National Aeronautics and
Space Administration

JET PROPULSION LABORATORY

2013 ANNUAL REPORT

Contents

Cover: Voyager 1, now in interstellar space, as imagined by a rider on the boom carrying its magnetometer instruments.

JPL's main facility, at the foot of Southern California's San Gabriel Mountains.

Director's Message

How do you capture the essence of a year? For the editors of the Merriam-Webster Dictionary, the single word that summed up 2013 was "Science." That's because it was, in fact, the single most looked-up word on the dictionary's website during the year.

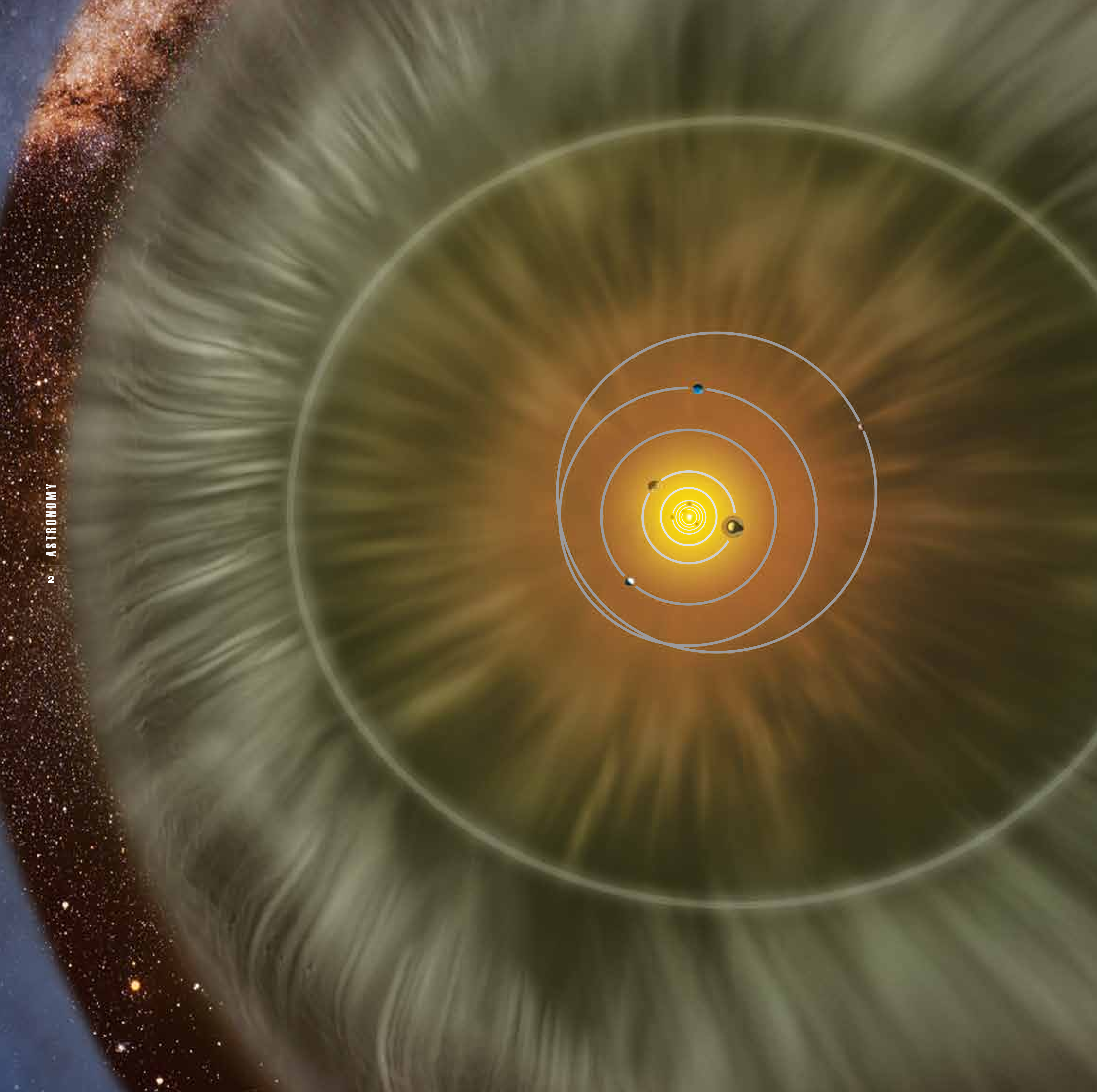
It was very gratifying to us that, in the coverage of this announcement, many news media pointed to our missions such as Voyager, Kepler, Spitzer, Jason and Mars Curiosity as examples of how strong science is in the public imagination. Of course, you could say that every year at JPL is a science year. And at the laboratory, you can't mention science without its sibling "Engineering" — all of the knowledge and capabilities that make the science possible.

Yet this was not the only sign of the impact of what we do on the culture at large. When Time magazine unveiled the 100 most influential people of the year, not one but three JPL people were on that list. This is a wonderful acknowledgement of what we do.

JPL exists to help pull the nation and the world into the future. We do this through the incredible talents of our people, and the infusion of ideas and abilities created by our identity as a part of both the NASA and Caltech families.

One of our employees who is profiled in the following pages said that at JPL, "We get to do things you can't do anywhere else in the world." That's why we are all here. I hope you will enjoy the stories of how they all lived those words in 2013.

The Orion Nebula, as viewed by the Wide-field Infrared Survey Explorer.



Into the Beyond

“Are we there yet?” That was the question Voyager scientists were asking themselves after decades of flight across billions of miles by the twin spacecraft. Finally, by September, the answer was: Yes!

“There” was the outer edge of the solar system — in technical terms, the heliopause, the zone where the bubble of charged particles enclosing the sun and planets gives way to interstellar space. By 2013 it was obvious that Voyager 1 had indeed become the first human-made object to enter the vast expanses between the stars.

It was hardly the first history-making milestone for the celebrated mission. Racing past the solar system’s four giant outer planets in the 1970s and 1980s, the Voyagers discovered rings at Jupiter and active volcanoes on Jupiter’s moon Io, teased apart the intricacies of Saturn’s rings, and got the first close looks at Uranus and Neptune.

To toast the interstellar event, TV’s Stephen Colbert invited Voyager project scientist Ed Stone on his show, where he presented Stone with NASA’s highest medal. Likening the historical impact of Voyager 1’s passage to Columbus’ arrival at America, Colbert quipped, “Do we get a day off and a mattress sale?”

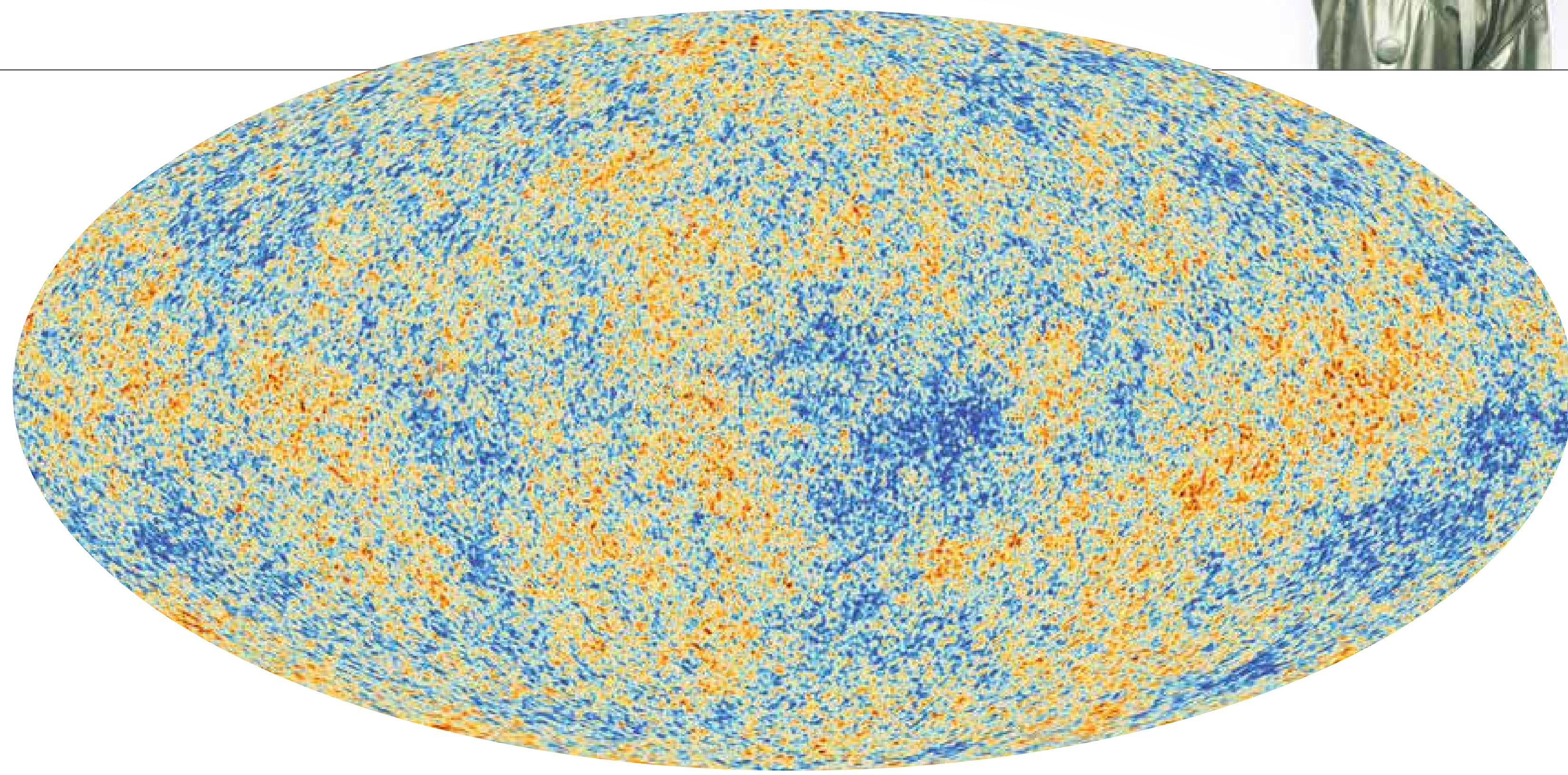
The outer zones of the solar system, which Voyager 1 has traversed to enter interstellar space.
Courtesy NASA/IBEX/Adler Planetarium

ASTRONOMY

Stephen Colbert bestows a NASA medal on the Voyager mission's Edward Stone. Courtesy Kristopher Long/Comedy Central

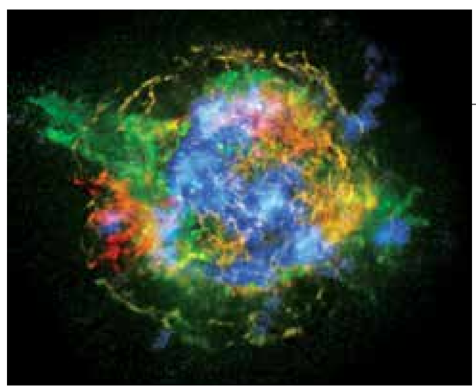
How far back in time can space telescopes see when they look into deep space? For **Planck**, a European space telescope with technology aboard from JPL, the answer is 99.997% of the way back to the Big Bang. During its four years aloft, Planck showed the universe is expanding more slowly than previously thought, and is 13.8 billion years old — 100 million years older than previous estimates. Another European mission that JPL participates in, the **Herschel Space Telescope**, captured views of clashing galaxies before it finished its mission.

