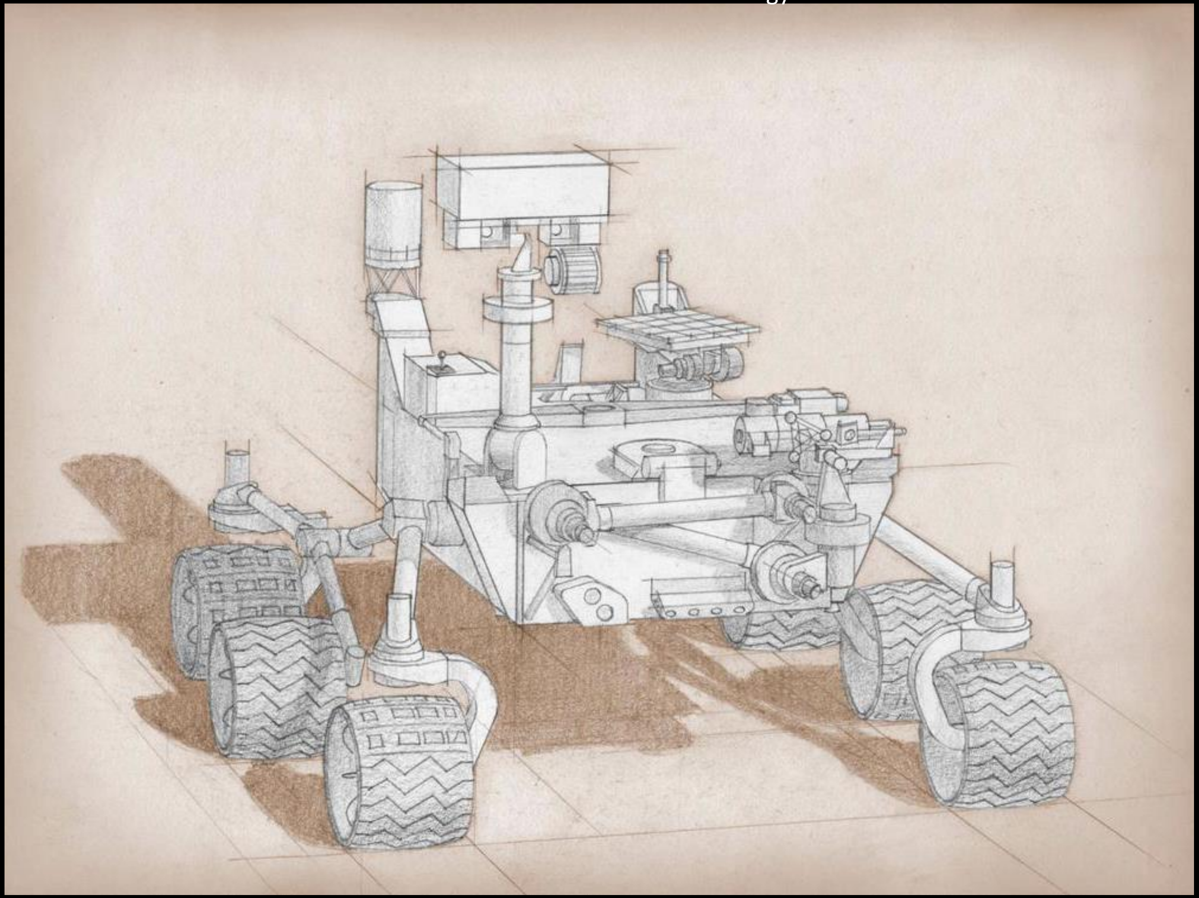
MARS 2020 MISSION UPDATE

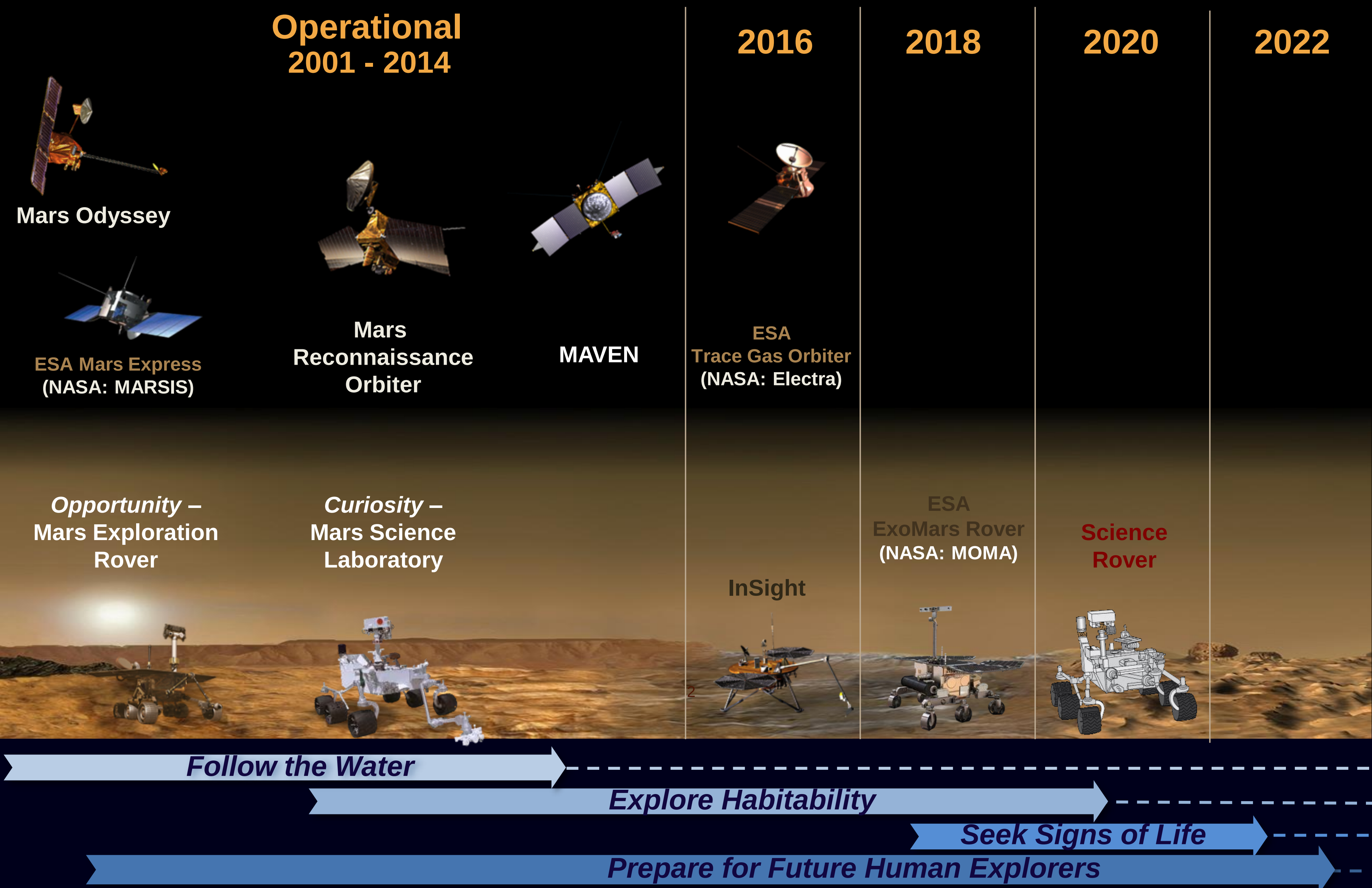
Jet Propulsion Laboratory
California Institute of Technology

