16	Capillary Electrophoresis–Mass Spectrometry (CE-MS)	Should not be an issue, but additional		TOTALION CHPEC-EST-WIS/WIS/IS UVUNUUTE. HELPS://pubs.ucs.org/uoi/10.1021/ucs.unutchem.8003884
		and at the control		
17	DNA Sequencer and associated '-omics' equipment (see note)	Should not be an issue, but additional		small footprint
18	Real-time PCR machine, i.e. a thermal cycler with fluorescence reading capability	Should not be an issue, but additional		
19	Selected Ion Flow Tube Mass Spectrometry (SIFT-MS) or Photon Transfer	No sample preparation: The gaseous sam	ple is directly analyzed	BENEFITS OF SIFT-MS INCLUDE: Instantaneous, quantitative analysis of air and headspace with very high
	Reaction-Mass Spectrometry (PTR-MS)			sensitivity and selectivity. Simultaneous analysis of chemically diverse VOCs (e.g. aldehydes, amines and
20	Electrospray ionization (ESI)-Mass Spectrometry AND/OR MALDI-ESI-MS			The ESI-MS can be stand alone or integrated into a MALDI (MALDI-ESI-MS). However, I am not sure if a MALDI-
21	Matrix-assisted laser desorption/ionization time of flight (MALDI-TOF-MS)			Sample prep requires complex sample loading onto micro-chip. Accurate and precise micorpipetting.
				If in high containment, may require specialized robotics, or micro manipulation tools MALDI MS: Are
14	Gas Chromatography (GC) Isotope Ratio Mass Spectrometer with quadrople mass	Powders can be measured in DWI to		
	spec and higher temperature conversion elemental analyzer (TC/EA) (see note) []	preserve pristinity. Should not be an		
22	Epifluorescence Microscope			
27	Ion chromatograph			
28	Inductively coupled plasma - optical emission spectrometry (ICP-OES)			
	Later Science Instruments			
MOSDT4	Electron Probe Microanalysis (EPMA)	-		
MOSDT5	a.k.a. Electron Microprobe High-Resolution Transmission Electron Microscopy (TEM) (TEM-SAED-EDX)			
MOSD15 MOSDT6	Nano-SIMS			
MOSDT7	Mössbauer Spectroscopy			
MOSDT8	Added microbiological capabilities			
	Sample Preparation			
29	Sterilization equipment for samples (see note)			
2	(
29.1	Heat chambers (1)			Necessity for reduncancy should be considered later
29.2	Radiation chamber (1)			Necessity for reduncancy should be considered later
23.2	nation chamber (1)			recessive for reducine y should be considered rate.
30	Rock sample prep capabilities (see note)			
20.501	Bock Sample Pren Space #1: rutting			
30.SP1 30.SP1.1	Rock Sample Prep Space #1: cutting Ultramicrotome			Equiped with FC7 croo flow chamber (low temp GN2) and CRION (for electrostatic discharge and
				Equiped with FC7 cryo flow chamber (low temp GN2) and CRION (for electrostatic discharge and charge mode)
				charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional
30.SP1.1	Ultramicrotome			charge mode)
30.SP1.1	Ultramicrotome Dry Wire Saw FiB-SEM			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional
30.SP1.1 30.SP1.2 7.3 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is
30.SP1.1 30.SP1.2 7.3	Ultramicrotome Dry Wire Saw FiB-SEM			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a construction of the cutting point is significantly improved because the sample is a property of the sample is a construction of the sample is a const
30.SP1.1 30.SP1.2 7.3 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is 1) Encapsulation/embedding system: https://globalsource.ro/en/sample- preparation/Metallography/accessories-for-mounting-resins/Technomat%20-Pressure-Pot 2) For
30.SP1.1 30.SP1.2 7.3 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a construction of the cutting point is significantly improved because the sample is a property of the sample is a construction of the sample is a const
30.SP1.1 30.SP1.2 7.3 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is 1) Encapsulation/embedding system: https://globalsource.ro/en/sample- preparation/Metallography/accessories-for-mounting-resins/Technomat%20-Pressure-Pot 2) For
30.SP1.1 30.SP1.2 7.3 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a property of the samp
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a proposed to the sample in the sample is a proposed because the sample in the
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample is a preparation of the sample is a prepara
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1 30.SP2.1	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a proposed to the sample in the sample is a proposed because the sample in the
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2 30.SP2.1	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a series of the series of t
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1 30.SP2.1	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/metallographylacessories-for-mounting-resins/Technomat%20-Pressure-Pot 2) For consolidation of loose highly porous rock there is the need for consolidation before mounting as thin section. For mounting rock samples on glass slide: need of mounting fixture for creation of a zero-bonding layer of res and dimination of eventual trapped bubbles (e.g. https://www.kemet-international.com/sg/products/metallography/geofix-mounting-fixture-), mounting resin and eventually UV light for resing curring. Automated thin section machine (need link to the model suggested by Mike), need of a vacuum pump. If
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2 30.SP2.1 30.SP2.2	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump)			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample of the sampl
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1 30.SP2.1	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/metallographylacessories-for-mounting-resin/Technomat%20-Pressure-Pot 2) For consolidation of loose highly porous rock there is the need for consolidation before mounting as thin section. For mounting rock samples on glass slide: need of mounting facture for creation of a zero-bonding layer of res and dimination of eventual trapped bubbles (e.g. https://www.kemet-international.com/sg/products/metallography/geofix-mounting-fixture-), mounting resin and eventually Utight for resing curring. Automated thin section machine (need link to the model suggested by Mike), need of a vacuum pump. If
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2 30.SP2.1 30.SP2.2	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump)			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample of the sampl
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1 30.SP2.2 30.SP2.1	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump)			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample of the sampl
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2 30.SP2.1 30.SP2.1 30.SP3.2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample in the sample is a preparation/method of the sample is a preparation/method of the sample is a preparation/method of the sample