Oldest light in the universe — the cosmic microwave ▷ background — mapped by Planck. Courtesy ESA/Planck Collaboration



Two and a half years in hibernation didn't hurt the **Wide-field Infrared Survey Explorer**. When ground controllers contacted the dormant space telescope in fall 2013, they found it was in fine shape for a new mission: to hunt for asteroids that could threaten Earth or serve as targets for future exploration missions.

With more than 3,800 candidate and confirmed exoplanets, the **Kepler** spacecraft is the most prolific planet-finder in history. In 2013, it discovered the first Earth-size rocky planet. It also found that about one-half of red dwarf stars in our galaxy have Earth-sized planets in their habitable zones.



X-ray energy is a great way to look for black holes, and the **Nuclear Spectroscopic Telescope Array** is optimized to do just that. Over the year it viewed great numbers of the extremely massive objects, some millions of times denser than our sun. As a fringe benefit, the observations serve as a powerful test of Einstein's theory of general relativity.

◁ Remnants of supernova Cassiopeia A, imaged by NuSTAR and other spacecraft.

Suzanne Dodd

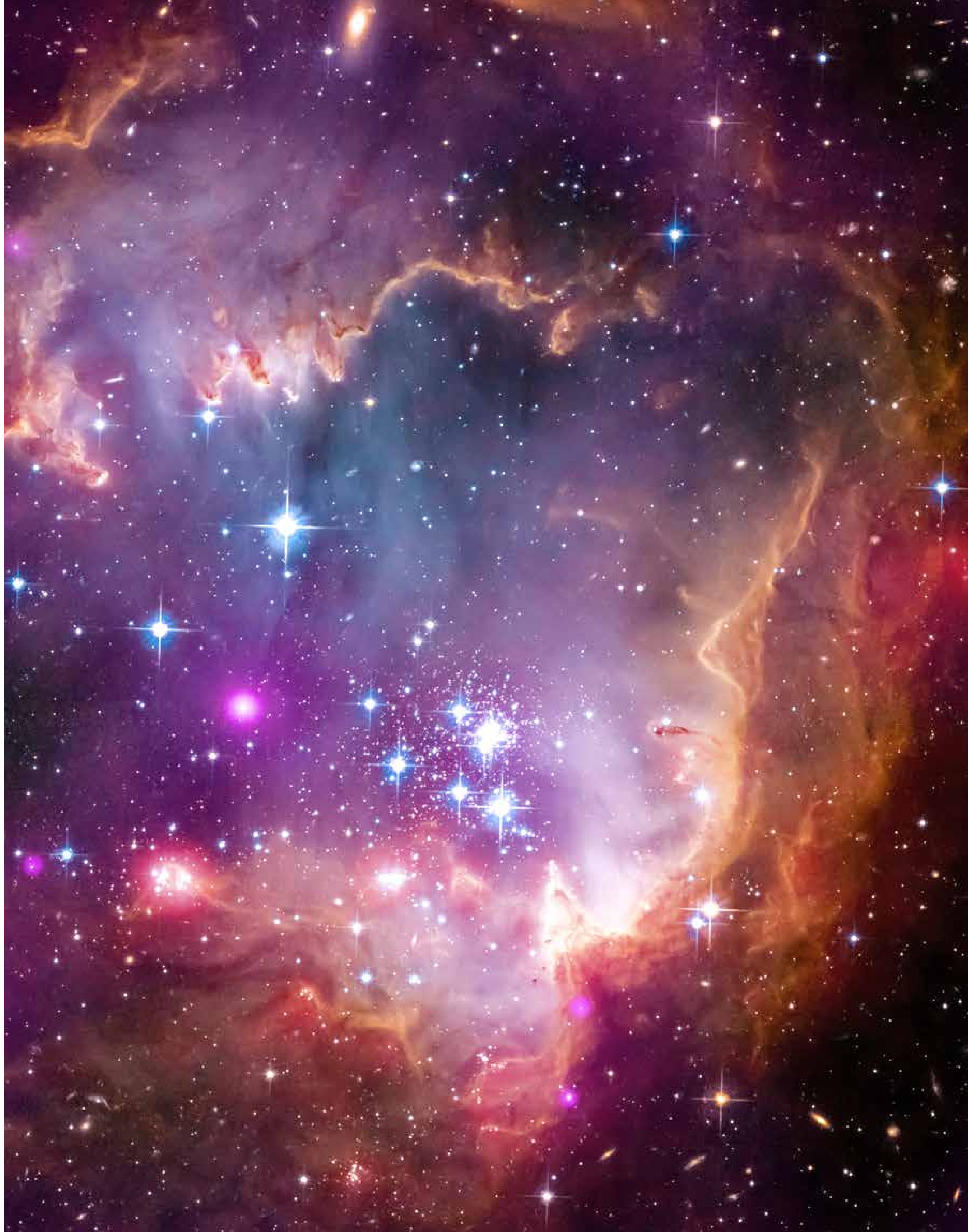
As places go, the Caltech pool has played an outsized role in Suzy Dodd's life. It was there that Dodd — an avid swimmer since age 10 — heard about a job opening on JPL's Voyager mission in 1984 when she was finishing up her bachelor's degree in engineering. Thirty years later, Dodd is still at JPL — and now she's the Voyager project manager.

Back when she joined the lab, her first assignment was helping to put together the commands that would control Voyager 2's flyby of Uranus. Not long after that, she was put in charge of the sequences the spacecraft would execute as it made its closest pass by distant Neptune — the last planet it would ever visit. "That was a special moment for me," she remembers now. "It was a big job — like doing a landing sequence at Mars."

Today Dodd is responsible not only for the dozen people who work with the Voyagers as the spacecraft exit the solar system, but also the teams on the Spitzer Space Telescope and the NuSTAR X-ray observatory. "Nothing is routine — there are a lot of surprises," she says.

Despite the demands of her three missions, Suzy still finds time to swim. And her JPL career isn't the only thing that came into Dodd's life via the Caltech pool. She also met her husband of 27 years on the pool deck.

Data from the Spitzer Space Telescope ▷ and NASA's Hubble Space Telescope were merged for this portrait of a portion of the Small Magellanic Cloud.

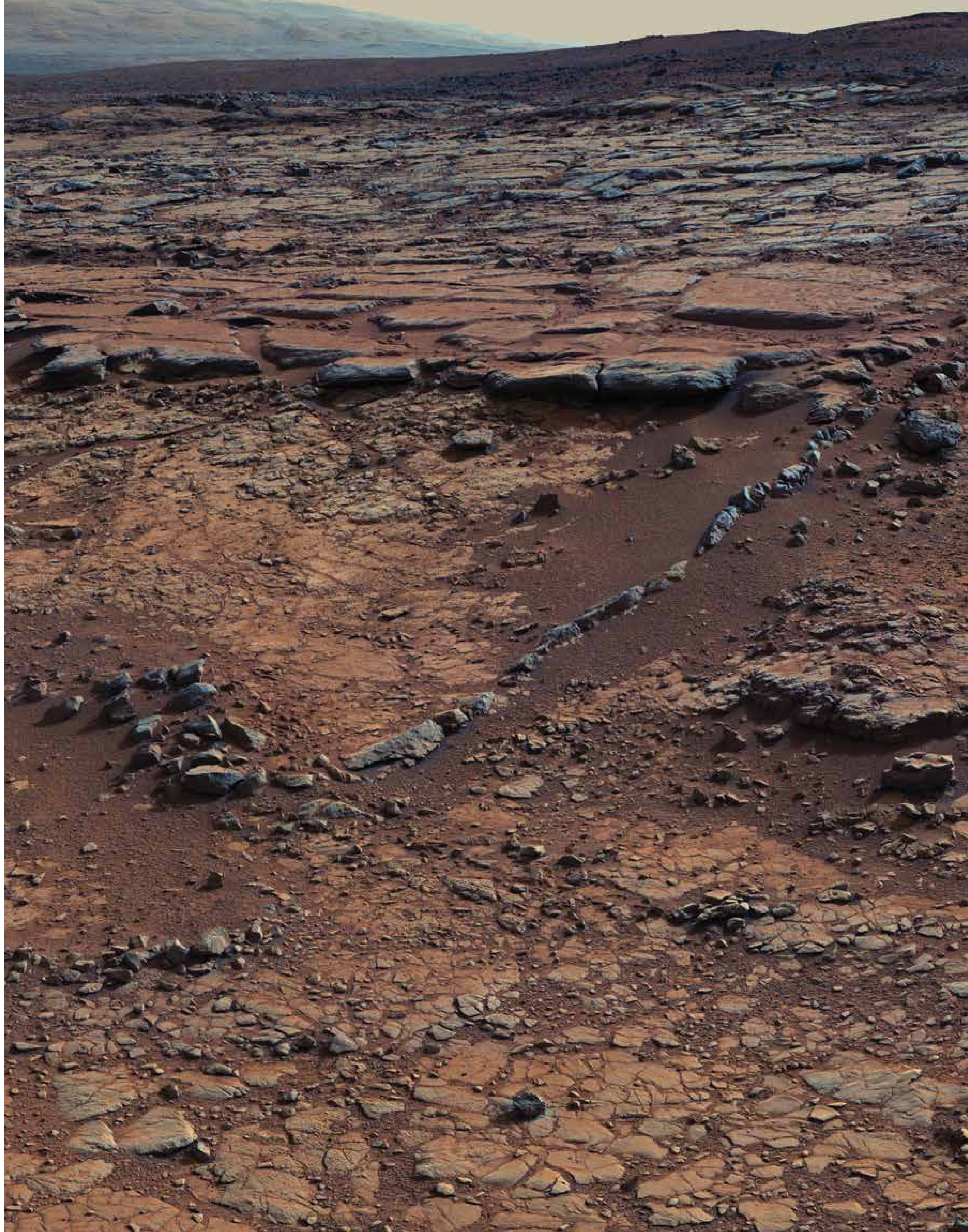


Martian Paydirt

It wasn't exactly "One and you're done," but for the scientists working with Mars Curiosity, they couldn't be happier. When the rover fed a powdered rock sample from its drill to its onboard instruments, the experiment was able to achieve the purpose of the entire expedition — just six months after landing. Ancient Mars, the analysis showed, held all the ingredients required to support living microbes.