MARS 2020 Project



Ken Farley, Project Scientist
Ken Williford, Deputy Project Scientist

Current & Future Mars Missions



EVOLVING MARS SCIENCE THEMES

Mars 2020 Scientific Objectives

A. Geologic History

Carry out an integrated set of context, contact, and spatially-coordinated measurements to characterize the geology of the landing site

B. *In Situ* Astrobiology

Find and characterize ancient habitable environments, identify rocks with the highest chance of preserving signs of ancient Martian life if it were present, and within those environments, seek the signs of life

C. Sample Return

Place rigorously documented and selected samples in a returnable sample cache for possible future return to Earth

Mars 2020 Scientific Objectives (2)

Additional objectives:

A) facilitate future human exploration by demonstrating an in situ resource utilization technology

B) demonstrate additional technologies required for future Mars exploration

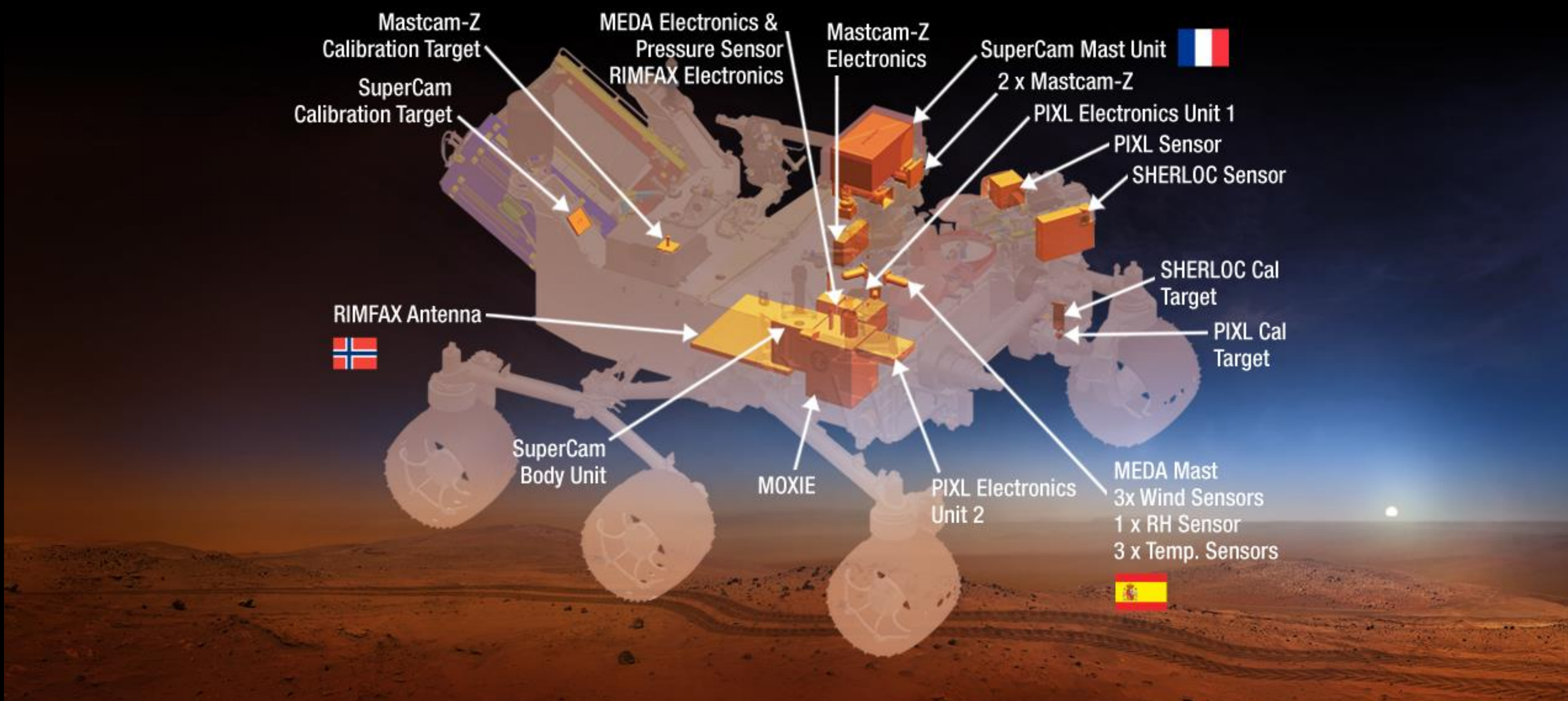
The Mars 2020 mission fulfills the high priority Decadal Survey objective to initiate the first step in the multi-mission campaign to (potentially) return carefully selected Martian samples to Earth

Mars 2020 Mission Implementation

1) Scientific observations required to assess geologic history and astrobiology are the same as the instruments required for selecting/documenting samples in the cache. *We are a single integrated science mission.*