30.5P1.1 30.5P1.2 7.3 30.5P2 30.5P2.1 30.5P2.2 30.5P3.30.5P3.30.5P3.1	Ultramicrotome Dry Wire Saw FiB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump)			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample in the sample is a preparation/method of the sample is a preparation/method of the sample is a preparation/method of the sample
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2 30.SP2.1 30.SP2.1 30.SP3.2	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample in the sample is a preparation/method of the sample is a preparation/method of the sample is a preparation/method of the sample
30.SP1.1 30.SP1.2 7.3 30.SP2 30.SP2.1 30.SP2.1 30.SP2.1 30.SP3.1	Ultramicrotome Dry Wire Saw FIB-SEM Rock Sample Prep Space #2 Embedding and Mounting Encapsulating and epoxy embedding Thin Section Mounting Rock Sample Prep Space #3 Sample grinding and polishing Thin Section System (incl. vacuum pump) Grinding/lapping Samples:			charge mode) The WELL 3500 "Premium" wire saw is identical to the 3500 "Base" saw, but accepts a series of additional accessories. Thanks to these, visualisation of the cutting point is significantly improved because the sample is a preparation/method of the sample in the sample is a preparation/method of the sample is a preparation/method of the sample is a preparation/method of the sample

Summary of Instrum	ments and Sample Bron Needs Bronosad for the SBE							
Summary of instrur	ments and Sample Prep Needs Proposed for the SRF				Reau	ired for		
Ref. #	Required Instrument Functionality	Reference instrument	Function	Curation	Sample Safety	Time-Sensitive	Sterilization-	Significant Instrument Comments
					Assessment	Science	Sensitive	
							Science	
30.SP4	CDI Madula Souttor Costor with nurs 0450 CD Turks Dury	https://www.guggimtock/-4504	Thin film applications Super fine carbon coating for higher quality	Х		X	U	
30.5P4	SPI Module Sputter Coater with pump or Q150 GB Turbo-Pumped Sputter Coater / Carbon Coater for Glove Box	https://www.quorumtech.com/q150t-plus- turbomolecular-pumped-coater-duplicate-1/	imaging using carbon rods and carbon cord	х		×	х	
31	Basic wet chemistry sample prep capabilities (see note)	parties parties adplicate 1/	Extraction and dissolution of samples for geochemistry analytical needs.		X	X	x	Need UPW
31	, and a second decided		This does not include microbiolgoical capabilities (see #32). Depending		^	^	^	
			on the elements to be analyzed, and on the type of contamination ot					
***	Vester		avoid, there might be a need to have several labs					
31.1 31.2	Vortex Sonicator			1				
31.3	Samples digestion with hot acid							
32	Microbiological laboratory capabilities (see note)		Biological sample prep and manipulation/storage of samples		Х	х	х	
22.1	heated and cooled incubators							
32.1 32.2	heated and cooled incubators freezers (-20, -80C)			1				
32.3	refrigerator							
32.4	analytical balance							
33 MOSDT9	Gas extraction and handling capabilities (see note) Vacuum chamber with T control for BET analyses sample prep			Х		х	х	
ANCILLARY LABORATORIES	Instrumentation to monitor cleanrooms and isolators		Monitoring the health of the cleanrooms and isolators					MOSDT is providing this list as a placeholder for standard real-time monitoring of
IN HIGH-CONTAINMENT			0					cleanrooms and isolators. The capabilities should be planned and integrated when feasible
								into the infrastructure itself.
CR1	Cleanroom Air Particle Counters							
CR2 CR3	Cleanroom Differential Pressure (Room-to-Room) Cleanroom Oxygen Monitors			1				
CR4	Cleanroom Radiation Monitors							
CR5	Cleanroom CO2 Monitors							
CR6	Cleanroom Temp. and RH%							
CR7 CR8	Isolator Air Particle Counters Isolator Differential Pressure							
CR9	Isolator O2 & H2O Monitors in ppm or ppt			1				
CR10	Isolator Temp. and RH%							
ANCILLARY LABORATORIES	Instrumentation to monitor organic, inorganic, biological, and particulates		Perform regular (daily) monitoring assessment of contamination within					MOSDT recommends the following list for monitoring of spaces under BSL4 equivalent
IN HIGH-CONTAINMENT	contamination in cleanrooms and isolators		the laboratory/clean rooms.					level in contact with the Martian samples. Witness plates, swabs and any other contamination monitoring plates should be measured under biocontainment, as any step
								of sterilization will not keep the CCK samples pristine
CCK1	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other							
	Contamination							
CCK2	FEG-SEM/EDX for Micro Particulate Identification (JEOL 7600)+C94:C111							
CCK3	XPS for Gross Surface/Thin-films/Oxidation (Thermo K-alpha) LA-HR-ICP-MS for Gross Surface Inorganics (Agilent)			1				
CCK4	VPD-HR-ICP-MS for Molecular Airborne Inorganics (Agrient)			1				
CCK6	TD-GC-MS with GL Sciences SWA-256 wafer analyzer for Molecular Airborne			1				
	Organics/Outgassing							
CCK7 CCK8	DART-qTOF-MS for Gross Surface Organics (JEOL) LC-MS for Amino Acids			1			-	
CCK8	AFM (Atomic Force Microcopy) for Surface Roughness/Thin-Films/Cleaning			1			-	
	Changes							
CCK10	IC (Anions and Cations)							
CCK11	Particle Deposition Monitor (PDM)	https://particle-deposition.com/products/	To monitor heavy sedimented particles in clean room					
				1				
				1				
CCK12	Optical Particle Counter (OPC)		Standard for monitoring the airborne particle concentration, also small					
			permanently installed systems are available for cleanroom. These are	1				
			necessary to monitor the ISO Class according to ISO 14644-1.	1				
				1				
CCK14	Automated Thermal desorption -GC-MS			<u> </u>				
CCK15	FTIR							
CCK17	PTR-MS Photo Ionization Detector Gas Detector		100					
CCK18	Prioro ionization Detector Gas Detector		A Photoionization Detector (PID) is a gas detector used to measures volatile organic compounds (VOCs), such as benzene, and other gases.	1				
CCK19	Online Bacterial Counter							
CCK20	Incubator	Standard lab equipement	to grow microorganisms responsible for biological contamination					
CCK21	DNA Analyzer							
CCK23 CCK24	Acids/Bases/Tox Cabinet High Temp. Emission Chamber	http://www.labtesting-equipment.com/quality-	Preparation of reagents in safe conditions for testing VOC and Formaldehyde Emission. Particularly relevant in BSL	1				
CCR24	mg. remp. chilasion chamber	9896637-high-temperature-test-chamber-chamber-for-	with presurized suits	1				
		testing-voc-and-formaldehyde-emission			<u> </u>			
ANCILLARY LABORATORIES	Instrumentation to monitor organic, inorganic, biological, and particulates in the							We expect UPW to be used in and out of containment. We recommend that the main
OUTSIDE OF HIGH- CONTAINMENT	UPW system real-time							production unit to be kept outside of containment, and to setup a loop with a sterilization point after the point of use. We recommend this specific list for real-time monitoring to be
CONTAINWENT								kept and used outside of containment. Specific CCK measurements at the point of use of
								UPW can be done using the CCK instruments below.