Cooking and analyzing the rock powder, Curiosity found sulfur, nitrogen, hydrogen, oxygen, phosphorus and carbon — all the building blocks thought to be essential to life. It proved as well that the spot — 550 yards east of its landing site in Gale Crater — was once not only wet, but much milder than sites surveyed by earlier rovers. Those other sites apparently were once awash in acidic or highly salty water.

The outcome was not only a scientific coup, but an engineering one as well. Curiosity collected the sample by deploying for the first time its high-power drill and then using a sophisticated onboard lab to conduct analysis. Despite achieving this milestone early on, Curiosity's mission was far from over. The car-sized rover rolled ahead, readying itself for other drilling and, eventually, for climbing onto nearby Mount Sharp.



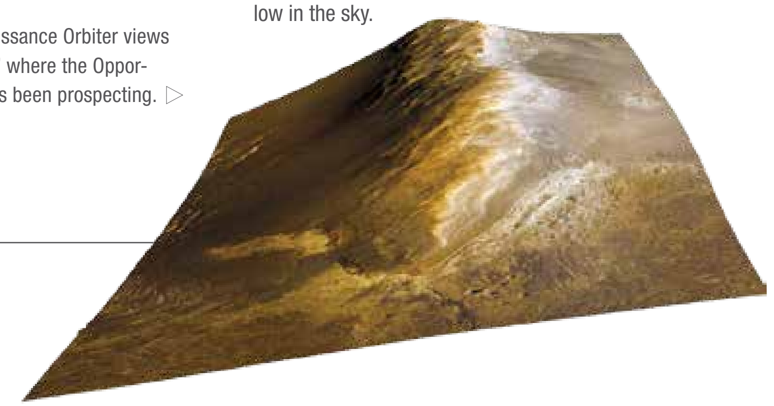
The "Yellowknife Bay" formation in Mars' Gale Crater, where the Curiosity rover unlocked a trove of life-related findings. ▷

If **Mars Reconnaissance Orbiter** had never flown, scientists would be without the staggering 200 trillion bits of data that the craft has sent since its arrival seven years ago. But it is there, and science is the better for the high-resolution images and other data it has beamed home. In 2013, that included shots of Curiosity and its plainly visible tracks, the rover's jettisoned parachute flapping in the wind, and even a possible view of a 1971 Soviet lander. The orbiter also spent the year counting impacts of space rocks, examining furrows evidently created by dry ice sledding down hillsides, and studying buried flood channels in 3D.

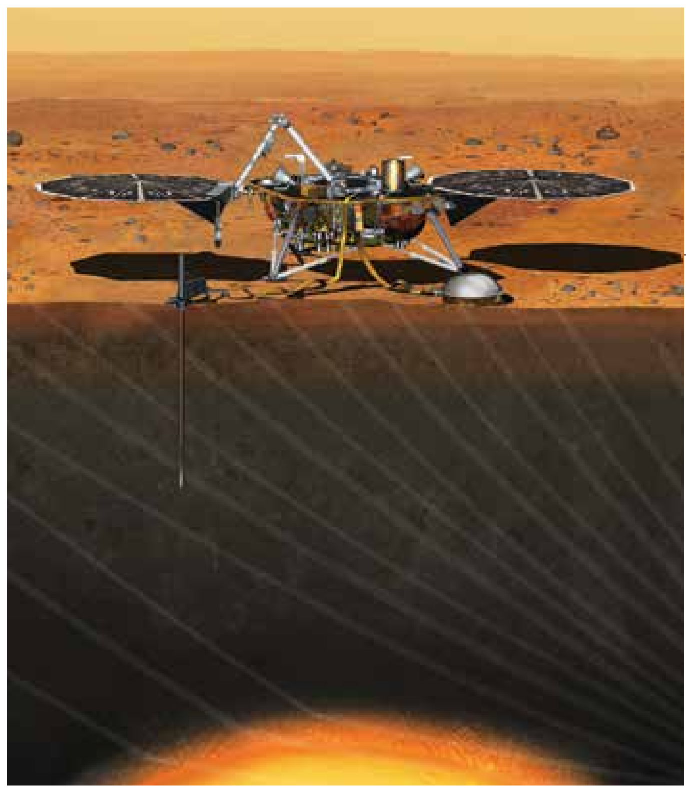
Martian gullies possibly created by dry ice sliding downhill, viewed by Mars Reconnaissance Orbiter. ▷

2013 was the year that the **Mars Exploration Rover Opportunity** became NASA's longest-ranging vehicle ever sent to another world, logging more than 24 miles of driving by year's end. It also held a major scientific coup for the rover: examining rocks near the rim of sprawling Endeavour Crater, it found clay minerals pointing to a much more life-friendly past environment than anywhere else it had visited in its decade on the Red Planet. With impending Martian winter, Opportunity then hightailed it south to a slope where its solar panels could keep the rover energized over many months with the sun low in the sky.

Mars Reconnaissance Orbiter views "Murray Ridge," where the Opportunity rover has been prospecting. ▷

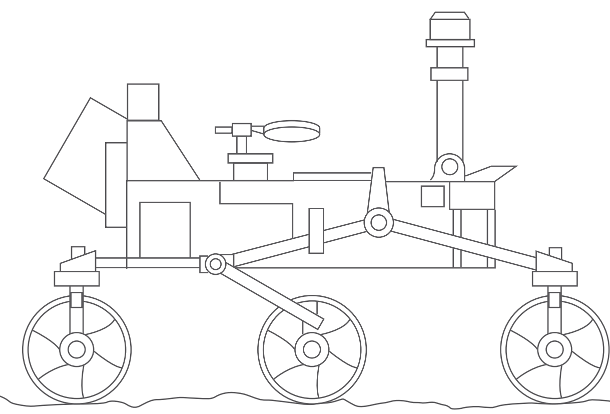


MARS EXPLORATION



◁ The InSight lander, due to go to Mars in 2016.

Sometimes discretion is the better part of valor, and mission planners hewed to that thinking in picking possible landing sites for the next Mars lander, called InSight, due to launch in 2016. In 2013 they selected four candidate sites, all distinguished by the fact that they are very flat and very safe, with scant rocks to get in the lander's way. That's not a minus for the mission's science; **InSight** isn't looking for photogenic panoramas. Rather, its chief aim is to listen for marsquakes and other readings to reveal details on the planet's interior, and to hammer a probe as deep as 16 feet below the surface to measure its internal heat.



Many signs point to the possibility of past or present life on Mars, but the evidence isn't unanimous. Several times the Curiosity rover sniffed for the presence of methane in Mars' atmosphere. If simple life like bacteria exists on Mars now — even under the planet's surface — scientists believe it could release the gas into the atmosphere. But **Curiosity** found no trace of it during its tests. Even so, say scientists, the result doesn't rule out the possibility of current-day life — there are plenty of bacteria on Earth that do not emit methane.