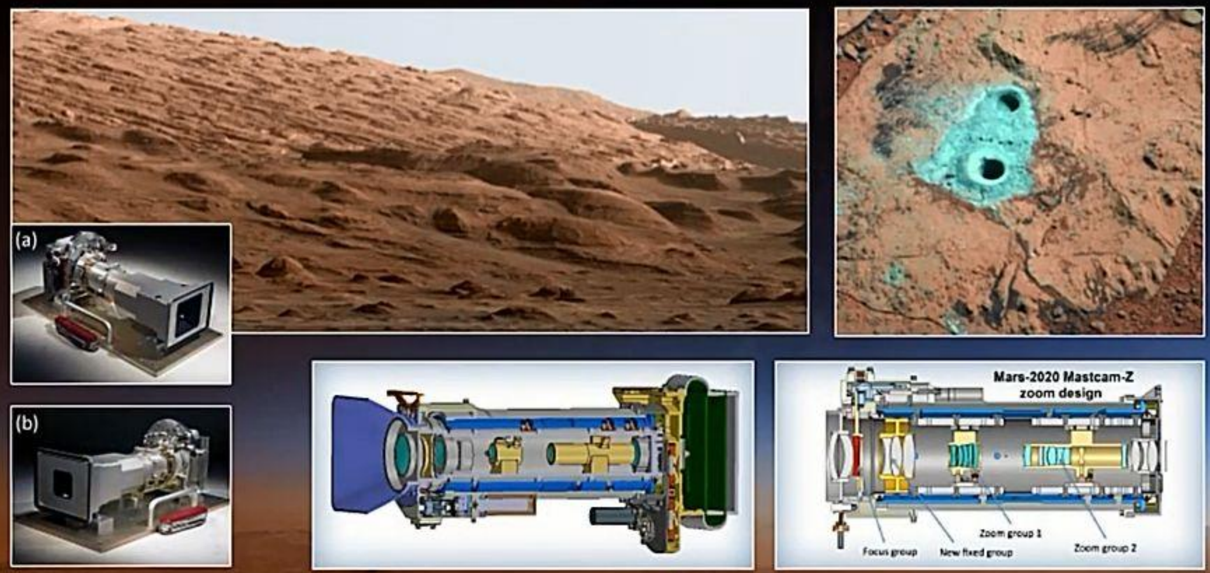
2) Overarching theme for Mars 2020 instruments: make both visual/textural and mineralogical observations at a range of spatial scales from outcrop to sub-mm. Also need elemental chemistry and detection of reduced carbon.

Mars 2020 Rover



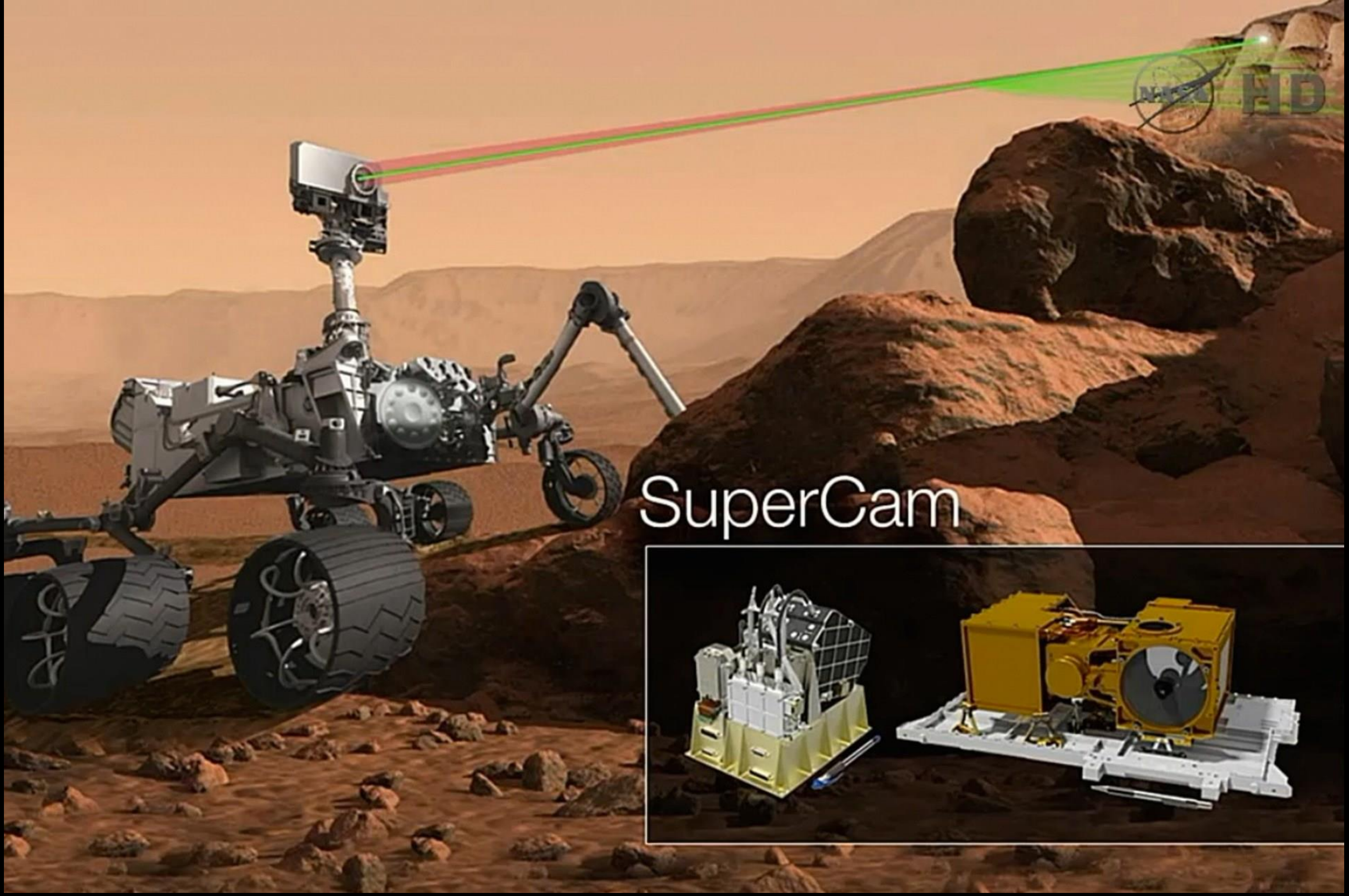
Mastcam-Z

A Geologic, Stereoscopic, and Multispectral Investigation for the NASA Mars-2020 Rover Mission



