SAMPLE

Solar System Missions: ExoMars

Europe's Mars Program

Aira Astralis

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Contents

Introduction

Chapter 1: The Discovery of ExoMars

Chapter 2: Understanding ExoMars

Chapter 3: Key Characteristics of ExoMars

Chapter 4: The Science Behind ExoMars

Chapter 5: Observation and Measurement of ExoMars

Chapter 6: Important Features of ExoMars

Chapter 7: ExoMars in Context

Chapter 8: Modern Understanding of ExoMars

Chapter 9: Research and Exploration of ExoMars

Chapter 10: Significant Discoveries About ExoMars

Chapter 11: Challenges and Mysteries of ExoMars

Chapter 12: Future Directions in ExoMars Research

Chapter 13: Fun Facts and Trivia About ExoMars

Chapter 14: Conclusion: The Significance of ExoMars

Conclusion

This free sample contains the Introduction and Chapter 1. The complete book contains the full contents above.

Introduction

ExoMars (Exobiology on Mars) is an astrobiology programme of the European Space Agency (ESA) composed of the Trace Gas Orbiter (TGO), the Schiaparelli lander, and a future rover Rosalind Franklin. The goals of ExoMars are to search for signs of past life on Mars, investigate how the Martian water and geochemical environment varies, investigate atmospheric trace gases and their sources and, by doing so, demonstrate the technologies for a future Mars sample-return mission. The first part of the programme is a mission launched in 2016.

The Trace Gas Orbiter (TGO) and a test stationary lander called Schiaparelli

(designed to test new key technologies to safely deliver the subsequent rover mission) were launched on 14 March 2016. TGO entered Mars orbit on 19 October 2016, and proceeded to map the sources of methane (CH_4) and other trace gases present in the Martian atmosphere that could be evidence for possible biological or geological activity. The TGO features four instruments and acts as a communications relay satellite.

The Schiaparelli experimental lander separated from TGO on 16 October and was maneuvered to land in Meridiani Planum, but it crashed on the surface of Mars. The second part of the programme was planned to launch in early 2020s, when a Russian lander named Kazachok was due to deliver the ESA's Rosalind Franklin rover to the Martian surface. The rover would also include some Roscosmos built instruments. On 17 March 2022, ESA suspended the mission due to the ongoing invasion of Ukraine by Russia.

In April 2024, the mission received new funding to restart construction and delivery of the Rosalind Franklin rover using a new European landing platform and NASA has agreed to provide the launch, currently scheduled for late 2028. The second mission operations and communications will be led by ALTEC's Rover Control Centre in Italy.

The programme's name states its ambition plainly: exobiology on Mars. Of all the questions a spacecraft can ask next door, the one ExoMars was built for is the oldest and hardest, whether Mars has ever harboured life, and it pursues it from two directions at once. From orbit, the Trace Gas Orbiter reads the planet's thin air for gases that would betray ongoing biology or geology beneath the surface; on the ground, the Rosalind Franklin rover is designed to do what no lander has done before, drill two metres deep and pull up samples that radiation has never touched. Between those two efforts sits everything this book is about: the instruments, the politics, the partnerships that fell apart and re-formed, the test lander that crashed and the lessons it bought, and the

quiet accumulation of discoveries that a spacecraft circling Mars has been sending home for nearly a decade.

Chapter 1: The Discovery of ExoMars

Originally conceived as a rover with a stationary ground station, ExoMars was planned to launch in 2011 aboard a Russian Soyuz Fregat rocket. ExoMars began in 2001 as part of the ESA Aurora program for the human exploration of Mars. That initial vision called for rover in 2009 and later a Mars sample-return mission. Another mission intended to support the Aurora program is a Phobos sample return mission.

Aurora itself is worth pausing on, because everything ExoMars became was shaped by it. Launched as an optional ESA programme, Aurora let each member state choose whether to contribute, and how much, which made ExoMars a mission assembled less by a single nation's resolve than by an ongoing diplomatic negotiation, with all the fragility that implies. The plan of 2005 already contained the seeds of everything that followed: a rover with a drill, a set of life-detection instruments known as the Pasteur payload, and a launch date, 2011, that would prove the first of many. What no planner in that room could have foreseen was the route the mission would take to the pad, through an American partnership that would collapse, a Russian one that would be destroyed by war, and a final rescue that would see NASA lend the rocket while Europe kept the dream.

In December 2005, the different nations composing the ESA gave approval to the Aurora program and to ExoMars. Aurora is an optional program and each state is allowed to decide which part of the program they want to be involved in and to what extent (e.g.