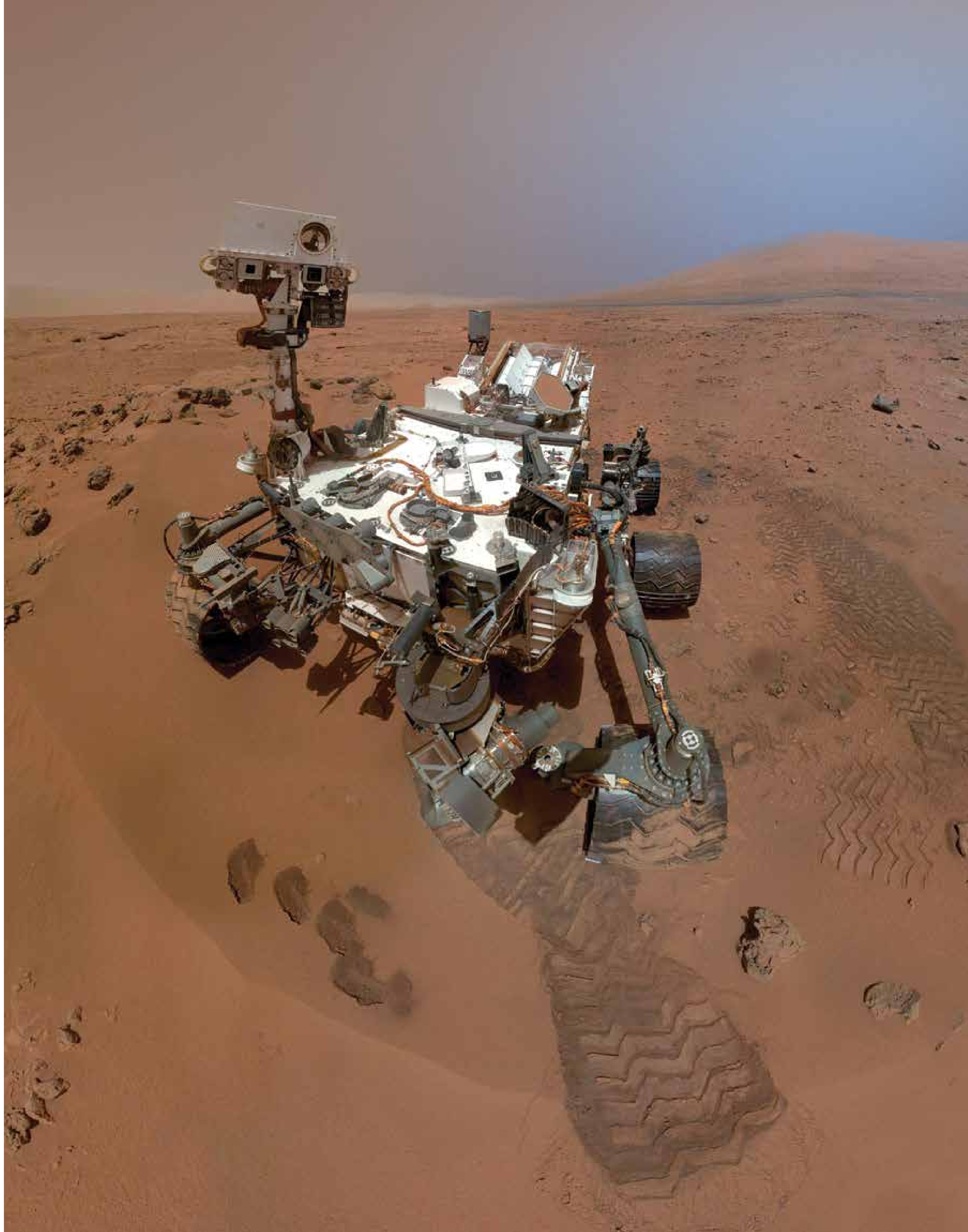
Matt Heverly

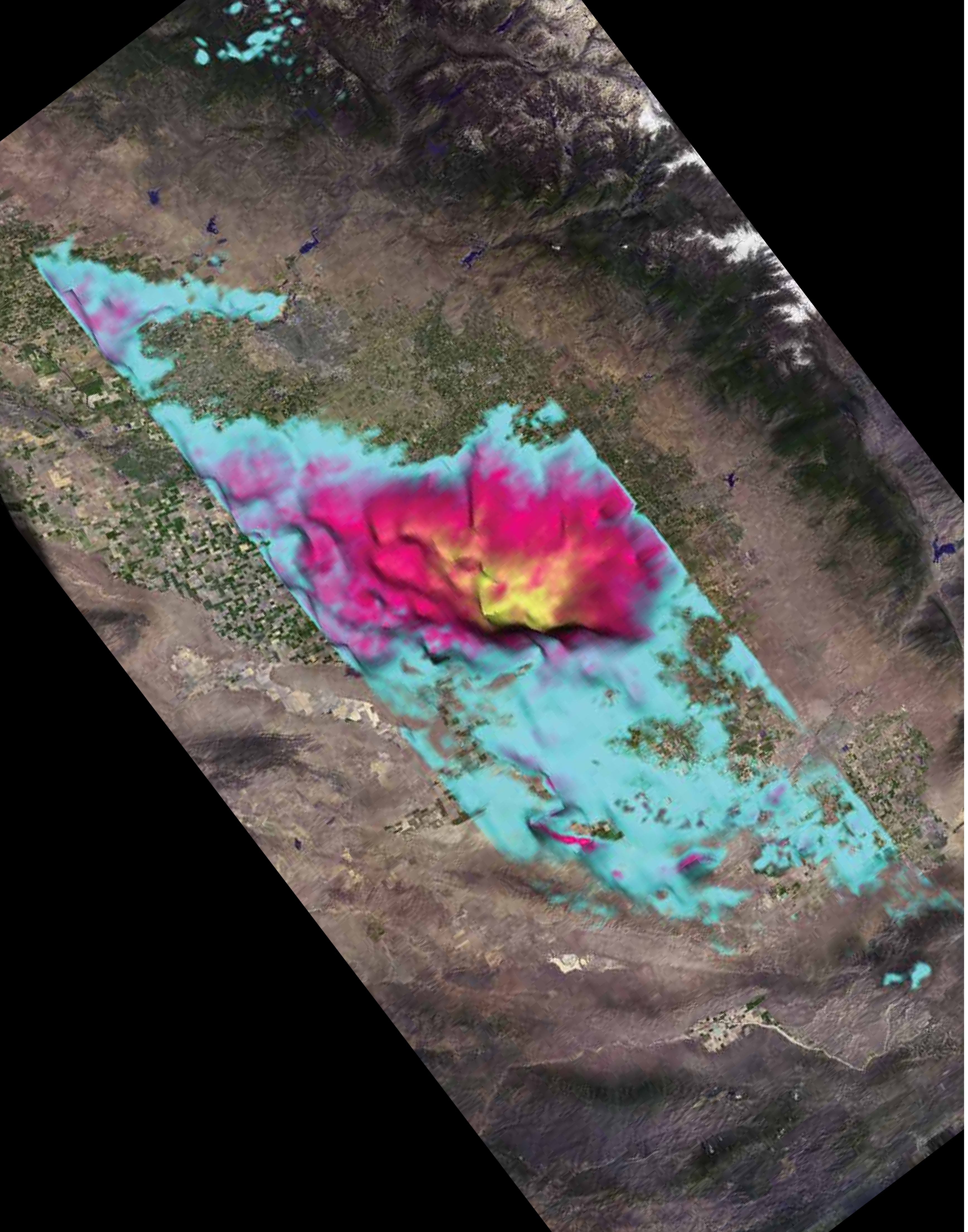
When he was in middle school, Matt Heverly liked to take apart toaster ovens to see how they worked. Today his day job likewise revolves around tinkering with hardware — but the gear he works with is slightly more complex.

That would be JPL's Curiosity rover, the 2,000-pound, nuclear-powered robot turning out science discoveries as it rolls across the surface of the Red Planet. As the mobility lead, Heverly is responsible for figuring out the step-by-step moves the rover makes every day — while keeping the vehicle safe.

Just after Curiosity landed, Heverly and the others on the 15-member rover driving crew were on "Mars time," as their waking and sleeping schedules slipped 40 minutes later every day to stay in sync with daylight hours for the rover. Now life is a little more normal; the team clocks in on regular office hours, sometimes planning rover activities for two to three days at a time.

The rover drivers are expert in a variety of specialties, from robotic hardware to machine vision to software. "This is an amazing place to be," says Heverly, who plays in two soccer leagues in his spare time. "We get to do things you can't do anywhere else in the world."





State of the Planet

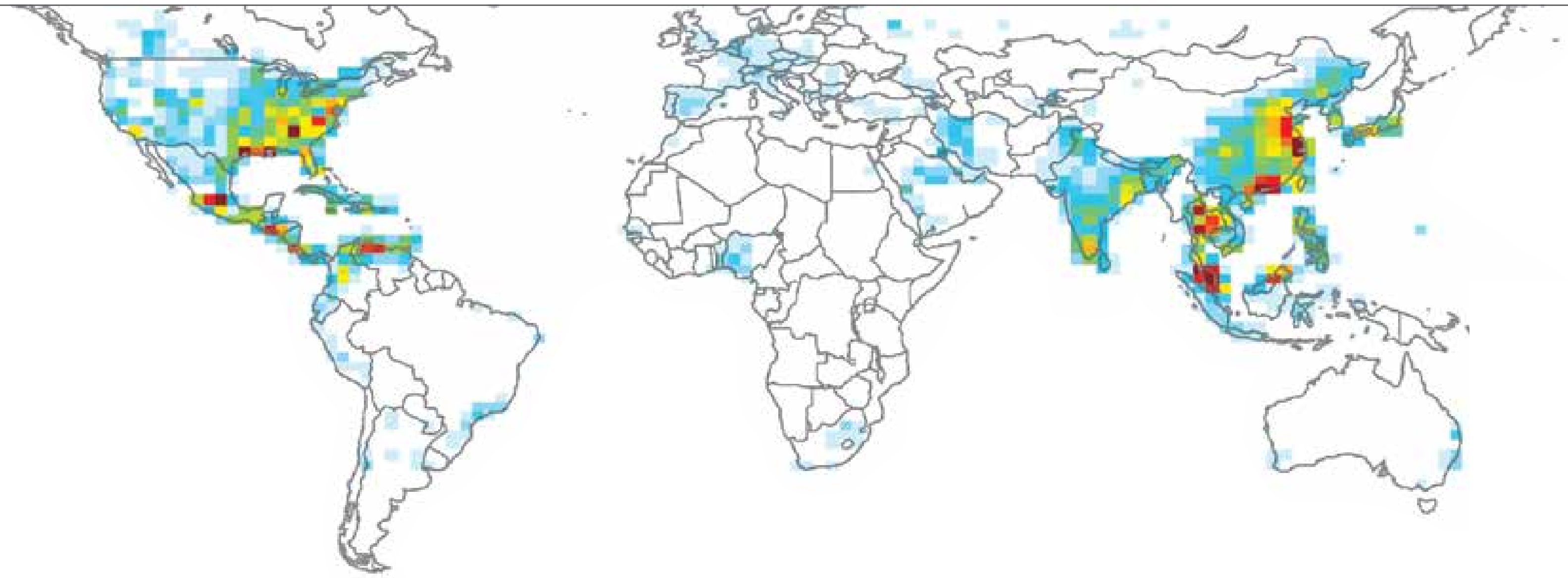
Throughout 2013, evidence continued to pile up reflecting the steadily increasing impacts of global climate change. As in previous years, scientists measured the ongoing loss of ice in the Arctic and Antarctic. Troubling climate trends turned up in other parts of the world. Amid those changes, JPL engineers prepared a slate of new missions capable of providing a greater understanding of the state of our planet.

Among the studies by JPL scientists, one used data from several satellites and surveys to show that Arctic sea ice volume declined 36 percent in the autumn and nine percent in the winter over the last decade. Another established that warming oceans are the main cause of ice shelf loss in the Antarctic.

Data from the twin Gravity Recovery and Climate Experiment, or GRACE, satellites showed that freshwater reserves were lost rapidly over the past decade in large parts of the arid Middle East — a region that climate change is making ever drier.

At the laboratory, meanwhile, three new missions moved closer to launch. As the year progressed, the Soil Moisture Active Passive satellite took shape in a JPL clean room. This mission will map water in Earth's soil to improve understanding of the cycling of water, energy and carbon. JPL also readied the RapidScat instrument in preparation for flight to the International Space Station, where it will monitor ocean winds around the globe. Also progressing toward launch was the Orbiting Carbon Observatory 2, a satellite that will make planet-wide measurements of carbon dioxide, the greenhouse gas that is the largest human-generated contributor to global warming.

Imaging radar reveals how California's Central Valley has sunk due to withdrawal of groundwater (data are colorized and exaggerated).



Ozone is widely known as a greenhouse gas that contributes to climate change, but scientists showed this year that it affects some parts of the world more than others. Working with data from JPL's **Tropospheric Emission Spectrometer** instrument, they found that ozone has more of a negative impact in areas closer to the equator — and in relatively cloud-free regions. That knowledge may help develop clean air standards tailored to different parts of the world.