								MOSDT recommends this strawman list for monitoring UPW, for TOC, organic, inorganic
								and microrganisms
UPW1	Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other							
UPW2	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination							
UPW3	TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)							
UPW4	Flow Cytometry: Cell particle count/biomarker (Orflo zEPI Flow)							
	-		-					

### PROPERTY OF THE PROPERTY O	Summary of Instru	ments and Sample Prep Needs Proposed for the SRF									
The content of the			Quickglance						Engineering Deta	ails	
100 100	Ref. #	Required Instrument Functionality	Size (handheld OR tabletop OR self-standing)	Is it possible to interface with	Org. cont.	Sample	Isolator Manual	Isolator Robotics/	Vibration	Power Requirements (V/A)	Size
1 1 1 1 1 1 1 1 1 1				isolator/DWI?	sensitive (Y/N)	Preparation	Manipulation via gloves	RMS handling (Y/N)	Sensitive (Y/N)		
38 Description and suppress production of the control of the contr						(Y/N)	(Y/N)				
38 Description and suppress production of the control of the contr											
Automatical Content of the Content											
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Autor Control and											
A Count of Cash and Cash of Section 19 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1											
1	30.SP4	SPI Module Sputter Coater with pump or Q150 GB Turbo-Pumped Sputter	In isolator			Y	Y	Y			26 / mm W x 490mm D x 494mm H (total height with
1	24				٧	V					
13	31	basic wet chemistry sample prep capabilities (see note)			T	, r					
1											
1											
3.3 Name (Application of the Content of the Con											
1											
### 15 March 19 180 March 19 March 19	31.3	Microbiological laboratory canabilities (see note)			v	v					
1.5 March					· ·	· ·					
1.1	32.1	heated and cooled incubators									
2.3 A Conference of States											
Section Sect					1	1			1	1	
Medical Process Management	33	Gas extraction and handling capabilities (see note)			N	N					
Michael Anderson Service Annexes for the service of the service Annexes of the service Anne		Vacuum chamber with T control for BET analyses sample prep									
1		Instrumentation to monitor cleanrooms and isolators									
Q3 State Control American Plants of Board (Control	IN HIGH-CONTAINMENT										
Q3 State Control American Plants of Board (Control	CR1	Cleanroom Air Particle Counters									
Col.	CR2	Cleanroom Differential Pressure (Room-to-Room)									
OSC State and Collection	CR3	Cleanroom Oxygen Monitors							1 -		
OR Description of the Control of the		Cleanroom Radiation Monitors				-	ļ				
GOT Audit and PATHON Controllers GOT AUDIT AND					1	 	-		1		-
Cold	CR7										
COST Substance and Profit Substance	CR8	Isolator Differential Pressure									
MACLES (MANUAL MASS) MINISTER (MANUAL MASS) M											
NEST COLD Color of Content (Content (Conte											
GSL1 Oscid Seriemmonespag Min Second Per Macro Particular/Other Control South Teach Ministry Particular/Other Ministry Par	ANCILLARY LABORATORIES	Instrumentation to monitor organic, inorganic, biological, and particulates									
COCTAINE A CONTRIBUTION OF A C	IN HIGH-CONTAINMENT	Containmation in cleam doms and isolators									
COCTAINE A CONTRIBUTION OF A C											
COCI AS DE AMPONTO MA NOR Per de courte per company (1907 PROPO) (1907 ACC) AND TO COLOR STATE COLOR S	CCK1	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other									
COCCI. United Carlo for Control Profession (Annual Control Con											
COX4 (A-MIC-PAR for from further company (pigent) COX5 (A-MIC-PAR for from further company (pigent) COX6 (A-MIC-PAR for from further company (pigent) COX7 (A-MIC-PAR for further further company (pigent) COX6 (A-MIC-PAR for further further company) COX6 (A-MIC-PAR for further further company	CCK2	FEG-SEM/EDX for Micro Particulate Identification (JEOL 7600)+C94:C111 VPS for Gross Surface/Thin films (Oxidation (Thorma K. alpha)									
COSS VPO-INTECONATION Continued to the Management (Agelman) Cost		LA-HR-ICP-MS for Gross Surface Inorganics (Agilent)									
COCK 1 TO CAR'S with 6.5 Sciences analyser for Moderate Anthonic Programs (CAR'S) with 6.5 Sciences analyser for Moderate Anthonic Programs (CAR'S) with 6.5 Sciences analyser for Moderate Anthonic Programs (CAR'S) with 6.5 Sciences and CAR'S with 6.5 Sci											
COCCI CAST PRINT CONTROL PARTICLE COUNTER (CPC) COCCI PARTICLE COUNTER (COUNTER (CPC)) COCCI PARTICLE COUNTER (CPC) COCCI P	CCK6	TD-GC-MS with GL Sciences SWA-256 wafer analyzer for Molecular Airborne									
COCI CAST AND ACCIDENT CONTROL COCINE		Organics/Outgassing									
COST ONLINE COST OF MICHAEL COUNTRY (CREATING CONTRY COST AND COST											
CX11 C(Area and Calcino) CX11 Particle Opposition Montal of DNA) CX12 Optical Particle Counter (DNC) CX13 Optical Particle Counter (DNC) CX14 Automated Thermal description -GC-MS CX15 Pit-Ad CX17 Pit-Ad CX17 Pit-Ad CX18 Pit-Do Ionization Detect or Sin Detector CX18 Pit-Do Ionization Detect or Sin Detector CX19 Pit-Ad CX19 Pit-											
COCI Particle Deposition Monitor (PDM)		Changes									
CCX14 Automated Thermal description -GC-MS CCX24 Automated Thermal description -GC-MS CCX25 PFEACE CCX27 PFEACE CCX28 Photo ionization Detector Gas Detector CCX29 Includer CCX29 Includer CCX20 Includ		IC (Anions and Cations)									
CCX14 Automated Thermal description -GC-MS CCX15 TIR CCX17 FIRA-S CCX18 Photo lonization Detector Gas Detector CCX19 Photo Contraction Detector Gas Detector CCX19 Online Bacterial Counter CCX19 Incubater CCX20 Incubater CCX21 INA Analyser CCX22 Analyse To Cabinet CCX24 High Temp. Emission Chamber Self standing NIA CCX24 High Temp. Emission Chamber Self standing NIA ANCLIARY LABORATORISS In an amounter organic, Inorganic, biological, and particulates in the Outside Counter Management Self Standing UPW1 Upw1 Squid Particle Counter for gross particulates in the Outside Counter Self-Self-Self-Cover Analyser UPW2 Optical Self-Semicracopy Pilot Cover of Pilot Counter Self-Self-Self-Self-Self-Self-Self-Self-	CCK11	Particle Deposition Monitor (PDM)									
CCX14 Automated Thermal description -GC-MS CCX15 TIR CCX17 FIRA-S CCX18 Photo lonization Detector Gas Detector CCX19 Photo Contraction Detector Gas Detector CCX19 Online Bacterial Counter CCX19 Incubater CCX20 Incubater CCX21 INA Analyser CCX22 Analyse To Cabinet CCX24 High Temp. Emission Chamber Self standing NIA CCX24 High Temp. Emission Chamber Self standing NIA ANCLIARY LABORATORISS In an amounter organic, Inorganic, biological, and particulates in the Outside Counter Management Self Standing UPW1 Upw1 Squid Particle Counter for gross particulates in the Outside Counter Self-Self-Self-Cover Analyser UPW2 Optical Self-Semicracopy Pilot Cover of Pilot Counter Self-Self-Self-Self-Self-Self-Self-Self-					1					Ì	
