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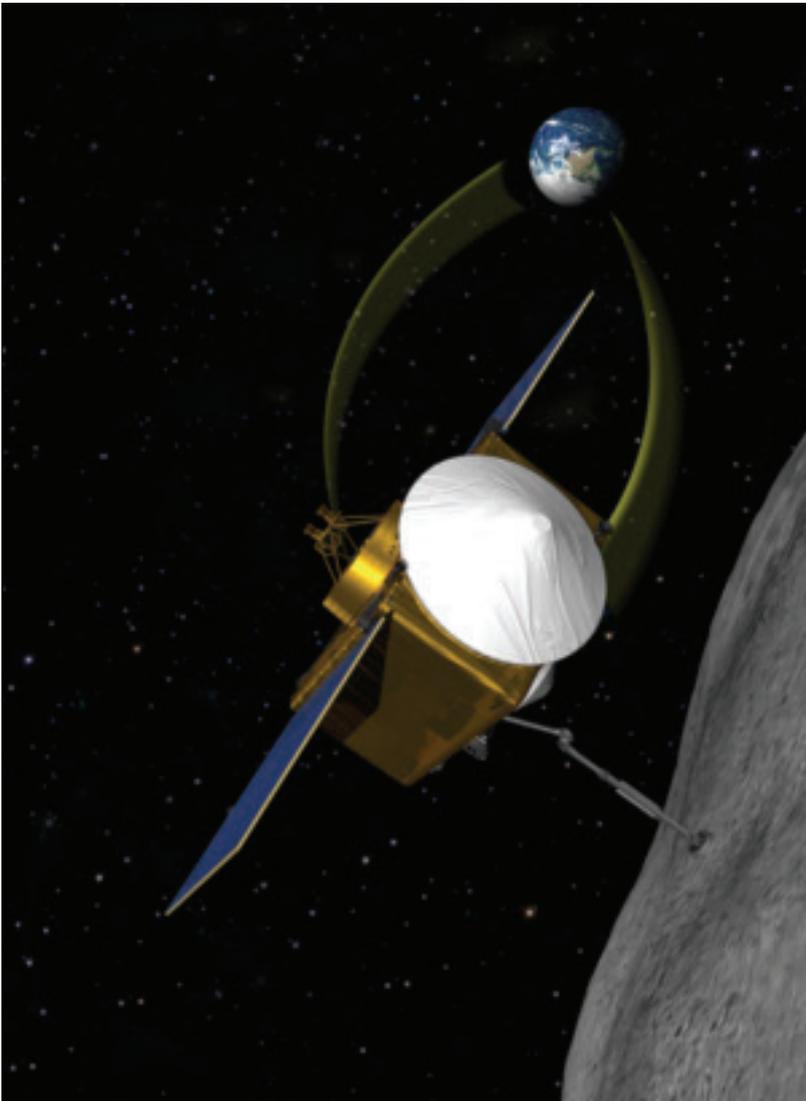
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Space environmental systems

Missions to asteroids, Earth orbit, and the Moon highlighted the activities of the interplanetary space community this year. Technical problems in the NASA Curiosity rover have the potential to create a two-year delay in the launch to Mars.

The NASA New Frontiers program picked the OSIRIS-REx (origins-spectral interpretation-resource identification-security-regolith explorer) to launch to asteroid 1999 RQ36 in 2016 on a mission that would return samples in 2023. The main purpose of the mission is to “shed light on the conditions of the infant solar system and how life emerged.” NASA Administrator Charles Bolden said, “This is a critical step in meeting the objectives outlined by President

OSIRIS-REx will travel to asteroid 1999 RQ36 in 2016 on a mission that would return samples in 2023.



Obama to extend our reach beyond low Earth orbit and explore into deep space.”

The University of Arizona is overseeing the mission with support from private industry and from NASA Goddard. This effort is an example of dual mission focus for the agency. Once the primary mission is completed and OSIRIS-REx has sent back asteroid material, the spacecraft itself will be redirected into a new solar orbit and will then be available to perform another mission in the future.

The Curiosity Mars rover was over budget and behind schedule at midyear. The NASA inspector general faulted project managers for routinely underestimating costs and calculated that adding an extra \$44 million to the development budget may be necessary to avoid another delay or cancellation. The \$44 million the report calls for is already on reserve and is included in the overall \$2.5-billion price tag. The possibility that the rover’s drill bit could contaminate the rock and soil samples it obtains and undermine the primary mission has been one of the major causes for concern. The mission would likely spend \$22 million from the reserves already set aside by NASA’s Science Mission Directorate. A two-year delay in Curiosity’s launch to Mars would significantly impact rover missions on the planet.

A Delta 2 rocket launched the SAC-D/Aquarius satellite into LEO in June on a mission to track changes in the amount of salt in the upper levels of the world’s oceans. This was the first of five United Launch Alliance missions scheduled for NASA this year. The Aquarius salinity sensor is a key success for the agency’s climate science program and will deliver the most detailed map ever made of the salt content of the Earth’s oceans.

A United Launch Alliance Delta II rocket carried the twin GRAIL (gravity recovery and interior laboratory) spacecraft into space in September on a mission to the Moon. GRAIL is taking its next big leap into deep space exploration with a mission that involves the formation flying of two spacecraft. NASA’s educational outreach programs are also part of the effort, which amounts to the start of a revolution in planetary science missions. Students will be able to image spots on the Moon. Former NASA astronaut Sally Ride’s educational program is heading the effort, with 600 teachers and students registered for the activity at www.moonkam.ucsd.edu. ▲