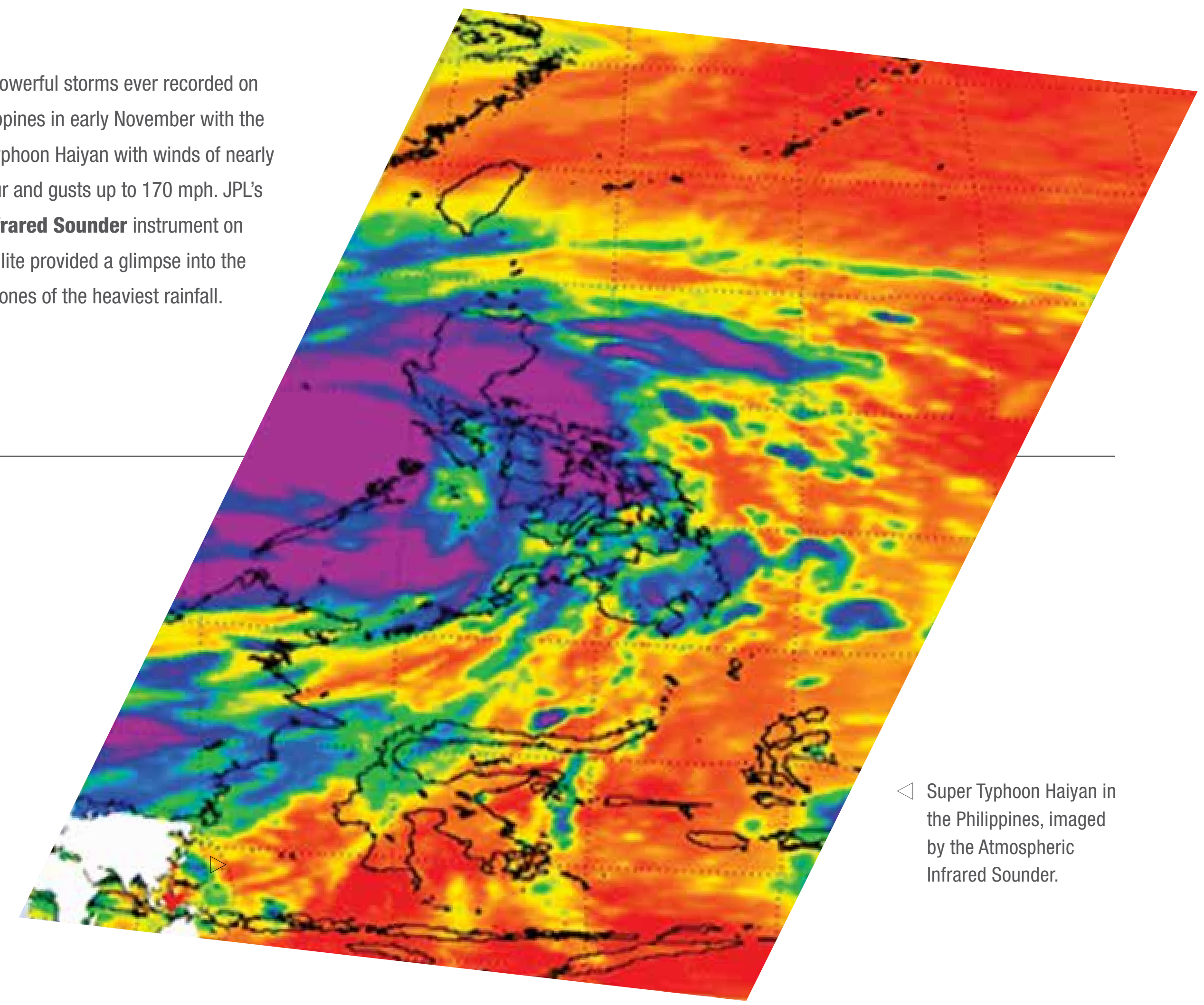
Ozone around the globe, as mapped by the Tropospheric Emission Spectrometer.

A megadrought in a part of the Amazon rainforest twice the size of California may be among the first signs of large-scale degradation from climate change, according to one team of scientists. They say that data from **QuikScat** and other NASA satellites reveal that forest canopies across the South American basin are showing damage persisting for many years.

Frozen arctic soils hold vast stores of carbon that may worsen climate change as warming causes them to be released. A JPL-led science team sought to understand the issue with airborne flights of an instrument destined to launch on the **Orbiting Carbon Observatory 2** in 2014.

One of the most powerful storms ever recorded on Earth hit the Philippines in early November with the arrival of Super Typhoon Haiyan with winds of nearly 150 miles per hour and gusts up to 170 mph. JPL's **Atmospheric Infrared Sounder** instrument on NASA's Aqua satellite provided a glimpse into the storm, revealing zones of the heaviest rainfall.

PLANET EARTH



Super Typhoon Haiyan in the Philippines, imaged by the Atmospheric Infrared Sounder.

Christian Frankenberg

Suppose you have a satellite in orbit around Earth created to measure one particular thing. But the readings, you realize, will be thrown off because of the satellite picking up something entirely different. To make it work, you need a way to separate the two.

That was Christian Frankenberg's dilemma. When the German-born scientist arrived at JPL in 2010 to work with the Orbiting Carbon Observatory 2 team, he realized that the satellite's measure of carbon molecules in the atmosphere would be affected by something else — the fluorescent glow of chlorophyll created by plants around the globe as they take in carbon dioxide.

Working with similar data from a Japanese satellite, Frankenberg came up with a way to separate them out in data processing — a solution that netted him two major JPL and NASA awards. The process not only gives scientists valuable information on chlorophyll in plants important in understanding global carbon cycles, but also fixes the carbon readings.

Orbiting Carbon Observatory 2 is due for launch in 2014. "We're really eager to see the first data," said Frankenberg, who enjoys spending time with his seven-year-old son when he is not working. "For the science team, most things are in place, thanks to the work we have been able to do so far."

Orbiting Carbon Observatory 2's observations will help ▷
scientists understand connections in climate change.

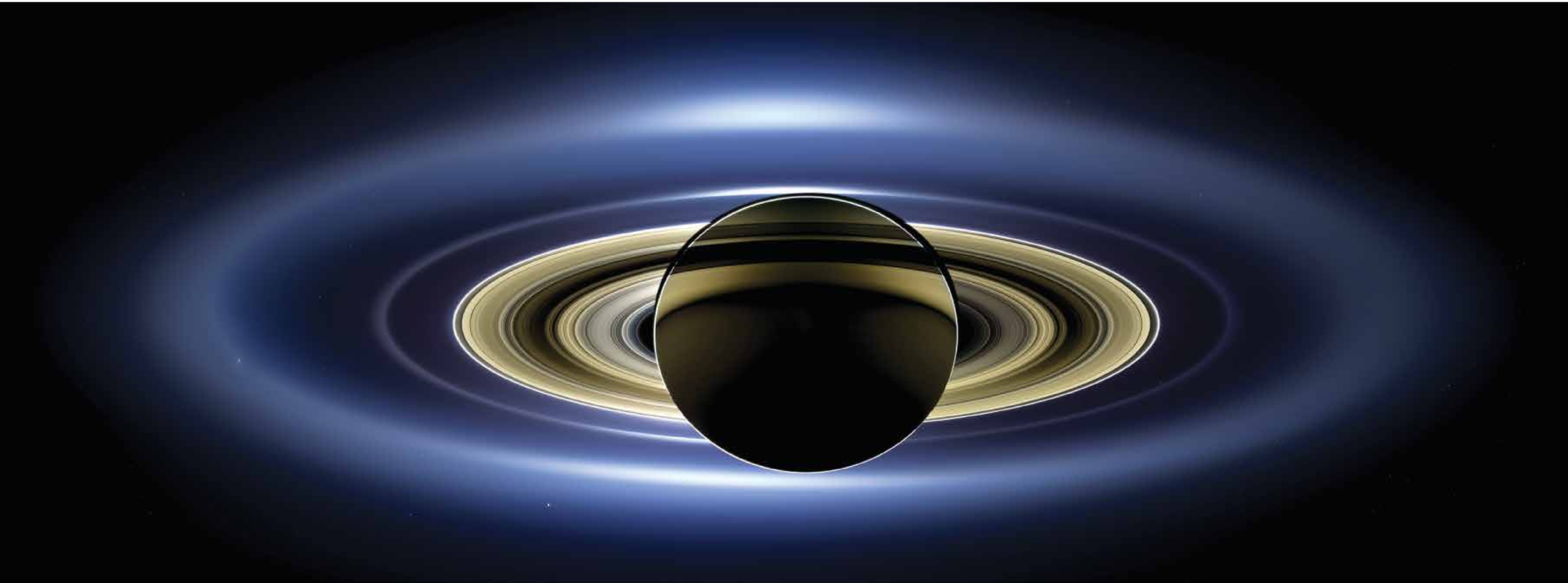
Through the Seasons

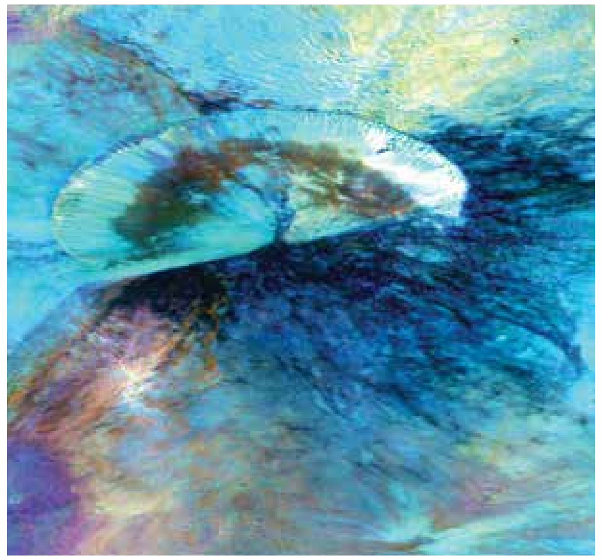
For the Cassini spacecraft at Saturn, 2013 was an opportunity to look at how the ringed planet and its largest moon, Titan, change through the seasons. During the year, Cassini's orbit took it far above the ecliptic plane, offering it dramatic views of the planet's north.

There it discovered a behemoth hurricane swirling around Saturn's north pole. Though similar to hurricanes on Earth, the dramatic storm at Saturn is 20 times larger and spins surprisingly fast. At Saturn's moon Titan, scientists used novel radar techniques to find the depth of one of its largest seas.

Looking ahead, scientists and engineers made plans for a dramatic finale to Cassini's mission before it plunges into Saturn in 2017. The spacecraft will steer in very close to Saturn and orbit between the top of its atmosphere and its innermost ring for Cassini's final 22 orbits. That will give it the chance to measure Saturn's gravity, ring mass and magnetic field with great accuracy.

