

## Overview of the Mars 2020 Mission

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The proposed Mars 2020 rover mission has three scientific objectives: 1) to characterize the geology of the landing site; 2) to identify and study ancient habitable environments, and in them, to assess the preservation potential for, and the presence of, biosignatures; and 3) to prepare a cache of scientifically-selected and well-documented samples for possible future return to Earth. The Mars 2020 Science Definition Team (SDT; Mustard et al., 2013) proposed a suite of measurement capabilities that would simultaneously meet the needs of these three objectives, with an overarching theme of making both visual/textural and mineralogical/chemical observations at a range of spatial scales from outcrop to sub-mm. The SDT recognized that these measurements could be enhanced with capabilities to characterize organic matter and to image subsurface structure. In addition to the science goals, the mission would seek to advance technologies and knowledge required for future missions, including possible human exploration of Mars.

NASA recently selected a payload of seven investigations for Mars 2020. Several of the investigations are centered around enhanced versions of instruments flown on previous missions, while others provide completely new observational capabilities. Two instruments on the rover mast would provide critical remote-sensing data at the outcrop scale and beyond. *Mastcam-Z* (PI Jim Bell, ASU) consists of a pair of panoramic cameras for broadband color imaging as well as for narrow-band spectral studies from the visible to the near IR. An important enhancement over the original Mastcam on the Mars Science Laboratory (MSL) mission is a 28-100 mm stereo zoom capability. Mastcam-Z will be the rover's main way to explore its surroundings at a range of spatial scales. Also mounted on the mast will be *SuperCam* (PI Roger Wiens, LANL), a descendent of ChemCam on MSL. Like ChemCam, SuperCam includes laser-induced breakdown spectroscopy for remote sensing of elemental compositions and a telescopic imager (updated to include color). SuperCam also has completely new capabilities including Raman spectroscopy and time-resolved fluorescence spectroscopy for remote mineral identification. SuperCam also includes a Vis-IR point spectrometer for determining mineralogy.

Two entirely new instruments on the rover arm will characterize rock and mineral composition at the thin-section scale. The Planetary Instrument for X-ray Lithochemistry (*PIXL*, PI Abigail Allwood, JPL) uses x-ray fluorescence to quantify and map the major and minor element composition of natural or abraded rock surfaces with sub-mm resolution. This analytical capability is complemented by those provided by *SHERLOC* (Scanning Habitable Environments with Raman & Luminescence for Organics & Chemicals; PI Luther Beegle, JPL). SHERLOC uses deep UV spectroscopy (Raman and

fluorescence) to detect, classify and map minerals and possible organic compounds, with a spatial resolution of 50  $\mu\text{m}$ . SHERLOC includes a microscopic imager that will place these measurements in context with visible structures and textures.

Subsurface structure beneath the rover, produced by bedding planes and other sources of compositional or density contrast, will be imaged with *RIMFAX* (Radar Imager for Mars' subsurFAce eXperiment; PI Svein-Erik Hamran, FFI, Norway). This ground penetrating radar is designed to image objects as small as  $\sim 10$  cm and extending to depths of up to a few hundred meters.

*MEDA* (Mars Environmental Dynamics Analyzer, PI Jose Rodriguez-Manfredi, Centro de Astrobiologia, Spain) expands on the REMS weather station aboard MSL as well as the TWINS station scheduled to fly on the InSight mission. This instrument package is mounted to the rover deck and the mast and will characterize temperature, relative humidity, wind velocity, atmospheric pressure, solar irradiation, and dust properties to inform Mars weather and climate models.

The final investigation aboard Mars 2020 is *MOXIE* (Mars Oxygen ISRU Experiment; PI Michael Hecht, MIT). This facility, contained within the body of the rover, seeks to demonstrate the capability to convert atmospheric carbon dioxide to oxygen using a solid oxide electrolyzer. Production of vital resources like  $\text{O}_2$  from commonly available materials on Mars is a key step towards future human exploration of Mars.

The proposed mission takes maximum advantage of heritage derived from the Mars Science Laboratory mission and its highly capable Curiosity Rover. The new rover's destination on Mars will be determined by a community-driven landing site selection process; the first of several landing site selection workshops was held in May 2014, with the next likely occurring in May 2015. The mission is planned for launch in summer of 2020 with arrival at Mars six months later, followed by a two year prime mission.