

Statement of

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before the

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Committee on Science, Space and Technology
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Thank you for the opportunity to testify today on the Mars 2020 mission.

I have been Mars 2020 project scientist since the mission's inception in early 2013. While I vividly recall my excitement and awe at the first Viking images of the surface of Mars scrolling slowly down a TV screen when I was a child, leading the science team on a future Mars mission was not something I could have pictured until recently. Trained in chemistry and Earth science, I spent most of my career developing lab techniques to interrogate the chemistry of small rock and mineral specimens for what they can tell us about the past. In 2011, I had the opportunity to join the Curiosity science team to do the same kind of work on Mars, specifically to attempt the first radiometric dating of rocks undertaken beyond Earth. The combination of Mars mission experience and an understanding of laboratory analysis of small samples put me in a perfect position to contribute to a mission involving both Mars exploration, and collection of samples that might someday be analyzed on Earth.

Mars 2020 will seek evidence of past life in a fossil Earth-like environment that existed in the first billion years after the dawn of the solar system. This flagship mission will engage many hundreds of scientists and the American public in a very challenging journey through one of the most intriguing landscapes in the solar system and some of the most profound scientific questions of our time.

Today Mars is too cold, too dry, and too exposed to harmful radiation to plausibly nurture life on its surface. However, more than two decades of sustained and strategic NASA-led exploration have shown that the red planet was once very different. Imagery from the Mars Odyssey and Mars Reconnaissance Orbiters reveals that prior to about 3.6 billion years ago, Mars had rivers, lakes, and possibly a vast northern ocean. Sophisticated analyses made on the planet's surface, most notably by the Spirit and Curiosity rovers, have richly documented ancient environments with all conditions believed necessary to sustain life. In that same early time period, conditions here on Earth were broadly similar, and life had already originated, evolved, and spread across the surface. However, unlike Earth, with its active erosion and plate tectonics, the geologic record of ancient Mars is exquisitely preserved for study, allowing us to seek answers to grand questions including how early climate and habitability evolve on rocky planets, the nature of prebiotic environments that might ultimately spawn life, and whether life is unique to Earth.

Seeking the signs of life in an ancient habitable environment is the central goal of the Mars 2020 mission. Thanks to a wealth of images from the Mars Reconnaissance Orbiter, the science

community has narrowed possible Mars 2020 landing sites down to three very different settings that on Earth are both habitable and inhabited: an ancient river and lake system, a fossil hot spring similar to those at Yellowstone National Park, and a setting where warm water once circulated through shallow subsurface rocks. Once on Mars, the rover will use its on-board instruments to investigate the local geology, to characterize the habitable environments the rover traverses, and to look for evidence of ancient life. Using Earth as a guide, we expect that any Martian life existing at that time was primitive, consisting only of microbes. Truly definitive discovery of microbial biosignatures by instruments on board the rover is unlikely, and can best be undertaken using the full arsenal of terrestrial laboratories. For this reason the Mars 2020 rover will prepare a complete suite of samples for possible return to Earth by a future mission.

Mars 2020 starts with the designs of the remarkably successful Mars Science Laboratory (MSL) mission and the Curiosity rover. To this platform a suite of very capable new science instruments is being added to explore the structure, chemistry, and mineralogy of the surface all the way from the regional scale down to the microscopic scale. In addition, the mission is developing advanced new capabilities for landing in rugged terrain, for autonomous navigation and science observation, and for robotic coring and caching of samples. These are critical steps towards unleashing the full capabilities of robotic solar system investigation. The mission will also test new technologies beneficial to future human Mars exploration, most notably a device to demonstrate conversion of carbon dioxide in the Martian atmosphere into oxygen for use as a component of rocket propellant. The mission is currently in the implementation phase (Phase C) with a substantial amount of hardware already completed. Launch will occur in the summer of 2020, with arrival on Mars on February 18, 2021. The rover will be landed using the spectacular sky-crane system pioneered by MSL, and will explore the Martian surface for at least two years. In that period the rover will core and cache at least twenty rock samples, each about the size and shape of a piece of chalkboard chalk. These will be thoroughly documented and placed on the surface, accessible to retrieval by a future mission or even by human explorers. By collecting and caching a diverse suite of high science-value rock samples, Mars 2020 fulfills the highest priority objectives of the Mars and planetary science communities as described in the most recent Planetary Science Decadal Survey (2013).

Mars 2020 will investigate a planet known with detail sufficient to compellingly address, for the first time, well-posed and profound scientific questions that would forever elude answers from Earth-bound study. Going well beyond observations on the Martian surface, return of the cache to terrestrial laboratories would provide future generations of scientists across many disciplines access to samples that would transform our understanding of Mars, the solar system, and life. There is still an enormous amount to learn about Mars, and the deeper we penetrate, the richer the scientific tapestry becomes. Mars 2020 makes the next big step in this decades-long journey, and provides new focus and foundation for human exploration of Mars.

It's an honor and a privilege for me to play a part in such a grand and ambitious undertaking. I look forward to your questions.