Cassini's shimmering, backlit view of Saturn. Earth, Mars, Venus and seven of Saturn's moons are points of light dwarfed by the ringed planet. ▽

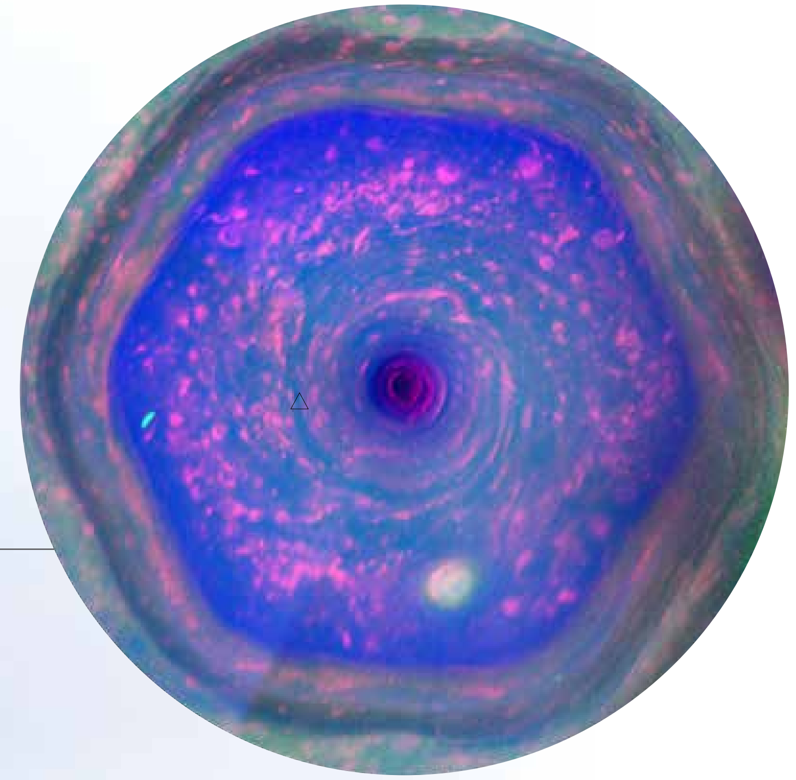




PLANETARY

△ A colorized view of the crater Antonia on the giant asteroid Vesta, imaged by Dawn.

As a figurative hybrid vehicle of outer space, **Dawn** may not have the pickup of a stock car, but its ion propulsion gets the job done. Departing from the giant asteroid Vesta in 2012 after orbiting it for more than a year, Dawn spiraled out in the asteroid belt between Mars and Jupiter en route to its next destination — the dwarf planet Ceres, where it is due to arrive in 2015. By the end of 2013, Dawn had passed the halfway mark in its flight between these two ancient worlds.



△ The best-ever view of a distinctive hexagon cloud formation around Saturn's north pole, captured by Cassini.

In 2013, Cassini turned its cameras to capture a memorable portrait of Saturn along with Earth, Venus and Mars. Though the latter were all just points of light, the mission invited space fans to look up and "**Wave at Saturn**" at the moment the picture was taken. Some 1,500 enthusiasts around the world also used social media to send in pictures they took of themselves showing what they were doing at the time of the Cassini photo.

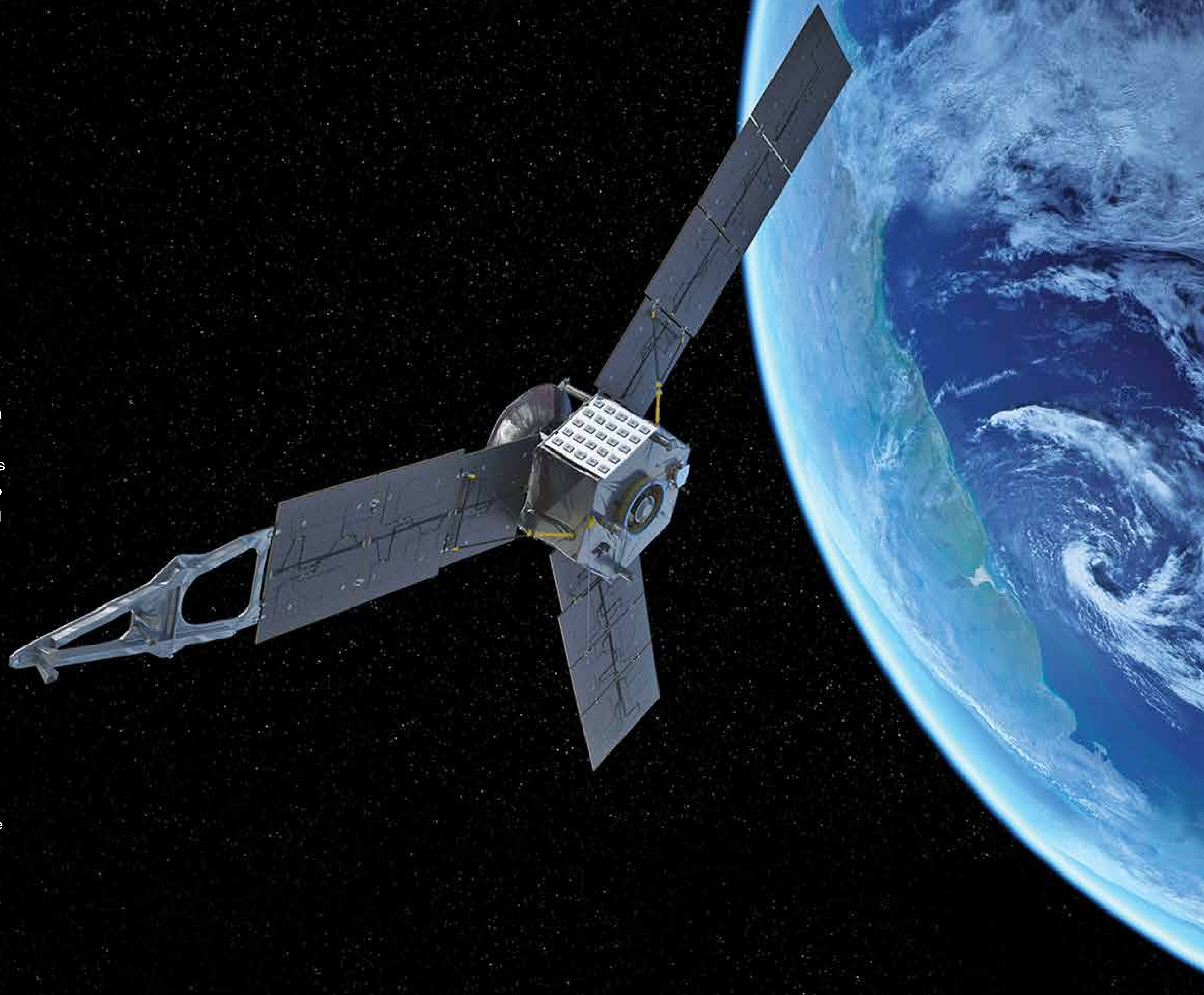
Hello, Goodbye

Earth flybys have become routine for spacecraft heading to the outer solar system, but when JPL's latest planetary mission streaked by its home planet in October, the team took maximum advantage of the opportunity. Skimming the top of Earth's ionosphere handed off enough gravitational energy to the Juno spacecraft to put it on course to arrive at Jupiter in 2016 — and provided plenty for its instruments to look at.

Racing in toward a planet as it grows from a point of light to a full-fledged world always has a feeling of awe for mission teams; Juno's crew likened it to a view from a starship as the spacecraft bore down on Earth and its moon, finally passing less than 350 miles over South Africa.

Juno not only snapped pictures of Earth as it sped by, but it heard from our planet as well. The team had invited ham radio operators to send a coordinated message in Morse code — "Hi" — to the spacecraft as it passed. Their transmissions were picked up by Juno's plasma instrument.

Next stop? The solar system's largest planet in July 2016. Juno will loop around Jupiter 33 times as it studies this gas giant's interior, atmosphere and enormous magnetosphere.



Artist's view of Juno's close pass by Earth.

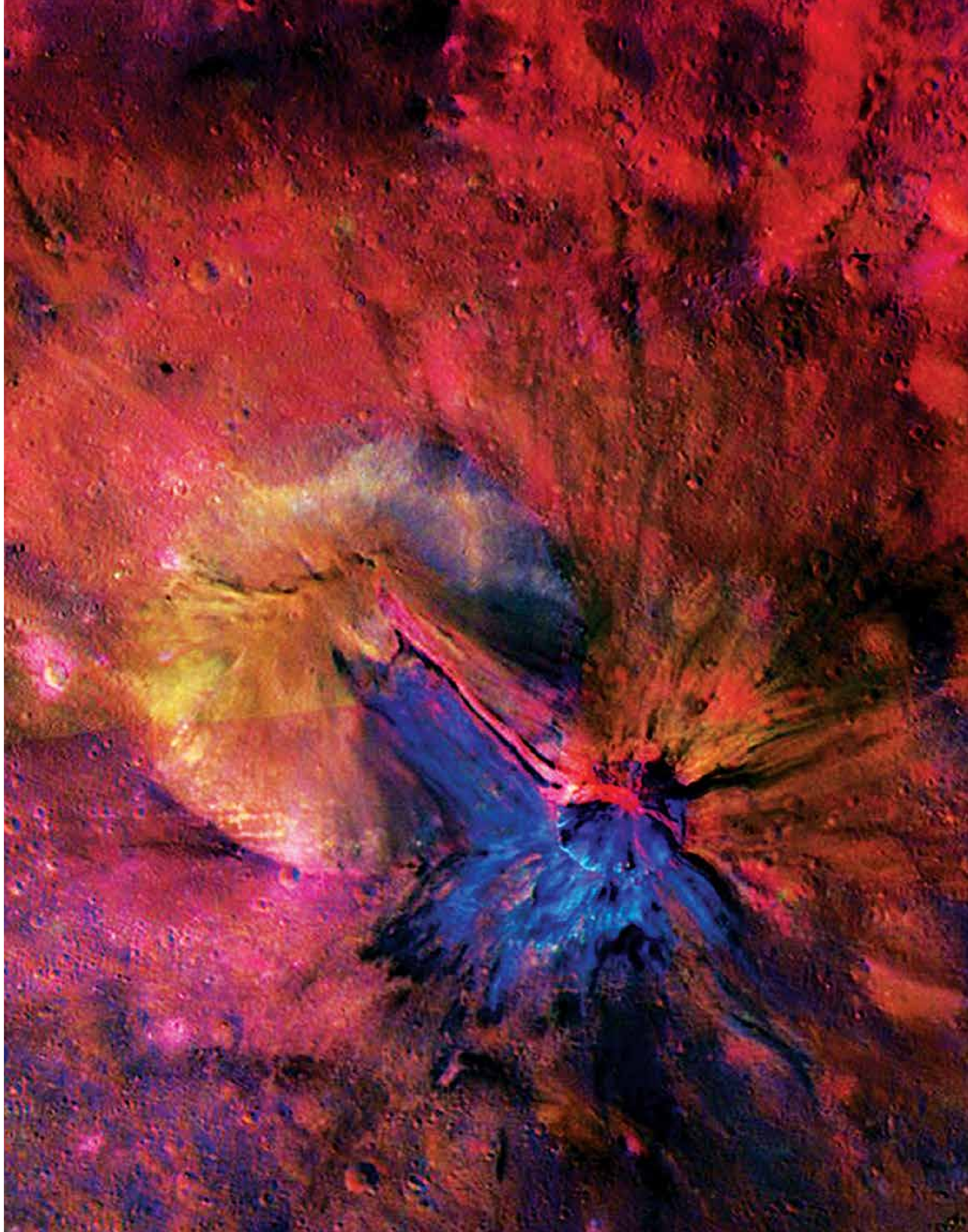
Carol Raymond

Carol Raymond's passion for the natural world started in her youth, growing up with woods behind her house in Connecticut and Long Island. Decades later, she is still enwrapped in nature — though the worlds involved are much farther away. As in, say, hundreds of millions of miles — off in the asteroid belt between Mars and Jupiter. There, the spacecraft for which Raymond serves as deputy principal investigator, Dawn, is visiting two of the most ancient objects in the solar system — the giant asteroid Vesta and the dwarf planet Ceres.