The Aurora program was initiated in 2002 with support of twelve nations: Austria, Belgium, France, Germany, Italy, the Netherlands, Portugal, Spain, Sweden, Switzerland, the United Kingdom and Canada In 2007, Canadian-based technology firm MacDonald Dettwiler and Associates Ltd. Astrium was also contracted to design the final rover.

In July 2009 NASA and ESA signed the Mars Exploration Joint Initiative, which proposed to use an Atlas rocket launcher instead of a Soyuz, which significantly altered the technical and financial setting of the ExoMars mission.

On 19 June, when the rover was still planned to piggyback the Mars Trace Gas Orbiter, it was reported that a prospective agreement would require that ExoMars lose enough weight to fit aboard the Atlas launch vehicle with a NASA orbiter.

Then the mission was combined with other projects to a multi-spacecraft mission divided over two Atlas V-launches: the ExoMars Trace Gas Orbiter

(TGO) was merged into the project, piggybacking a stationary meteorological lander slated for launch in January 2016. It was also proposed to include a second rover, the MAX-C. In August 2009 it was announced that the Russian Federal Space Agency (now Roscosmos) and ESA had signed a contract that included cooperation on two Mars exploration projects: Russia's Fobos-Grunt project and ESA's ExoMars.

Specifically, ESA secured a Russian Proton rocket as a "backup launcher" for the ExoMars rover, which would include Russian-made parts. On 17 December 2009, the ESA governments gave their final approval to a two-part Mars exploration mission to be conducted with NASA, confirming their commitment to spend ?850 million ($1.23 billion) on missions in 2016 and 2018.

In April 2011, because of a budgeting crisis, a proposal was announced to cancel the accompanying MAX-C rover, and fly only one rover in 2018 that would be larger than either of the vehicles in the paired concept. One suggestion was that the new vehicle would be built in Europe and carry a mix of European and U.S. NASA would provide the rocket to deliver it to Mars and provide the sky crane landing system.

Despite the proposed reorganisation, the goals of the 2018 mission opportunity would have stayed broadly the same. Under the FY2013 Budget President Obama released on 13 February 2012, NASA terminated its participation in ExoMars due to budgetary cuts to pay for the cost overruns of the James Webb Space Telescope. With NASA's funding for this project completely cancelled, most of these plans had to be restructured.

On 14 March 2013, representatives of the ESA and the Russian space agency (Roscosmos), signed a deal in which Russia became a full partner. Roscosmos would supply both missions with Proton launch vehicles with Briz-M upper stages and launch services, as well as an additional entry, descent and landing module for the rover mission in 2018. Under the agreement, Roscosmos was granted three asking conditions: Roscosmos would contribute two Proton launch vehicles as payment for the partnership.

The Trace Gas Orbiter payload shall include two Russian instruments that were originally developed for Fobos-Grunt. All scientific results must be intellectual property of the European Space Agency and the Russian Academy of Sciences (i.e. Roscosmos would have been be part of all the project teams and would have had full access to research data). ESA had originally cost-capped the ExoMars projects at ?1 billion, (USD 1.3 billion) but the withdrawal of the U.S.

So in March 2012, member states instructed the agency's executive to look at how this shortfall could be made up. One possibility was that other science

activities within ESA may have to step back to make ExoMars a priority. In September 2012 it was announced that new ESA members, Poland and Romania, would be contributing up to ?70 million to the ExoMars mission.

ESA has not ruled out a possible partial return of NASA to the 2018 portion of ExoMars, albeit in a relatively minor role. Russia's financing of ExoMars was to be partially covered by insurance payments of 1.2 billion roubles (US$40.7 million) for the loss of Fobos-Grunt, and reassigning funds for a possible coordination between the Mars-NET and ExoMars projects. On 25 January 2013, Roscosmos fully funded the development of the scientific instruments to be flown on the first launch, the Trace Gas Orbiter (TGO).

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ABOUT THE AUTHOR

Aira Astralis is a science writer specializing in astronomy and space exploration. Her work spans the full breadth of humanity's relationship with the cosmos -- from the earliest naked-eye observations to the engineering marvels of modern space missions.

Her books are built on a foundation of primary sources: peer-reviewed research, mission archives, and direct engagement with the scientific community. She writes for readers who want to understand not just what we know about the universe, but how we came to know it.

She believes that the most important frontier is not out there but in the gap between what scientists discover and what the public understands. Her books exist to close that gap.