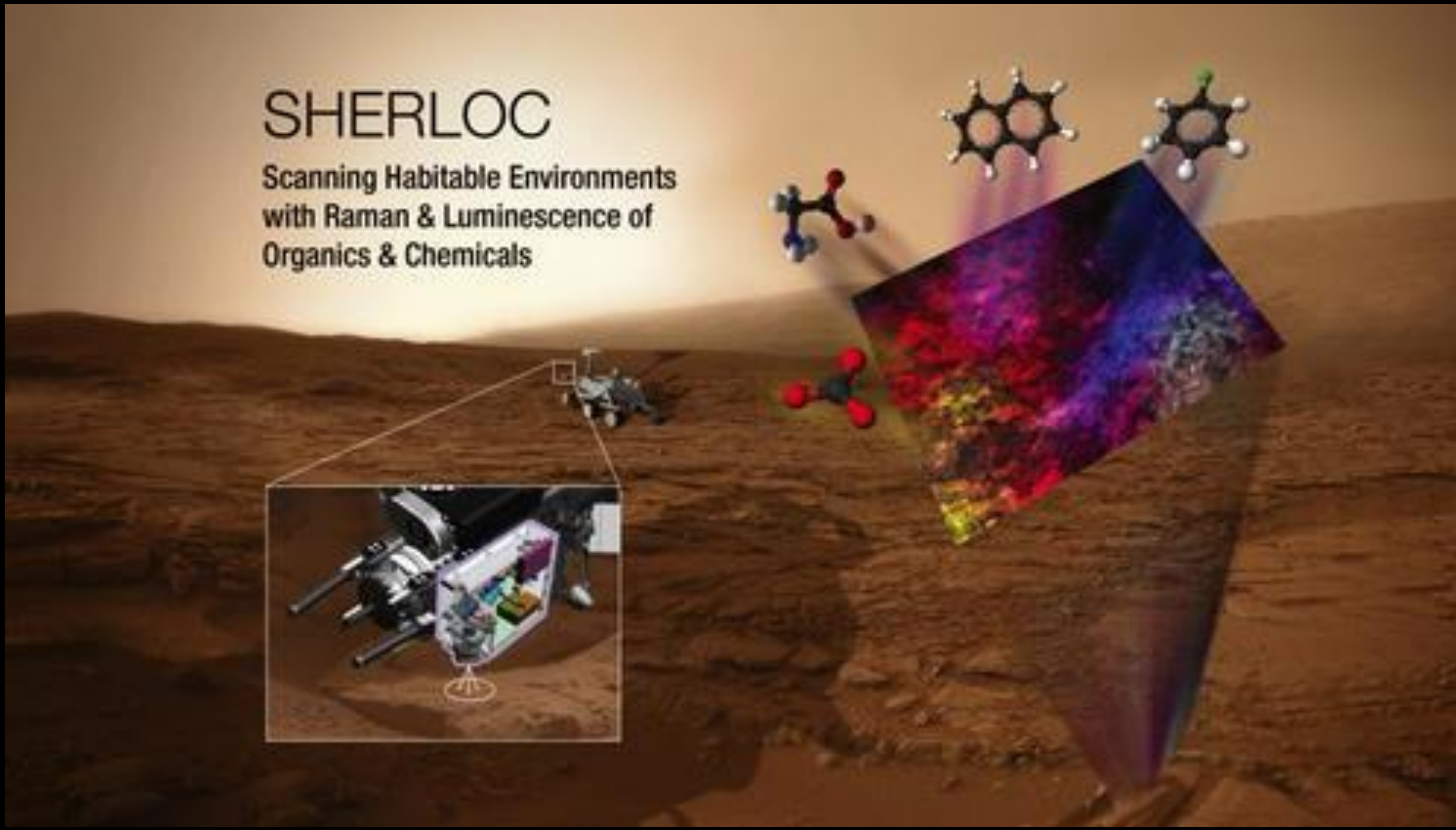
PI Jim Bell, ASU (with Malin Space Science Systems)

-improved stereo **zoom** camera with strong MSL heritage



PI Roger Wiens, LANL, with major French and Spanish involvement

- advancement on MSL Chemcam – has laser induced breakdown spectroscopy (LIBS) + remote Raman and fluorescence spectroscopy + visible and infrared spectroscopy + remote micro-imaging (“telescope”). **Goal is remote mineralogy and chemistry, including organic detection.**