Not that she thought from the start that her interests would take her so far off-world. After her curiosity was piqued in college by geophysics, and more particularly paleomagnetism — studying the ancient recordings of Earth's magnetic field in rocks — Raymond spent time on ships mapping seafloor plate tectonics. Only after coming to JPL in 1990 did she begin gravitating toward solar system missions, signing onto Dawn when it was first proposed in 2000.

And though her professional interests may keep her deeply involved with the history of the solar system, Raymond likes to keep the outdoors close at hand. When she's not busy with the mission, she tends vegetables and keeps chickens in a rustic neighborhood in Altadena.

Dawn's view of complex layering inside and outside ▷
a crater called Aelia on the giant asteroid Vesta.



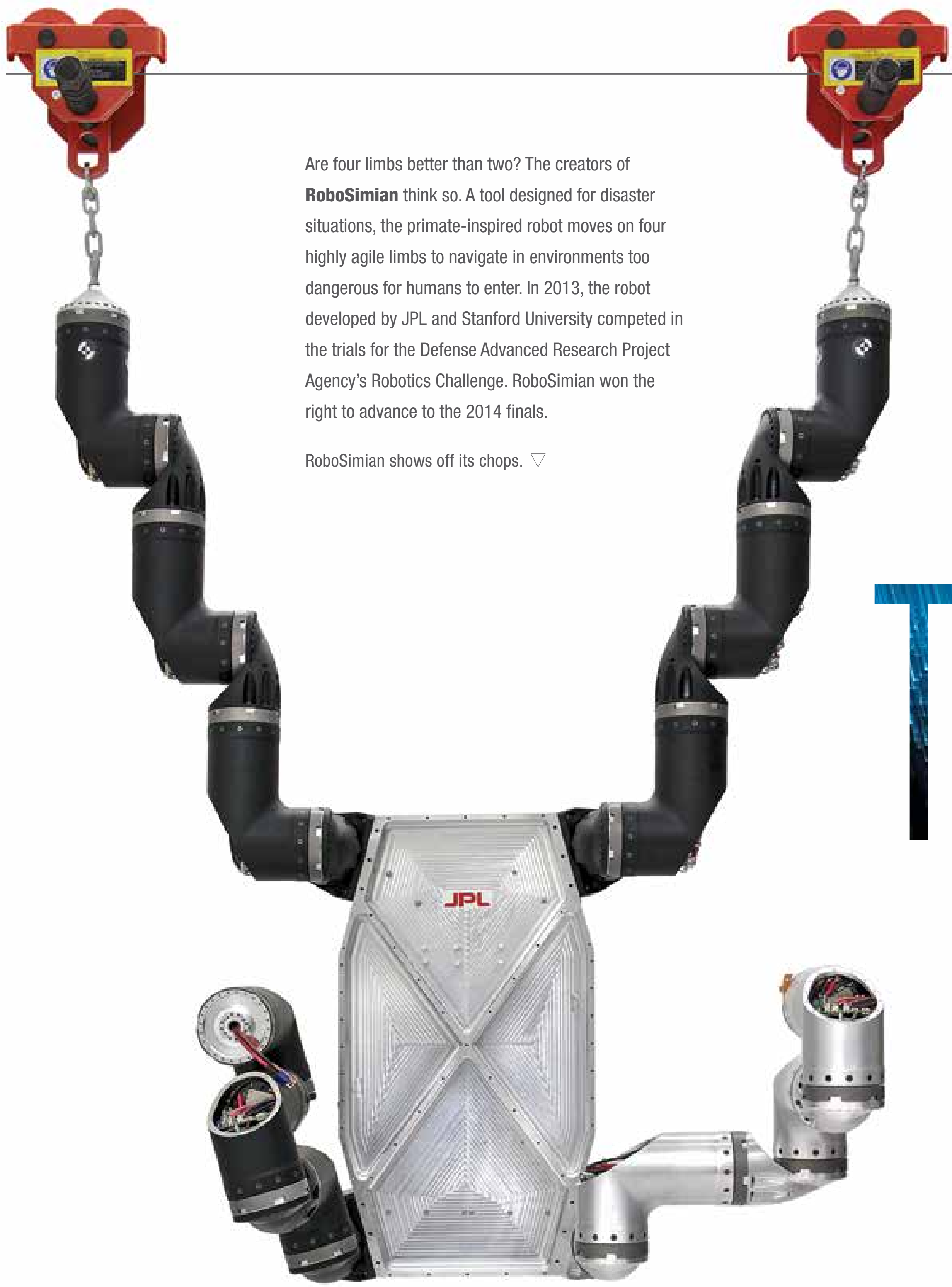
Making the Future

Doing the ordinary is not the JPL way; the laboratory exists to take up exploration challenges that would be too risky for other parts of government and industry. One of the chief ways that JPL brings this about is by constantly developing and infusing new technologies into its missions.

Future robotic and human missions to Mars will involve spacecraft much larger and heavier than the rovers and landers sent there so far. Slowing such payloads from supersonic speeds as they arrive at the planet calls for approaches more capable than the Viking-era parachutes used so far. To address that need, JPL is developing Low-Density Supersonic Decelerator technologies to brake larger spacecraft at higher speeds. During the year, rocket sleds were used to test elements of the system before planned high-altitude supersonic tests in 2014 and 2015.

Some technology initiatives take advantage of newer members of JPL's staff. Many early career hires have been involved in the Optical Payload for Lasercomm Science, an experiment that will use lasers to beam high-rate video from the International Space Station to Earth after launch in 2014. JPL also worked with universities to develop a pair of small satellites called CubeSats that were lofted into space in December to test new algorithms for imaging.

◁ A Low-Density Supersonic Decelerator vehicle will fly in Earth's stratosphere at Mach 4 to test new ways of delivering large payloads to other planets.



Are four limbs better than two? The creators of **RoboSimian** think so. A tool designed for disaster situations, the primate-inspired robot moves on four highly agile limbs to navigate in environments too dangerous for humans to enter. In 2013, the robot developed by JPL and Stanford University competed in the trials for the Defense Advanced Research Project Agency's Robotics Challenge. RoboSimian won the right to advance to the 2014 finals.

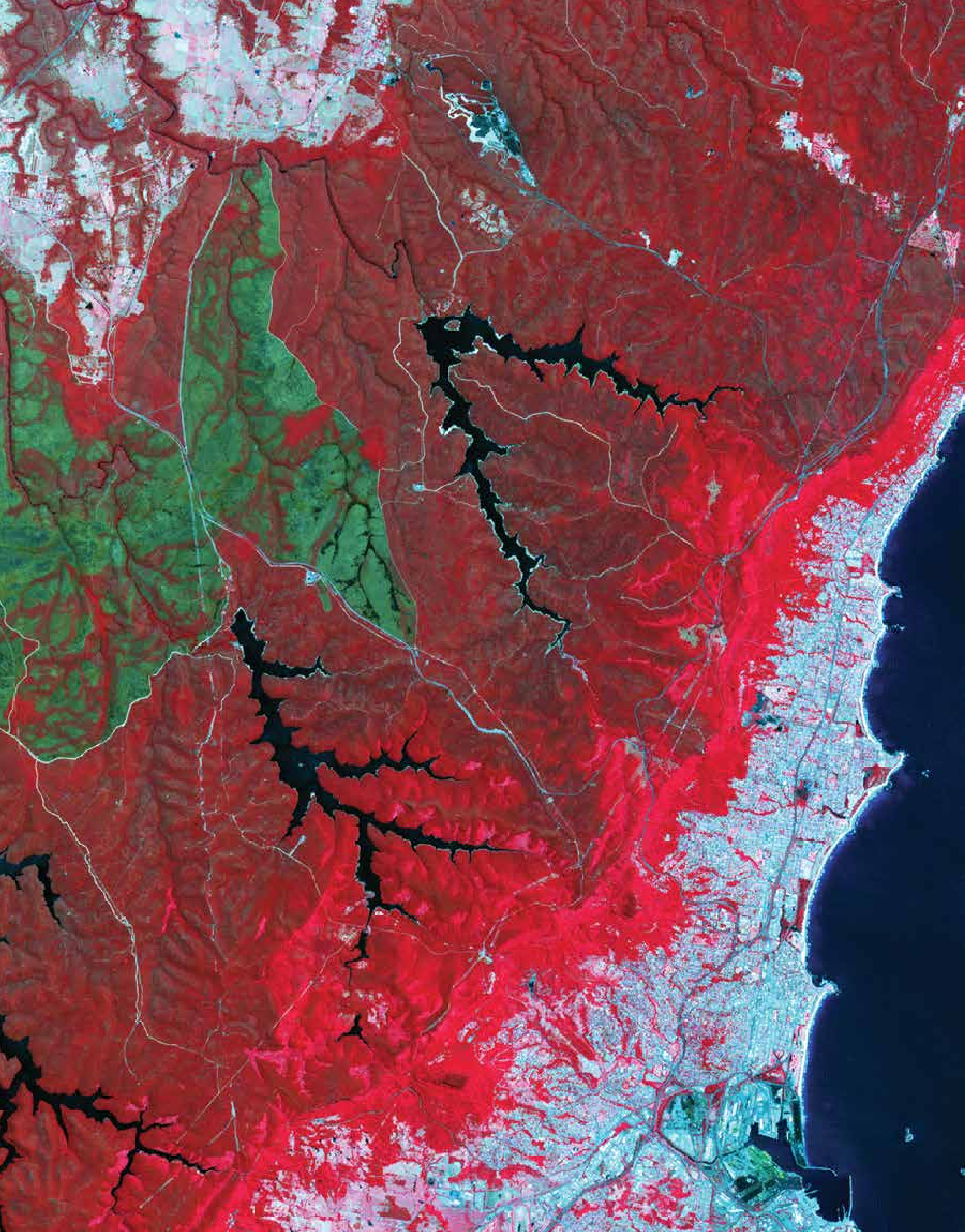
RoboSimian shows off its chops. ▽

Rescuing the seriously injured from rubble caused by events such as major earthquakes could become easier with a radar technology developed by JPL for the Department of Homeland Security. Tests showed that the device, called **Finding Individuals for Disaster and Emergency Response**, can detect the heartbeat or breathing of individuals buried as deep as 30 feet in crushed materials or hidden behind 20 feet of solid concrete.