CCX14 Automated Thermal description -GC-MS CCX15 TIR CCX17 FIRA-S CCX18 Photo lonization Detector Gas Detector CCX19 Photo Contraction Detector Gas Detector CCX19 Online Bacterial Counter CCX19 Incubater CCX20 Incubater CCX21 INA Analyser CCX22 Analyse To Cabinet CCX24 High Temp. Emission Chamber Self standing NIA CCX24 High Temp. Emission Chamber Self standing NIA ANCLIARY LABORATORISS In an amounter organic, Inorganic, biological, and particulates in the Outside Counter Management Self Standing UPW1 Upw1 Squid Particle Counter for gross particulates in the Outside Counter Self-Self-Self-Cover Analyser UPW2 Optical Self-Semicracopy Pilot Cover of Pilot Counter Self-Self-Self-Self-Self-Self-Self-Self-											
CCX14 Automated Thermal description -GC-MS CCX15 TIR CCX17 FIRA-S CCX18 Photo lonization Detector Gas Detector CCX19 Photo Contraction Detector Gas Detector CCX19 Online Bacterial Counter CCX19 Incubater CCX20 Incubater CCX21 INA Analyser CCX22 Analyse To Cabinet CCX24 High Temp. Emission Chamber Self standing NIA CCX24 High Temp. Emission Chamber Self standing NIA ANCLIARY LABORATORISS In an amounter organic, Inorganic, biological, and particulates in the Outside Counter Management Self Standing UPW1 Upw1 Squid Particle Counter for gross particulates in the Outside Counter Self-Self-Self-Cover Analyser UPW2 Optical Self-Semicracopy Pilot Cover of Pilot Counter Self-Self-Self-Self-Self-Self-Self-Self-	CCK12	Optical Particle Counter (OPC)							1	1	
CCK15 FTR MS CCK18 Photo ionization Detector Gas Detector CCK19 Online Bacterial Counter CCK20 Incubator CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 A ick/98aev/Tox Cabinet CCK24 High Temp. Emission Chamber Self standing NIA ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Pearls For post particulates) - 2 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For post particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination					1					Ì	
CCK15 FTR MS CCK18 Photo ionization Detector Gas Detector CCK19 Online Bacterial Counter CCK20 Incubator CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 A ick/98aev/Tox Cabinet CCK24 High Temp. Emission Chamber Self standing NIA ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Pearls For post particulates) - 2 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For post particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination					1					Ì	
CCK15 FTR MS CCK18 Photo ionization Detector Gas Detector CCK19 Online Bacterial Counter CCK20 Incubator CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 A ick/98aev/Tox Cabinet CCK24 High Temp. Emission Chamber Self standing NIA ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Pearls For post particulates) - 2 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For post particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination					1					Ì	
CCK15 FTR MS CCK18 Photo ionization Detector Gas Detector CCK19 Online Bacterial Counter CCK20 Incubator CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 DNA Analyzer CCK21 A ick/98aev/Tox Cabinet CCK24 High Temp. Emission Chamber Self standing NIA ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Pearls For post particulates) - 2 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For post particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination UPW3 TOC Counter (Pearls For gross particulates) - 3 micron (HAC 8011+) Contamination	CCK14	Automated Thermal desorption -GC-MS			<u> </u>						
CCK19 Photo lonization Detector Gas Detector CCK18 Photo lonization Detector Gas Detector CCK19 Online Baterial Counter CCK20 Incubator CCK21 Incubator CCK21 Photo Analyzer CCK23 Acidy/Bases/Tox Cabinet CCK24 High Temp. Emission Chamber Self standing N/A Instrumentation to monitor organic, inorganic, biological, and particulates in the UPW system real-time CVX1AINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Bench Coop) (GE M9 TOC)		FTIR							1	1	
CCK19 Online Bacterial Counter CCK20 Incubator CCK21 DNA Analyzer CCK21 Analyses Self-standing Se		PTR-MS									
CCX21 Inclubator CCX21 DNA Analyzer CCX23 Acids/State/Tox Cabinet CCX24 High Temp. Emission Chamber CCX24 High Temp. Emission Chamber Self standing N/A ANCILARY LABORATORIES OUTSIDE OF High- COXTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (height of the Total Organic Carbon > 0.05 ppt (SE M9 TOX)	CCK18	Photo Ionization Detector Gas Detector									
CCX21 Inclubator CCX21 DNA Analyzer CCX23 Acids/State/Tox Cabinet CCX24 High Temp. Emission Chamber CCX24 High Temp. Emission Chamber Self standing N/A ANCILARY LABORATORIES OUTSIDE OF High- COXTAINMENT UPW1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (height of the Total Organic Carbon > 0.05 ppt (SE M9 TOX)	COVAO	Online Parterial Counter		+	1	1			1		
CCX21 DNA Analyzer CCX23 Acidy Bases/Tox Cabinet CCX24 High Temp. Emission Chamber Self standing N/A ANCILLARY LABORATORIES OUTSIDE OF High- CONTAINMENT UPW system real-time UPW system real-time UPW 2 Optical Stereomicroscopy/Microscopy for Macro Particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate (Other Contamination UPW3 TOX Counter (Pench top) for Total Organic Carbon > 0.5 pp (SE M9 TOX)					+	1	-		1	1	+
CCX24 High Temp. Emission Chamber Self standing N/A from 90*135*134 to maximum 150*186* ANCILLARY LABORATORIES OUTSIDE OF HIGH-CONTAINMENT UPW system real-time UPW system real-time UPW 1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Pench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)									1	1	
ANCILIARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW system real-time UPW1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate(Other Contamination UPW3 TOC Counter (Pench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)	CCK23	Acids/Bases/Tox Cabinet									
ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW system real-time UPW system real-time UPW system real-time UPW pricial Stereomicroscopy Microscopy for Macro Particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy Microscopy for Macro Particulate (Other Contamination UPW3 TOC Counter (Pench top) for Total Organic Carbon > 0.05 pp) (GE M9 TOC)	CCK24	High Temp. Emission Chamber	Self standing	N/A							from 90*136*154 to
OUTSIDE OF HIGH- CONTAINMENT UPW 1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (hench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)					1					Ì	maximum 150*186*267.