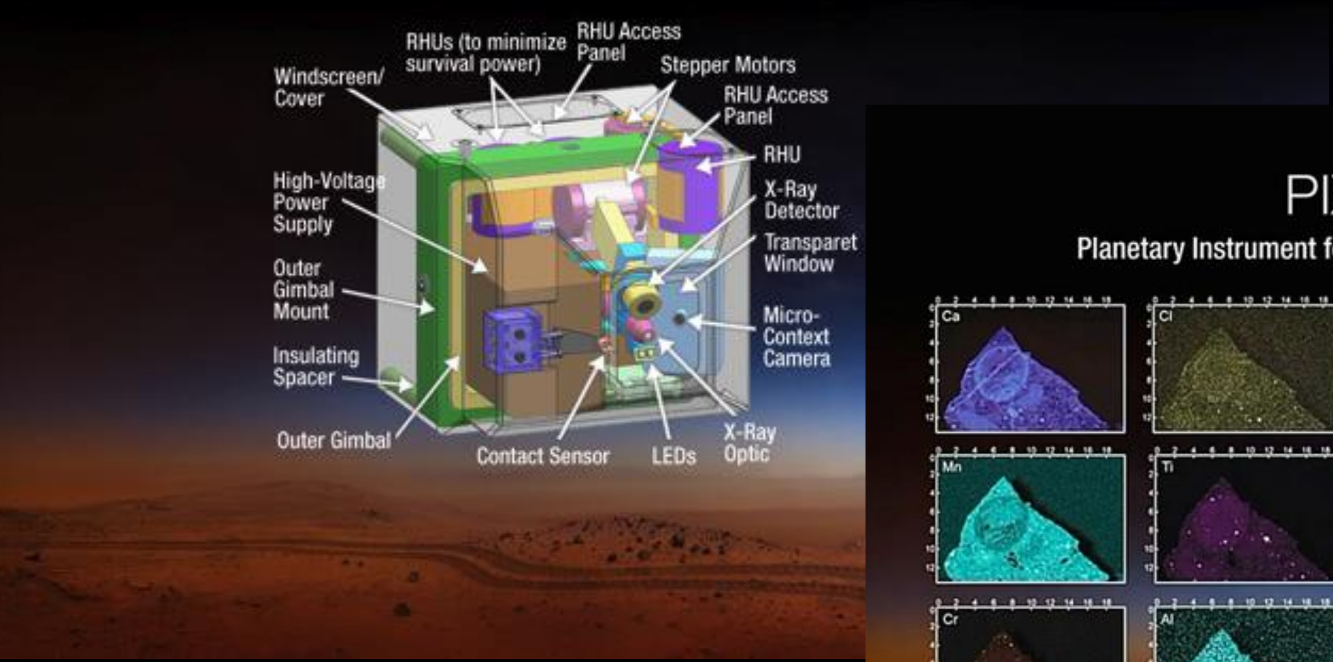


PI Luther Beegle, JPL

- laser induced fluorescence and Raman spectroscopy to identify minerals and organic molecules, highly spatially resolved (~50 um scale)

PIXL Arm-Mounted Sensor Head

Planetary Experiment for X-Ray Lithochemistry



PI Abigail Allwood, JPL

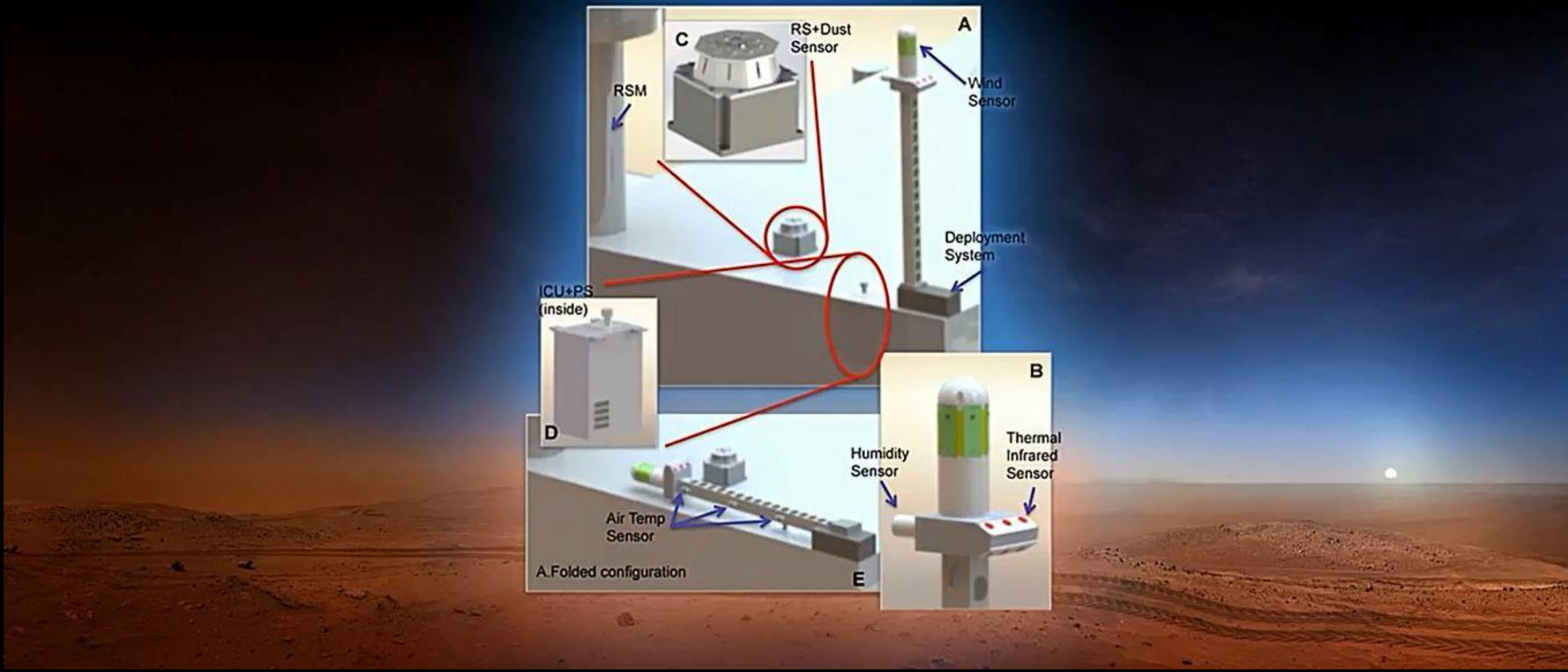
- x-ray fluorescence technique to measure rock chemical composition at the ~100 um scale.

PI Svein-Erik Hamran, Norway

- discover and map sub-surface geologic structure down to 500 m depth with ground-penetrating radar

