The Mars 2020 Mission

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Caroline described the Mission launched 30 Jul 2020 and the events since Perseverance Rover landed on Mars 18 Feb 2021. The talk focussed on the scientific objectives, reasons for landing in the Jezero crater, what the Rover is and will be doing. The first 100 days of the mission were devoted to testing and commissioning.

A key objective was to land on an area that was flat and also relatively old part of the crust (first billion years?) and hence might contain evidence for early life before Mars lost its water. Jezero crater was selected as it appeared to contain a variety of sedimentary, igneous, hydrothermal and impact units, hence a likely range of both geochemistry and age, plus evidence of river channels, a delta and distal delta remnants i.e. an aqueous environment.

An ultimate aim is for a subsequent mission to collect the samples and return them to Earth. The return of some igneous rocks will be particularly important for geochronology but a key difference compared to Earth is that we do not have unaltered sedimentary rocks from around 4Ga, so any evidence of early life would prove that it was not unique to Earth.

Each instrument on board the Rover is itself a fantastic piece of miniature technology, but the combination of data from multiple instruments (laser, Raman, UV and X-ray spectrometers) for identification of lithology and organic molecules, plus the coring and core retention capability, helicopter observation etc) will provide unprecedented mineralogical and biological data from the planet.

A particularly interesting aspect of the geochemical spectrometer is that it uses a slice of an NHM Martian meteorite as a calibration standard for SHERLOC - a UV spectrometer. Other test objects on board include various samples of space suit materials to see how they perform in a Martian atmosphere over the long term. Another experiment unique to the Rover is MOXIE which is designed to test if oxygen can be produced from the Martian atmosphere. To date, a variety of sizes and colours of boulders can clearly be seen within the crater.

The international science team probably numbers about a thousand scientists and engineers, supported by and using data from highly innovative, miniaturised instruments. However, not all instruments can be miniaturised for extra-terrestrial use and so the cached samples, it is hoped, will be retrieved and returned to Earth by around 2031, with strong European (ESA) input, taking great attention to detail as far as possible contamination is concerned, in both directions.

Discussion

Q: It has been reported that there are caves on Mars (lava tubes?), is this true?
A: Not as far as is known; but in any case, the Rover is not able to go into a cave. However, in future, it would theoretically be possible for the helicopter.

Q: Regarding the long discussions about the payloads, if you as a petrologist particularly interested in the age of Martian rocks for subsequent return to Earth, what would your choice of instrument have been?
A: Probably an instrument called KARLI for K-Ar dating; this is at the prototype stage now but which may well be used on future missions to the Moon.

Q: With respect to the delta remnants in the crater, what are the processes that created these remnants and where has the eroded material gone?
A: Current thinking is that a lake formed followed by a catastrophic break which scoured a lot of the deltaic material.

Q: Who is leading on the sedimentological or geomorphological aspects of the research?
A: Bryony Horgan is one author who has published a paper, also Catherine Morgan and Bethany Ehlmann.

Q: What is the timeline to confirm a biological signal or does this have to wait until samples are returned to Earth?
A: If all the instruments are working, with data from clean, flat surfaces, then biosignatures should be recognised with a high degree of confidence.

John Bennett