OUTSIDE OF HIGH- CONTAINMENT UPW 1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (hench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)	ANCILLARY LABORATORIES	Instrumentation to monitor organic, inorganic, biological, and particulates in the									
UPW1 Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)	OUTSIDE OF HIGH-	UPW system real-time									
UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Denth top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)	CONTAINMENT										
UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Denth top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)											
UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Denth top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)											
UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Denth top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)											
UPW2 Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination UPW3 TOC Counter (Denth top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)	UPW1	Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+)									
UPW3 TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)		Optical Stereomicroscopy/Microscopy for Macro Particulate/Other									
UPW3 TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC) UPW4 Flow Cytometry: Cell particle count/biomarker (Orflo ±EPI Flow)					1				1		
UPW4 How Lytometry: Lesi particie count/biomarker (Drifto ±PH How)	UPW3	TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)			1	1			1		
	UPW4	riow Cytometry: Cen particle count/biomarker (Orflo zEPI How)		L	1	<u> </u>	L		1	1	

Ref. # R	ents and Sample Prep Needs Proposed for the SRF						
30.SP4 S						Analysis sasyisamanta	
30.SP4 S	Required Instrument Functionality	Mass (kg)	Specialized Gas	Cooling Needs	Special infrastructure	Analysis requirements Analysis under inert gas	Special Lighting
	equired instrument runctionality	IVIdSS (Kg)	Requirements	Cooling Needs	req	Arialysis under mert gas	Needs
			Requirements		req		iveeus
	SPI Module Sputter Coater with pump or Q150 GB Turbo-Pumped Sputter	40 kg					
	Coater / Carbon Coater for Glove Box	40 NB					
31 B	Basic wet chemistry sample prep capabilities (see note)						
,							
1							
,							
31.1 V	Vortex						
31.2 Se	Sonicator						
31.3 Si	Samples digestion with hot acid						
	Microbiological laboratory capabilities (see note)						
32	incrobiological laboratory capabilities (see note)						
32.1 h	neated and cooled incubators						
	reezers (-20, -80C)						
							
	refrigerator						
	analytical balance						
33 G	Gas extraction and handling capabilities (see note)						
MOSDT9 V	/acuum chamber with T control for BET analyses sample prep						
ANCILLARY LABORATORIES In	nstrumentation to monitor cleanrooms and isolators						
IN HIGH-CONTAINMENT							
CR1 C	Cleanroom Air Particle Counters						
	Cleanroom Differential Pressure (Room-to-Room)						
CR3 C	Cleanroom Oxygen Monitors						
CR4 C	Cleanroom Radiation Monitors						
	Eleanroom CO2 Monitors						
CR6 C	Cleanroom Temp. and RH%						
CR7 Is	solator Air Particle Counters						
CR8 Is	solator Differential Pressure						
	solator O2 & H2O Monitors in ppm or ppt						
CR10 Is	solator Temp. and RH%						
ANCILLARY LABORATORIES In	nstrumentation to monitor organic, inorganic, biological, and particulates						
IN HIGH-CONTAINMENT CO	contamination in cleanrooms and isolators						
CCK1 0	Ontical Staroomicroscopy/Microscopy for Macro Particulate/Other						
	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination						
CCK2 FI	FEG-SEM/EDX for Micro Particulate Identification (JEOL 7600)+C94:C111						
CCK3 X	KPS for Gross Surface/Thin-films/Oxidation (Thermo K-alpha)						
CCK4	.A-HR-ICP-MS for Gross Surface Inorganics (Agilent)						
CCK5 V	/PD-HR-ICP-MS for Molecular Airborne Inorganics (Agilent)						
CCK6	FD-GC-MS with GL Sciences SWA-256 wafer analyzer for Molecular Airborne						
0	Organics/Outgassing						
CCK7 D	DART-qTOF-MS for Gross Surface Organics (JEOL)						
CCK8	.C-MS for Amino Acids						
CCK9 A	AFM (Atomic Force Microcopy) for Surface Roughness/Thin-Films/Cleaning						
2003	Changes						
CCK10	C (Anions and Cations)						
CCK11 P	Particle Deposition Monitor (PDM)						
CCVII P	article deposition Monitor (FDM)						
							Ì
CCK12 O	Optical Particle Counter (OPC)						Ì
							Ì
							Ì
							Ì
	Automated Thermal desorption -GC-MS						1
CCK14	TIR						
CCK14 A	PTR-MS			 			
CCK15 F							
CCK15 F CCK17 P	Photo Ionization Detector Gas Detector		1				
CCK15 F CCK17 P							
CCK15 F CCK17 P CCK18 P	http://www.informatic						
CCK15 F CCK17 P CCK18 P CCK19 O	Online Bacterial Counter						
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir	ncubator						
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK21 D	ncubator DNA Analyzer						
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK21 D	ncubator						
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK21 D CCK21 A	ncubator DNA Analyzer	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK21 D CCK21 A	ncubator DNA Analyzer Acids/Bases/Tox Cabinet	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK21 D CCK21 A	ncubator DNA Analyzer Acids/Bases/Tox Cabinet	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 C CCK20 Ir CCK21 D CCK21 D CCK23 AA CCK24 H	ncubator DNA Analyzer Acids/Basses/fox Cabinet High Temp. Emission Chamber	100*161*210					
CCK15 F	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK18 P CCK21 D CCK22 IF CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator DNA Analyzer Acids/Basses/fox Cabinet High Temp. Emission Chamber	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 Ir CCK20 A CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES Ir	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK18 P CCK21 D CCK22 IF CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK18 P CCK21 D CCK22 IF CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK18 P CCK21 D CCK22 IF CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK18 P CCK21 D CCK22 IF CCK21 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator NAK Analyzer ActidyBases/Tox Cabinet riigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 IF CCK21 D CCK21 D CCK22 D CCK23 A CCK24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH-	ncubator NAA Analyzer NAA Analyzer Naidyflasses/Tox Cabinet High Temp. Emission Chamber nstrumentation to monitor organic, inorganic, biological, and particulates in the PW system real-time	100*161*210					
CCK15 F CCK17 P CK18 P CK19 C CK29 I CK20 II CK220 II CK223 A CK223 A CK224 H ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT UPW1 LL	ncubator NAK Analyzer Acidy/Bases/Tox Cabinet righ Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the JPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+)	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 II CCK21 D CCK21 D CCK22 A CCK24 H ANCILLARY LABORATORIES II OUTSIDE OF HIGH- CONTAINMENT UPW1 LI UPW1 LI	Incubator NAL Analyzer And Analyzer And Analyzer Indiff Bases/Tox Cabinet Itigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the PPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other	100*161*210					
COX15 F COX17 P COX18 P COX19 O COX20 IF COX22 IF COX23 A COX23 A COX24 H ANCILLARY LABORATORIES IF OUTSIDE OF HIGH- CONTAINMENT UPW1 LL UPW1 LL UPW2 O C	ncubator NAK Analyzer Acidy/Bases/Tox Cabinet cidy/Bases/Tox Cabinet instrumentation to monitor organic, inorganic, biological, and particulates in the JPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+)	100*161*210					