MEDA

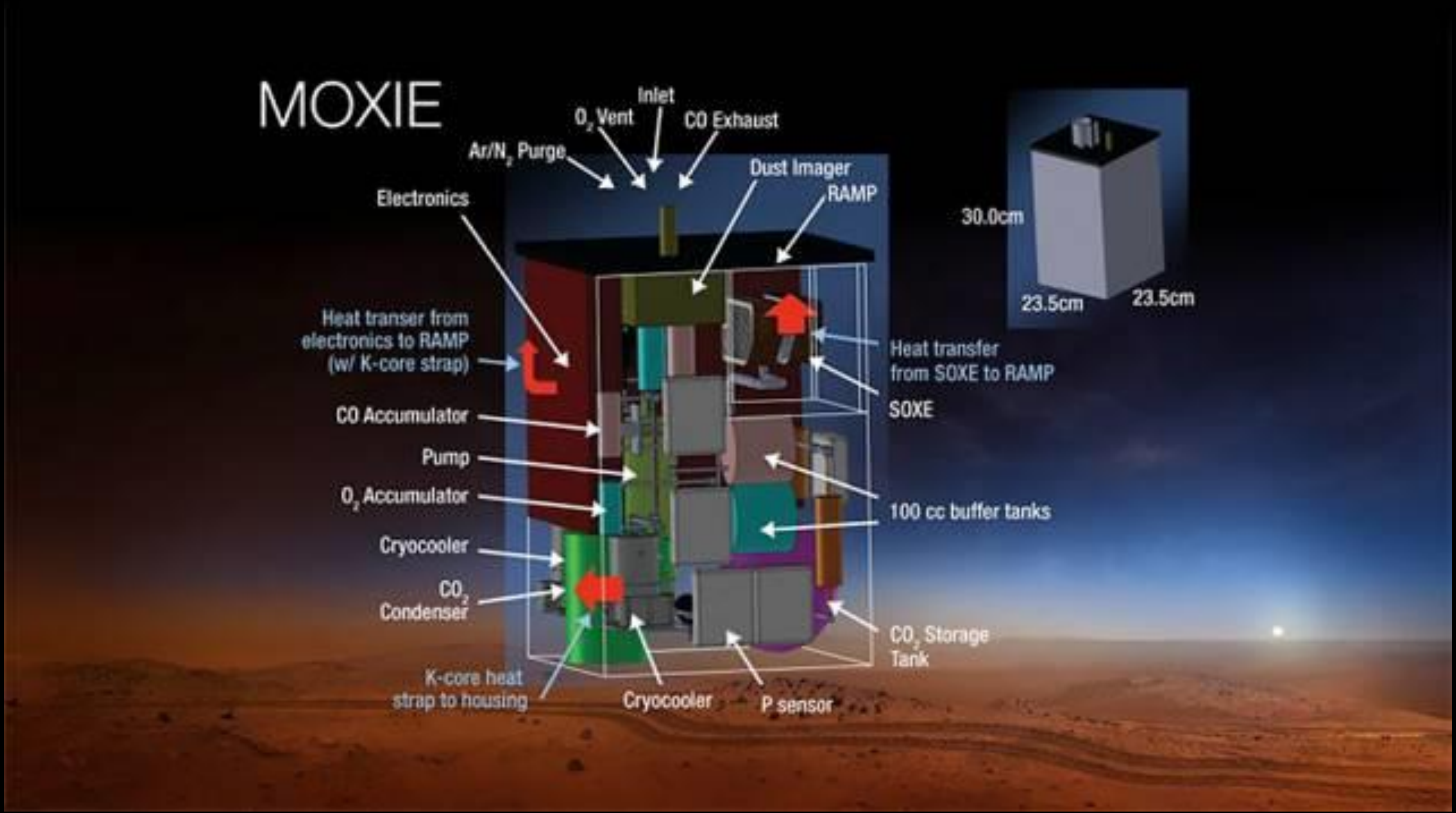
Mars Environmental Dynamics Analyzer



PI Jose Rodriguez Manfredi, CAB Madrid, Spain

- temperature, humidity, wind, dust analyzer with strong Mars mission heritage

Mars Oxygen ISRU Experiment



PI Michael Hecht, MIT with JPL build

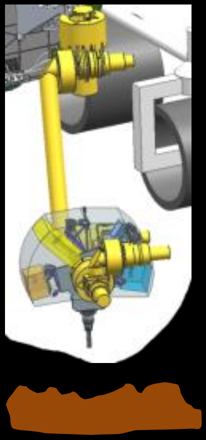
-convert CO_2 to O_2 as possible future resource (oxidant); Human Exploration and Operations Directorate contribution

Returned Sample Science

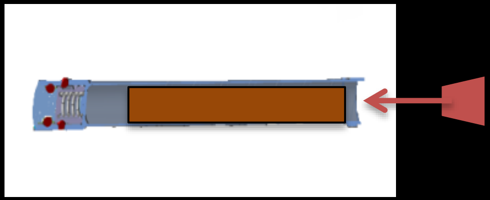
Lead: David Beaty (JPL)

Step 1: Intensive study of region of interest with in-situ instruments, including of abraded surfaces for maximum science return

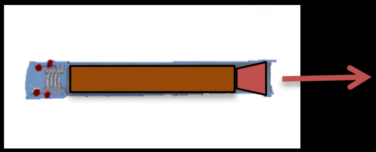
Step 2: Sample site selection, drilling, caching



1) Rover would drill a core of pencil-like thickness, 5 cm long, directly into a clean tube



2) Tube would be hermetically sealed



cache

3) Sealed tube would be cached

Note: core not visible to science instruments; no proxy core capability but will have science access to both drill hole and tailings

New Sample Caching Approach: Adaptable Cache

What:

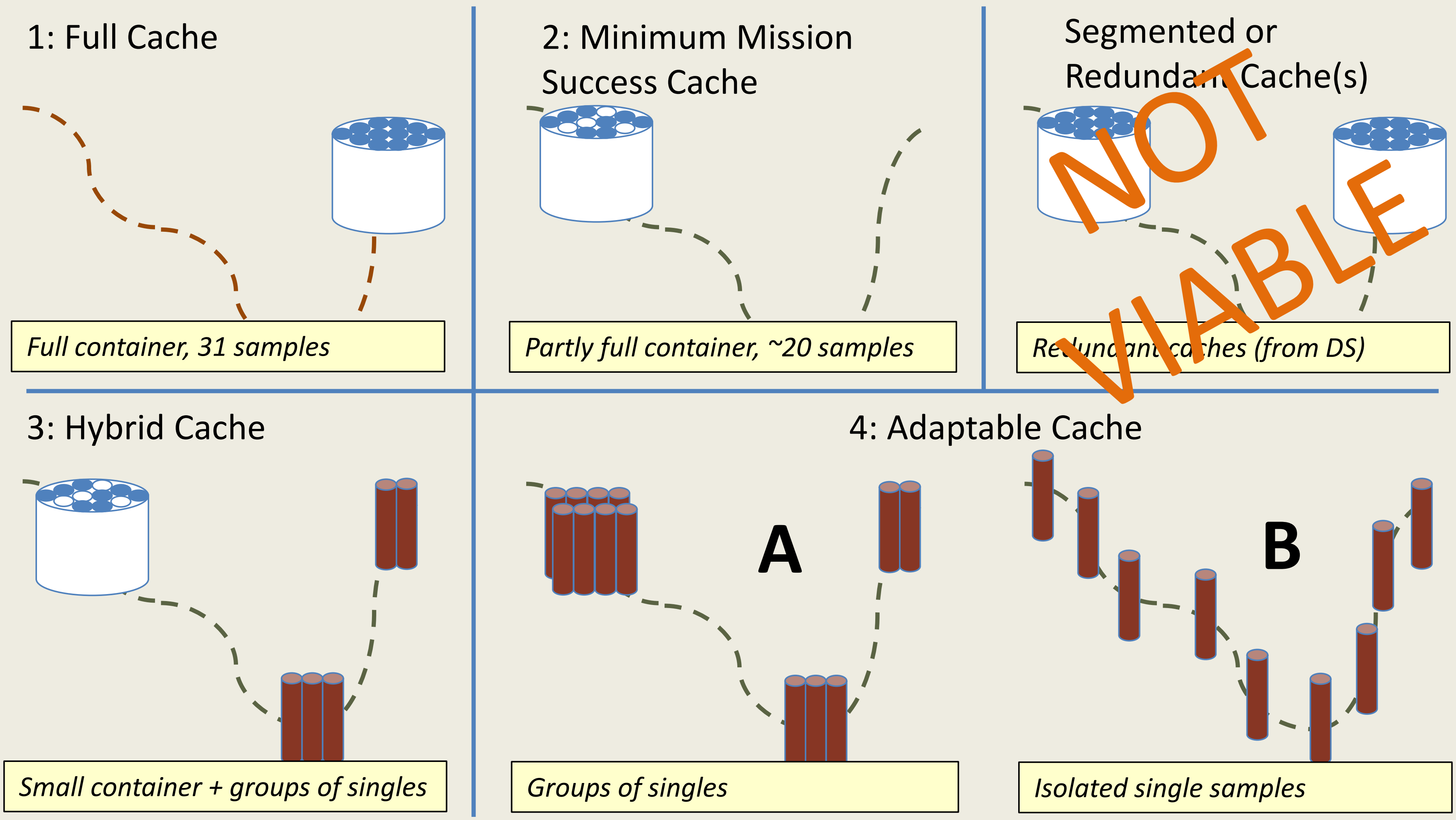
- rather than fill a single container and place it on the ground when it is adequately full, the new Mars 2020 plan is to place individual samples or groups of samples on the surface for possible future pick-up

Why:

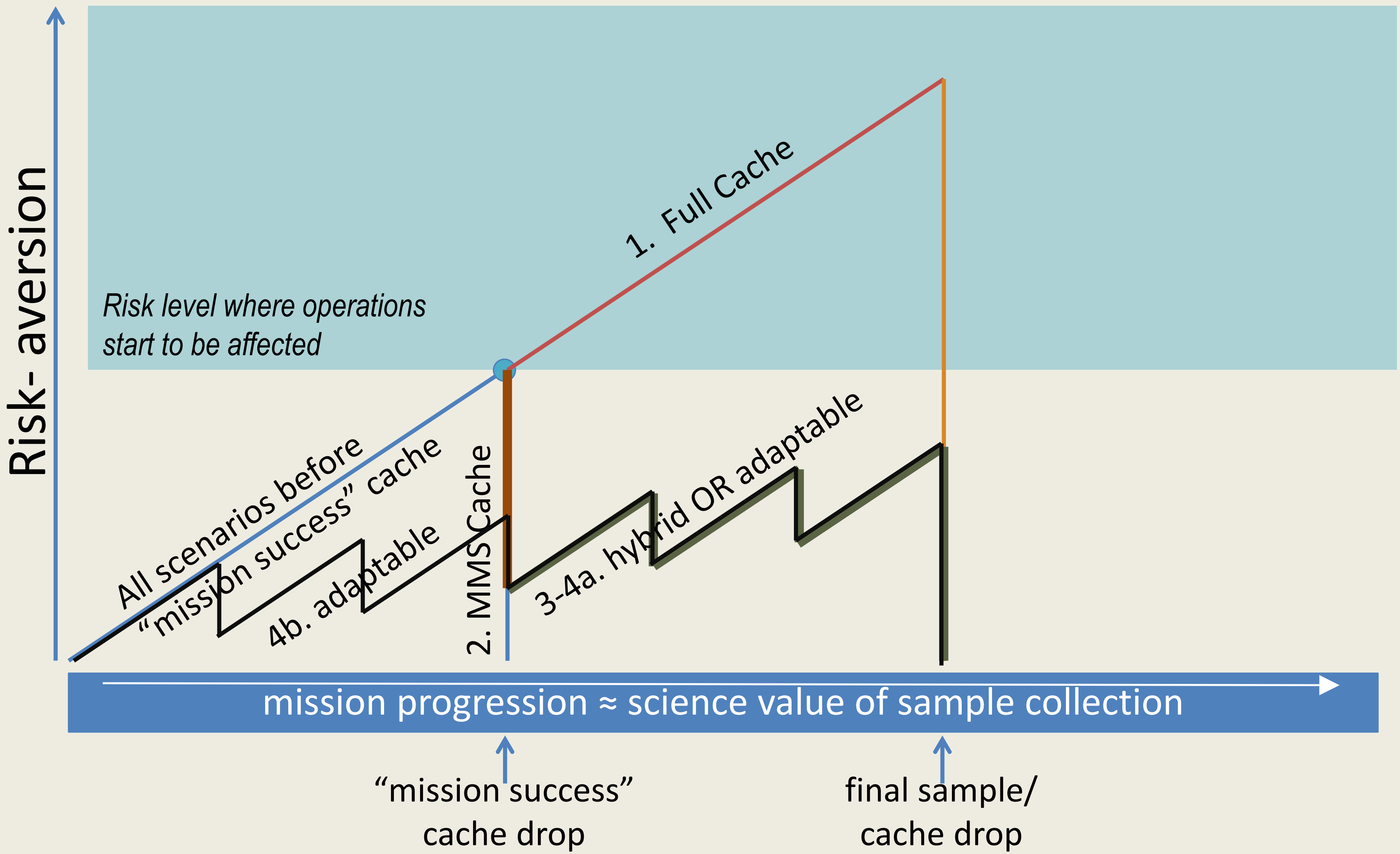
- improves potential science return
- improves the evolution of mission risk as the number of samples increases
- across Mars 2020 and possible return mission, reduces engineering complexity

After detailed study of science and engineering considerations, MPO recommended, and NASA HQ approved, the adaptable cache. This approach is now the Mars 2020 baseline.