CCK15 F CCK17 P CCK18 P CCK19 O CCK20 If CCK21 D CCK21 D CCK22 A CCK24 H ANCILLARY LABORATORIES If OUTSIDE OF HIGH- CONTAINMENT UPW1 LI UPW2 O C UPW3 T	Incubator NAL Analyzer And Analyzer And Analyzer Indiff Bases/Tox Cabinet Itigh Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the PPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other	100*161*210					

C	wants and Consula David Nords Duranced South a CDT				
Summary of Instrur	nents and Sample Prep Needs Proposed for the SRF	Sample prep			
Ref. #	Required Instrument Functionality	Detailed Sample Preparation Requirments	Sample Prep in sample prep area (separate): is the sample to be analyzed prepared in a general sample pre area? Y: sample must be prepared following a certain protocol using capabilities and isntruments identified in the Sample Prep section, and it doesn't need to be linked to the instrument, but can be transported to the instrument. NI: sample preparation must occur in co-location with the targetted analytical instrument. N/A: no sample prep required	Level of pristinity before prep or analysis	Level of pristinity afte prep or analysis (Pristine, Psub, Rest, Terminal
30.SP4	SPI Module Sputter Coater with pump or Q150 GB Turbo-Pumped Sputter Coater / Carbon Coater for Glove Box				Rest
31	Basic wet chemistry sample prep capabilities (see note)				
31.1	Vortex				
31.2	Sonicator Samples digestion with hot acid				
31.3 32	Microbiological laboratory capabilities (see note)				
32.1	heated and cooled incubators				
32.2 32.3	freezers (-20, -80C) refrigerator				
32.4	analytical balance				
33	Gas extraction and handling capabilities (see note)				
MOSDT9	Vacuum chamber with T control for BET analyses sample prep				
ANCILLARY LABORATORIES IN HIGH-CONTAINMENT	Instrumentation to monitor cleanrooms and isolators				
CR1	Cleanroom Air Particle Counters				
CR2	Cleanroom Differential Pressure (Room-to-Room)				
CR3	Cleanroom Oxygen Monitors				
CR4	Cleanroom Radiation Monitors Cleanroom CO2 Monitors				
CR5	Cleanroom CO2 Monitors Cleanroom Temp. and RH%				
CR7	Isolator Air Particle Counters				
CR8	Isolator Differential Pressure				
CR9	Isolator O2 & H2O Monitors in ppm or ppt				
CR10	Isolator Temp. and RH%				
ANCILLARY LABORATORIES IN HIGH-CONTAINMENT	Instrumentation to monitor organic, inorganic, biological, and particulates contamination in cleanrooms and isolators				
CCK1	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination				
CCK2 CCK3	FEG-SEM/EDX for Micro Particulate Identification (JEOL 7600)+C94:C111 XPS for Gross Surface/Thin-films/Oxidation (Thermo K-alpha)				
CCK4	LA-HR-ICP-MS for Gross Surface Inorganics (Agilent)				
CCK5	VPD-HR-ICP-MS for Molecular Airborne Inorganics (Agilent)				
ССКЕ	TD-GC-MS with GL Sciences SWA-256 wafer analyzer for Molecular Airborne Organics/Outgassing				
CCK7 CCK8	DART-qTOF-MS for Gross Surface Organics (JEOL) LC-MS for Amino Acids				
ССК9	AFM (Atomic Force Microcopy) for Surface Roughness/Thin-Films/Cleaning Changes				
CCK10	IC (Anions and Cations)				
CCK11	Particle Deposition Monitor (PDM)				
CCK12	Optical Particle Counter (OPC)				
CCK14	Automated Thermal desorption -GC-MS				
CCK15	FTIR				
CCK17	PTR-MS				
CCK18	Photo Ionization Detector Gas Detector			-	
CCK19 CCK20	Online Bacterial Counter Incubator				
CCK20	DNA Analyzer				
CCK23	Acids/Bases/Tox Cabinet				
CCK24	High Temp. Emission Chamber				
ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT	Instrumentation to monitor organic, inorganic, biological, and particulates in the UPW system real-time				
	United the state of the state o				
UPW1 UPW2	Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other				
UPWZ	Contamination				
UPW3	TOC Counter (bench top) for Total Organic Carbon > 0.05 ppb (GE M9 TOC)				
UPW4	Flow Cytometry: Cell particle count/biomarker (Orflo zEPI Flow)				

	ruments and Sample Prep Needs Proposed for the SRF			the state of the s
	ruments and sample Frep Needs Froposed for the SKF			Notes
Ref. #	Required Instrument Functionality	Sample Prep under inert gas	Sub Sample mass/volume needed in	
	•		sample prep	
30.SP4	SPI Module Sputter Coater with pump or Q150 GB Turbo-Pumped Sputter			The Q150 GB turbo pumped sputter coater is dedicated to work in glove box
	Coater / Carbon Coater for Glove Box			Key features
31	Basic wet chemistry sample prep capabilities (see note)			Made beautiful from the formation for the standard beautiful to the st
<i></i>				
31.1	Vortex			
31.2	Sonicator			
31.3	Samples digestion with hot acid			
32	Microbiological laboratory capabilities (see note)			
~				
32.1	heated and cooled incubators			
32.2	freezers (-20, -80C)			
32.3	refrigerator			
32.4	analytical balance			
33	Gas extraction and handling capabilities (see note)			
MOSDT9	Vacuum chamber with T control for BET analyses sample prep			
ANCILLARY LABORATOR	Instrumentation to monitor cleanrooms and isolators			
IN HIGH-CONTAINMENT				
CR1	Cleanroom Air Particle Counters			
CR2	Cleanroom Differential Pressure (Room-to-Room)			
CR3	Cleanroom Oxygen Monitors			
CR4	Cleanroom Radiation Monitors			
CR5	Cleanroom CO2 Monitors			
CR6	Cleanroom Temp. and RH%			
CR7	Isolator Air Particle Counters			
CR8	Isolator Differential Pressure			
CR9	Isolator O2 & H2O Monitors in ppm or ppt			
CR10	Isolator Temp. and RH%			
ANCILLARY LABORATOR	IES Instrumentation to monitor organic, inorganic, biological, and particulates			Assumption on BSL4 level for overall facility: what part of the lab (or of the isolators) will be hot?
IN HIGH-CONTAINMENT	contamination in cleanrooms and isolators			What to do with the CCK samples from the hot area? Can we sterilize some of the CCK samples to get out of
				containment for measurement?
CCK1	Optical Stereomicroscopy/Microscopy for Macro Particulate/Other		<u> </u>	
	Contamination			
CCK2	FEG-SEM/EDX for Micro Particulate Identification (JEOL 7600)+C94:C111			
CCK3	XPS for Gross Surface/Thin-films/Oxidation (Thermo K-alpha)			
CCK4	LA-HR-ICP-MS for Gross Surface Inorganics (Agilent)			
CCK5	VPD-HR-ICP-MS for Molecular Airborne Inorganics (Agilent)			
CCK6	TD-GC-MS with GL Sciences SWA-256 wafer analyzer for Molecular Airborne			
	Organics/Outgassing			
CCK7	DART-qTOF-MS for Gross Surface Organics (JEOL)			
CCK8	LC-MS for Amino Acids			
сск9	AFM (Atomic Force Microcopy) for Surface Roughness/Thin-Films/Cleaning			
	Changes			
CCK10	IC (Anions and Cations)			
CCK11	Particle Deposition Monitor (PDM)			it's an "advanced" Particle Fall Out Meter (PFO): A PFO can only measure a particle area coverage/obscuration;
				the PDM can also measure particle size and number as well as time resolved analysis. Meanwhile, there are also
				other systems available we would consider for sedimented particle monitoring systems, e.g. ASML is currently
				using a system from FastMicro https://fast-micro.com/
CCK12	Optical Particle Counter (OPC)			Larger particles are more subject to gravity, so they cannot be controlled by the flow and therefore sediment
				faster. In this respect, airborne particles and their measurement methods must always be seen as complementary to the methods for measuring sedimented particles (like PDM). And you have to consider also
				complementary to the methods for measuring sedimented particles (like PDM). And you have to consider also that the processes, material, personnel etc. inside a clean environment could significantly contribute to
				that the processes, material, personnel etc. inside a clean environment could significantly contribute to (particle) contamination:
				(particle) containfffdtion.
CCK14	Automated Thermal desorption -GC-MS			
CCK15	FTIR			
	0.70 4.40			
CCK17	PTR-MS			
CCK17 CCK18	PTR-MS Photo Ionization Detector Gas Detector			
CCK18	Photo Ionization Detector Gas Detector			
CCK18	Photo Ionization Detector Gas Detector Online Bacterial Counter			
CCK18 CCK19 CCK20	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator			
CCK18 CCK19 CCK20 CCK21	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer			
CCK18 CCK19 CCK20 CCK21 CCK23	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acids/Basse/Tox Cabinet			
CCK18 CCK19 CCK20 CCK21	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer			
CCK18 CCK19 CCK20 CCK21 CCK23	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acids/Basse/Tox Cabinet			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy'Basse/Tox Cabinet High Temp. Emission Chamber			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATOR:	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer AcidyBase/Tox Cabinet High Temp. Emission Chamber ES Instrumentation to monitor organic, inorganic, biological, and particulates in the			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH-	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy'Basse/Tox Cabinet High Temp. Emission Chamber			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATOR:	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer AcidyBase/Tox Cabinet High Temp. Emission Chamber ES Instrumentation to monitor organic, inorganic, biological, and particulates in the			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH-	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer AcidyBase/Tox Cabinet High Temp. Emission Chamber ES Instrumentation to monitor organic, inorganic, biological, and particulates in the			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH-	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer AcidyBase/Tox Cabinet High Temp. Emission Chamber ES Instrumentation to monitor organic, inorganic, biological, and particulates in the			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH-	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer AcidyBase/Tox Cabinet High Temp. Emission Chamber ES Instrumentation to monitor organic, inorganic, biological, and particulates in the			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH- CONTAINMENT	Photo Ionization Detector Gas Detector Online Bacterial Counter Inclustor DNA Analyzer Acidy/Base/Tox Cabinet High Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the UPW system real-time			
CCK18 CCK19 CCK20 CCK21 CCK21 CCK23 CCK24 ANCILLARY LABORATOR OUTSIDE OF HIGH- CONTAINMENT UPW1	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy/Bases/Tox Cabinet High Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the UPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+)			
CCK18 CCK19 CCK20 CCK21 CCK23 CCK24 ANCILLARY LABORATORI OUTSIDE OF HIGH- CONTAINMENT	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy/Bases/Tox Cabinet High Temp. Emission Chamber High Temp. Emission Chamber UPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other			
CCK18 CCK19 CCK20 CCK21 CCK21 CCK23 CCK24 ANCILLARY LABORATOR OUTSIDE OF HIGH- CONTAINMENT UPW1 UPW2	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy/Basee/Tox Cabinet High Temp. Emission Chamber Instrumentation to monitor organic, inorganic, biological, and particulates in the UPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other Contamination			
CCK18 CCK19 CCK20 CCK21 CCK21 CCK23 CCK24 ANCILLARY LABORATOR OUTSIDE OF HIGH- CONTAINMENT UPW1	Photo Ionization Detector Gas Detector Online Bacterial Counter Incubator DNA Analyzer Acidy/Bases/Tox Cabinet High Temp. Emission Chamber High Temp. Emission Chamber UPW system real-time Liquid Particle Counter for gross particulates > 1 micron (HIAC 8011+) Optical Stereomicroscopy/Microscopy for Macro Particulate/Other			

Summary of Instrum	nents and Sample Prep Needs Proposed for the SRF							
					Requ	ired for		
Ref. #	Required Instrument Functionality	Reference instrument	Function	Curation	Sample Safety	Time-Sensitive	Sterilization-	Significant Instrument Comments
					Assessment	Science	Sensitive	
							Science	
ANCILLARY LABORATORIES	Instrumentation to clean isolators and tools - Cleaning Lab (see notes)		Cleaning Lab to support preparation /maintenance of clean material					In order to prepare all material to be installed in "hot areas", within isolator, a dedicated
OUTSIDE OF HIGH-			before integration in hot areas.					room for precision and utra clean preparation of equipment is recommended. The room
CONTAINMENT								should be large enough to host several isolators being cleaned at the same time. A trade-off
Clean1	Supercritical Fluid cleaning			х	х			
Clean2	CO2 Snow-Cleaning (separate Mini-Environment) incl. Robotic Arm + handheld							
	nozzle							
Clean3	Oxygen Plasma or other low-pressure plasma Cleaning							
Clean4	H2O2 Cleaning							
Clean5	Ultrasonic Bath made of quartz glass							
Clean6	Ultrasonic Bath made of PVDF/PFA	· · · · · · · · · · · · · · · · · · ·						
Clean7	Ultrasonic Bath made of stainless steel	· · · · · · · · · · · · · · · · · · ·						
Clean8	Ultrasonic Cleaning Unit	· · · · · · · · · · · · · · · · · · ·						
ANCILLARY LABORATORIES	Instrumentation for sterilizing and releasing materials other than samples from		Releasing material and effluents that is not the samples					MOSDT recommends to have the full range of sterilization equipment typical of a BSL4 labor
ACROSS BIOBARRIER	the biocontained area							

Summary of Instrum	nents and Sample Prep Needs Proposed for the SRF									
		Quick glance						Engineering Detai		
Ref. #	Required Instrument Functionality	Size (handheld OR tabletop OR self-standing)	Is it possible to interface with	Org. cont.	Sample	Isolator Manual	Isolator Robotics/	Vibration	Power Requirements (V/A)	Size
			isolator/DWI?	sensitive (Y/N)		Manipulation via gloves	RMS handling (Y/N)	Sensitive (Y/N)		
					(Y/N)	(Y/N)				
ANCILLARY LABORATORIES	Instrumentation to clean isolators and tools - Cleaning Lab (see notes)									
OUTSIDE OF HIGH-										
CONTAINMENT										
Clean1	Supercritical Fluid cleaning				N					
Clean2	CO2 Snow-Cleaning (separate Mini-Environment) incl. Robotic Arm + handheld									
	nozzle									
Clean3	Oxygen Plasma or other low-pressure plasma Cleaning									
Clean4	H2O2 Cleaning									
Clean5	Ultrasonic Bath made of quartz glass									
Clean6	Ultrasonic Bath made of PVDF/PFA									
Clean7	Ultrasonic Bath made of stainless steel									
Clean8	Ultrasonic Cleaning Unit									·
ANCILLARY LABORATORIES		atory.								
ACROSS BIOBARRIER	the biocontained area									

Summary of Instrur	ments and Sample Prep Needs Proposed for the SRF						
						Analysis requirements	
Ref.#	Required Instrument Functionality	Mass (kg)	Specialized Gas Requirements	Cooling Needs	Special infrastructure req	Analysis under inert gas	Special Lighting Needs
ANCILLARY LABORATORIES OUTSIDE OF HIGH- CONTAINMENT	Instrumentation to clean isolators and tools - Cleaning Lab (see notes)						
Clean1	Supercritical Fluid cleaning						
Clean2	CO2 Snow-Cleaning (separate Mini-Environment) incl. Robotic Arm + handheld nozzle						
Clean3	Oxygen Plasma or other low-pressure plasma Cleaning						
Clean4	H2O2 Cleaning						
Clean5	Ultrasonic Bath made of quartz glass						
Clean6	Ultrasonic Bath made of PVDF/PFA						
Clean7	Ultrasonic Bath made of stainless steel						
Clean8	Ultrasonic Cleaning Unit						
ANCILLARY LABORATORIES ACROSS BIOBARRIER	Instrumentation for sterilizing and releasing materials other than samples from the biocontained area						

Summary of Instrui	ments and Sample Prep Needs Proposed for the SRF				
		Sample prep			
Ref. #	Required Instrument Functionality	Detailed Sample Preparation Requirments	Sample Prep in sample prep area (separate): is the sample to be		Level of pristinity after
			analyzed prepared in a general sample pre area?	analysis	prep or analysis
			Y: sample must be prepared following a certain protocol using		(Pristine, Psub, Rest,
			capabilities and isntruments identified in the Sample Prep section, and		Terminal
			it doesn't need to be linked to the instrument, but can be trasnported		
			to the instrument.		