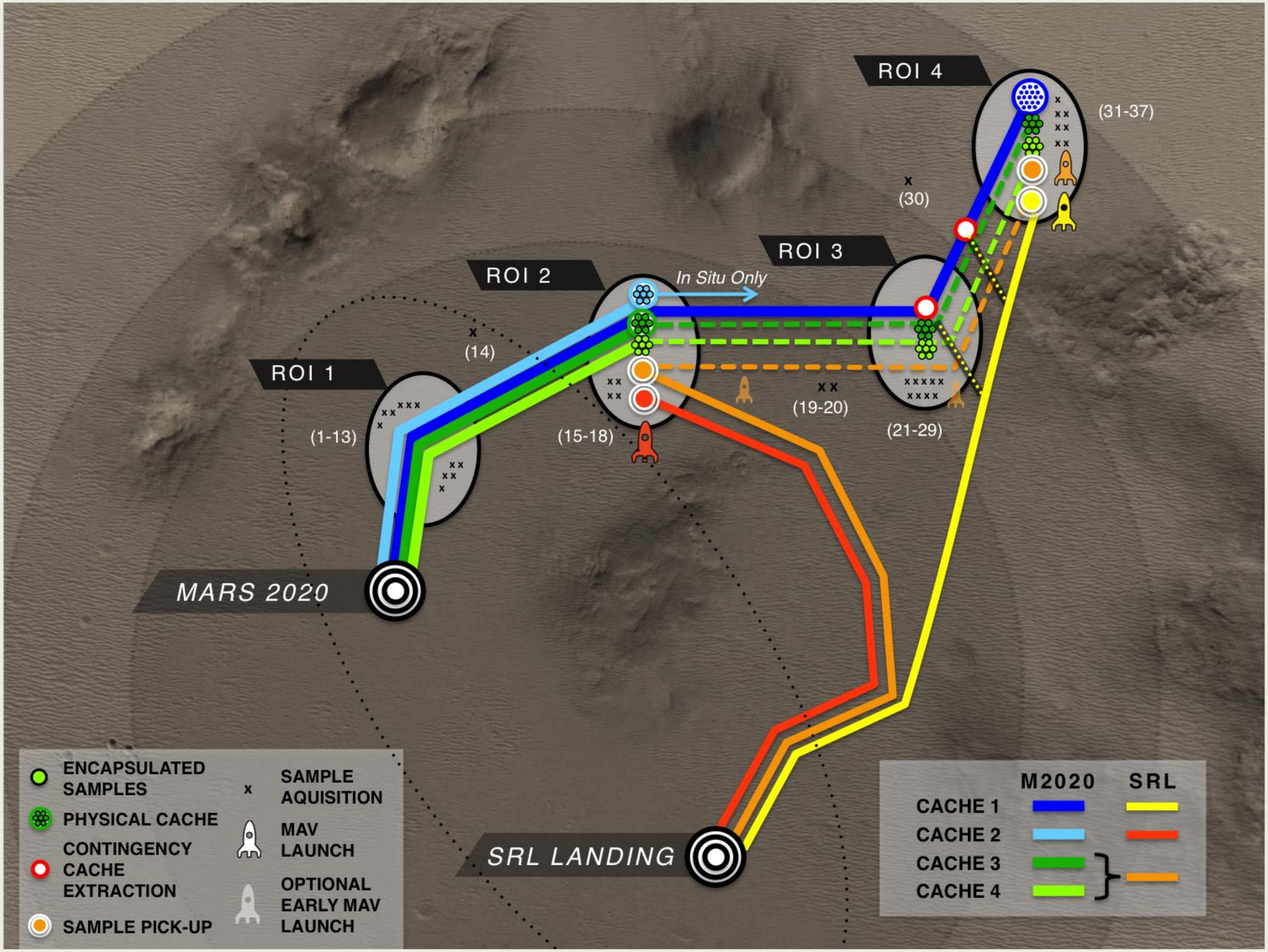
Possible Mars 2020 Caching Scenarios



Cache Risk Evolution



Traverse & Sampling Scenarios



Pros and Cons of Adaptable Cache

Pros:

1. Cache risk minimized, so would not dominate rover operations
2. All tubes on board rover could be filled and made available for possible return
3. “Best” samples for return could be identified when all science data is fully digested
4. No need to return inferior samples with “best” samples.
5. Caching system somewhat simpler for Mars 2020
6. Retrieval mission need not deal with “dead” Mars 2020 rover

Cons:

1. Maximum temperature of samples may be increased above desired science goal
2. Greater traverse potentially required for retrieval mission
3. Retrieval mission must be able to locate and transfer tubes from surface into MAV

Mars 2020 Second Landing Site Workshop (LSW2)

- Mars 2020 science team is working to understand how science observations will meet science objectives, and how both science objectives and capabilities are affected by landing site selection. This will be a focus of the second Mars 2020 Project Science Group meeting next month, and will help inform LSW2.

- further discussion of LSW2 later in the meeting.

Mars 2020 Project Update:

Capabilities

1. <u>Turret Imager.</u> Project studied options and recommended inclusion to NASA HQ.
   - will serve science, engineering, and outreach objectives

2. <u>Engineering Cameras.</u> New design with color and higher resolution to replace MSL navcam/hazcams

3. <u>Three New EDL Cameras.</u> Rover-mounted looking at descent stage; descent stage-mounted looking at rover; backshell-mounted looking at cruise stage/parachute.

4. <u>Terrain Relative Navigation during EDL.</u> Recommended to NASA HQ.

4\. <u>Nuclear Power Source.</u> NEPA process completed, nuclear power source approved.

Mars 2020 Project Update:

Challenges

1. Planetary Protection. Current intensive focus on requirements definition with Planetary Protection Office.

2. Operational Efficiency. Many enhancements under consideration to ensure that all science objectives can be met in nominal mission.