			N: sample preparation must occur in co-location with the targetted		
			analytical instrument N/A: no sample prep required		
			N/A. IIO sample prep required		
ANCILLARY LABORATORIES	Instrumentation to clean isolators and tools - Cleaning Lab (see notes)				
OUTSIDE OF HIGH-					
CONTAINMENT					
Clean1	Supercritical Fluid cleaning				
Clean2	CO2 Snow-Cleaning (separate Mini-Environment) incl. Robotic Arm + handheld				
	nozzle				
Clean3	Oxygen Plasma or other low-pressure plasma Cleaning				
Clean4	H2O2 Cleaning				
Clean5	Ultrasonic Bath made of quartz glass				
Clean6	Ultrasonic Bath made of PVDF/PFA	·		·	
Clean7	Ultrasonic Bath made of stainless steel				
Clean8	Ultrasonic Cleaning Unit				
ANCILLARY LABORATORIES	Instrumentation for sterilizing and releasing materials other than samples from				
ACROSS BIOBARRIER	the biocontained area				

Summary of Instrui	ments and Sample Prep Needs Proposed for the SRF			
				Notes
Ref. #	Required Instrument Functionality	Sample Prep under inert gas	Sub Sample mass/volume needed in	
			sample prep	
ANCILLARY LABORATORIES	Instrumentation to clean isolators and tools - Cleaning Lab (see notes)			Supporting equipment should be: Storage Shelf (Stainless Steel), Handling Space/Table (Stainless Steel) closed
OUTSIDE OF HIGH-				surface, Handling Space/Table (Stainless Steel) perforated, Rolling Cart (Stainless Steel) (2), Solvent Cabinet,
CONTAINMENT				Storage for Cleaning Agents/Detergents, Drainage on Floor Level, Drying Cabinet, Thermal
Clean1	Supercritical Fluid cleaning			
Clean2	CO2 Snow-Cleaning (separate Mini-Environment) incl. Robotic Arm + handheld			
	nozzle			
Clean3	Oxygen Plasma or other low-pressure plasma Cleaning			
Clean4	H2O2 Cleaning			
Clean5	Ultrasonic Bath made of quartz glass			
Clean6	Ultrasonic Bath made of PVDF/PFA			
Clean7	Ultrasonic Bath made of stainless steel			
Clean8	Ultrasonic Cleaning Unit			
ANCILLARY LABORATORIES	Instrumentation for sterilizing and releasing materials other than samples from			
ACROSS BIOBARRIER	the biocontained area			

instrument ref. #	NOTES (update 28/09 from Supplement B)
1	Assume that more than one optical reflected (non-polarized) light microscope will
	be required to support optimal work flow. Needed for both pre-BC, BC, and PE.
	For BC, assume one is needed in each isolator
5	Assume that more than one analytical balance will be required to support optimal
	work flow and sample prep for multiple instruments, and one analytical balance
	will be needed inside each pristine isolator used for BC
7	The SEM will need to have ports for additional detectors, possibly including CL,
-	EDS, WDS, FIB, and EBSD, and Focused Ion Beam capability—this is an important
	sample prep step for other measurements. Gminek et al., 2021 report calls for a
	Variable Pressure Scanning Electron Microscope with Energy Dispersive X-ray
	Spectrometer (EDS). Tait et al., 2021 state the need for capability for both Field
	Emission- and Variable Pressure-SEM, that could potentially be combined in one
8+9	Confocal Raman Spectrometer and Deep UV Fluorescence Spectrometer
	functionality could potentially be combined in one instrument
13	Assume that different kinds of microscopes (and in some cases more than one
13	copy) will be required to support optimal work flow. This may include, but not be
	limited to: petrographic microscope, reflected light microscopy with Z-(focus)
	stacking, binocular microscope (Ref. #1 above). See Table 2.
14	This GC-IRMS system must optimized for complex, high molecular weight volatiles
	and their stable isotopes for SSAP related investigations and time-sensitive life
	science. This is a distinct instrument from the GC-IRMS called for in row 23. This
	would mainly be used to analyze high-molecular weight organic compounds
	extracted from the samples via solvent extraction. These analyses are destructive.
17	Would include nanopore, Bioanalyzer, MiSeq, etc.
23	This GC-IRMS system must be optimized for low molecular weight volatiles and
25	
	their stables isotopes and would be used for the analysis of headspace and other
	gas samples, including those evolved during sample sterilization, and would also
	need to include a high temperature conversion elemental analyzer (TC/EA) for
	pyrolysis of solid samples and extracts to characterize volatiles hosted in mineral
	phases. Quadropole mass spec (QMS) to measure noble gas isotope ratios (e.g.,
	40/36 Ar, 84Kr/132Xe, 129/132 Xe)
24	Laser spectrometer will be used for sample headspace gas characterization and to
	analyze gases evolved during sample sterilization. These techniques are non-
	destructive and could be performed before analyzing samples via GC-IRMS using
	instruments named in rows 14 or 23, depending on the intent of the analysis. It
	should be noted that important progress in these types of techniques is being
	made, and a final decision on instrumentation for the SRF should take
	forthcoming improvements into account.
20	
29	Sterilization equipment will be needed for both samples (as required by PP) and
	for hardware and tools that come in contact with samples (to meet
	contamination control requirements)
30	Rock sample prep lab will need to include multiple functions, including but not
	limited to: Thin section preparation and polished thick section preparation,
	Sputter coaters and vacuum evaporators for C and Au or Ir or Pt-Pd conductive
	coatings, Agate mortar and pestle, Capability to grind samples with KBr and press
	into pellets, capability to prepare a flat surface, Micro-drilling, particle micro-
	manipulator, microtome.
31	Basic wet chemistry lab would need to include multiple functionalities including
J 1	the capability to perform solvent extractions and other preparations. Would need
	to include equipment such as laminar flow hoods, glassware, sample handling
	tools, and other equipment commonly found in wet chemistry laboratories
32	Microbiology lab will need to include items for biological sample prep and
	manipulation/storage of samples: heated and cooled incubators, freezers (-20, -
	80C), refrigerator, analytical balance, laminar flow hood, vortexer,
	microbiological glassware, plasticware consumables,
33	microbiological glassware, plasticware consumables, Gas extraction and handling equipment (e.g., custom vacuum lines, inert carrier