TECHNOLOGY

At first it was just a few small antennas. But 50 years ago, the portals charged with communicating with missions beyond Earth orbit formally became the **Deep Space Network**, evolving into a collection of antennas up to 230 feet in diameter on three continents. In 2013, the network's engineers began celebrating the anniversary while working to upgrade capabilities to support missions in years to come.

Late night in the desert: Goldstone's ▷ largest antenna tracks spacecraft day and night.



Major External Awards

Bonnie Buratti

American Astronomical Society, Division for Planetary Sciences

Vice Chair

John M. Carson III

American Institute of Aeronautics and Astronautics

Associate Fellow

Goutam Chattopadhyay

Institute of Electrical and Electronics Engineers, Microwave Theory and Techniques Society

Distinguished Microwave Lecturer

Keith Comeaux

Louisiana State University

Hall of Distinction

Richard Cook

National Space Club

Astronautics Engineer Award

Time Magazine

100 Most Influential People in the World

Thomas Cwik

American Institute of Aeronautics and Astronautics

Associate Fellow

Dawn Flight Team

Smithsonian National Air and Space Museum

Trophy for Current Achievement

Dariush Divsalar

Institute of Electrical and Electronics Engineers

Alexander Graham Bell Medal

Bethany Ehlmann

National Geographic

Emerging Explorer

Murthy Gudipati

Indian Institute of Science Alumni Association of North America

Alumni Award

Sarath Gunapala

Institute of Electrical and Electronics Engineers, Photonics Society

Aron Kressel Award

Jeffery Hall

American Institute of Aeronautics and Astronautics

Associate Fellow

Herschel SPIRE Instrument Team

British Interplanetary Society and Arthur C. Clarke Foundation

Arthur C. Clarke Award for Academic Study and Research

Jeanne Holm

Federal Computer Week Magazine

Federal 100 Award

Douglas Hofmann

White House

Presidential Early Career Award for Scientists and Engineers

Jet Propulsion Laboratory

CIO Magazine

CIO 100 Award for IT Excellence

Computer World Magazine

100 Best Places to Work in IT

Information Week Magazine

Top 10 Government IT Innovator

JPL Social Media Team

International Academy of Digital Arts and Sciences

Webby Award for Overall Social Presence

Webby People's Voice Award

Sawhorse Media

Shorty Award, Foursquare Mayor of the Year

South by Southwest

Interactive Award, Best Social Media Campaign

Social Media Week Los Angeles

Social 25 Digital Media Influencers

Attila Komjathy

GPS World Magazine

Leadership Award

Kam Lau

Institute of Electrical and Electronics Engineers

Aerospace and Electronic Systems Society Pioneer Award

Leslie Livesay

International Academy of Astronautics, Basic Engineering Section

Corresponding Member

George Lutes

Institute of Electrical and Electronics Engineers, Aerospace and Electronic Systems Society

Pioneer Award

Mars Curiosity Mission Team

American Institute of Aeronautics and Astronautics Foundation

Award for Excellence

National Aeronautic Association

American Institute of Aeronautics and Astronautics

Award for Excellence

Collier Trophy

National Space Club

Dr. Robert H. Goddard Memorial Trophy

Nelson P. Jackson Aerospace Award

Space Foundation

Jack Swigert Award for Space Exploration

Mars Curiosity Landing Team

Smithsonian National Air and Space Museum

Trophy for Current Achievement

Veronica McGregor

Rotary National Award for Space Achievement Foundation

Space Communicator Award

Scars from more than 100 wildfires in Australia's New South Wales, captured by ASTER.

Thomas Painter

American Geophysical Union, Cryosphere Focus Group

President

Robert Pappalardo

International Academy of Astronautics, Basic Science Section

Corresponding Member

Rajeshuni Ramesham

Society of Photo Optical Instrumentation Engineers

Fellow

Carol Raymond

International Academy of Astronautics, Basic Science Section

Corresponding Member

Tomas Soderstrom

Federal Computer Week

Federal 100 Award

Solar System Exploration Website

International Academy of Digital Arts and Sciences

Webby People's Voice Award, Science and Government

Adam Steltzner

International Academy of Astronautics, Basic Engineering Section

Corresponding Member

Edward Stone

Aero Club of Southern California

Howard Hughes Memorial Award

International Astronautical Federation

World Space Award

Peter Theisinger

Time Magazine

100 Most Influential People in the World

David Ting

International Society for Optics and Photonics

Fellow

Vandi Tompkins

Leadership California

Trailblazer Award

Jennifer Trosper

California Legislative Women's Caucus

Breaking the Glass Ceiling Award

Jakob van Zyl

International Academy of Astronautics, Basic Science Section

Corresponding Member

Duane Waliser

American Meteorological Society

Fellow

Donald Yeomans

Time Magazine

100 Most Influential People in the World

Major Contractor Partners

Lockheed Martin Corporation

Desktop Institutional Computing, Gravity Recovery and Interior Laboratory, InSight, Juno, Mars 2020, Mars Odyssey, Mars Reconnaissance Orbiter, Mars Science Laboratory, Repointing Mirror Engineering, Rosetta, Spitzer Space Telescope, Ultra Compact Imaging Spectrometer

Exelis Incorporated

Deep Space Network Operations

Northrop Grumman Systems Corporation

James Webb Space Telescope Mid-Infrared Instrument, Soil Moisture Active Passive

Raytheon

Data Systems Implementation and Operations, Focal Plane Assembly Modules, W-Band Gallium Nitride Monolithic Microwave Integrated Circuits for Cloud Doppler Radar

Computer Science Corporation

Information Technology Infrastructure Support

EMCOR Government Services Incorporated

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Orbital Sciences Corporation

Active Cavity Radiometer Irradiance Monitor, Dawn, Ocean Surface Topography Mission/Jason 2, Orbiting Carbon Observatory 2

ATK Space Systems Incorporated

Active Cavity Radiometer Irradiance Monitor, Europa, Low-Density Supersonic Decelerator, Mars 2020, Mars Lander Propellant Tank Development, Mechanical and Thermal Engineering, Seawinds/Ocean Surface Topography Mission/Jason 2

Malin Space Science Systems

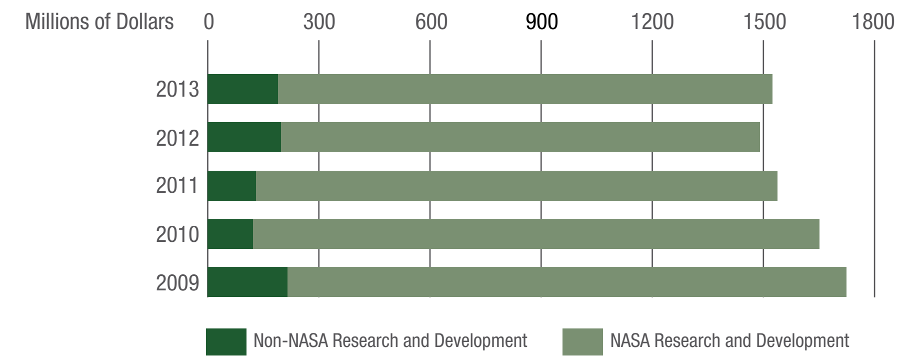
Juno, Mars Science Laboratory, Mars Reconnaissance Orbiter

G4S

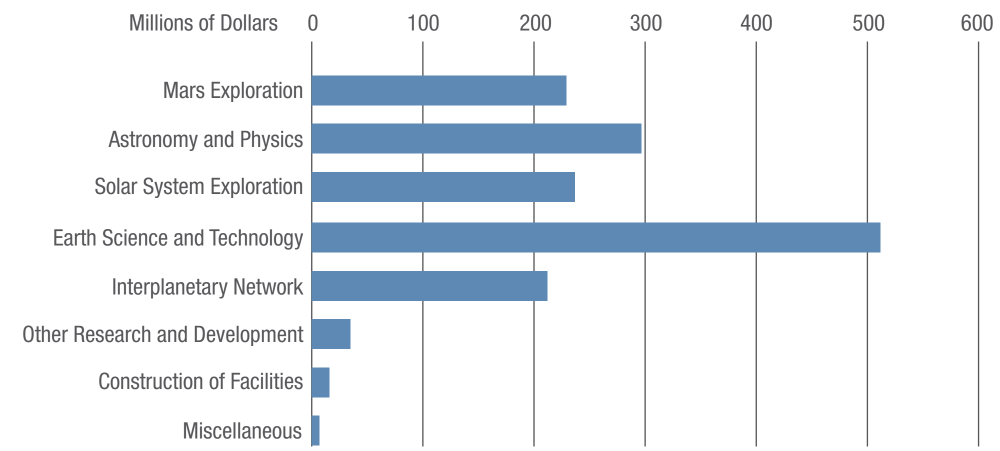
Security and Fire Services

Budget and Workforce

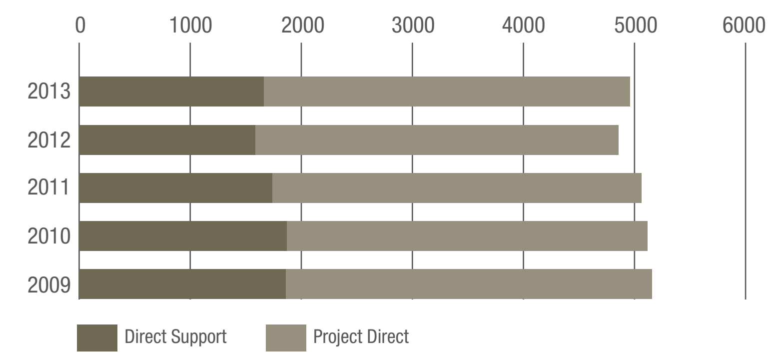
Total Costs



Total Costs by Program



Total Personnel



2013 total includes early career hires

Caltech Board of Trustees Committee on JPL

Ex Officio Members

Consulting Participants

Standing Attendees

JPL bid farewell to outgoing Caltech President Jean-Lou Chameau, here standing with JPL Director Charles Elachi. As a division of Caltech, JPL benefits from the oversight of the institute's trustee board, as well as from many campus–lab research collaborations.

JPL Advisory Council

Deep Space Network antennas in California's desert equipped with new technology called beam waveguides.

JPL Executive Council

Charles Elachi
Director

Larry D. James
Deputy Director

Chris P. Jones
Associate Director
Flight Projects and Mission Success

Jakob van Zyl
Associate Director
Project Formulation and Strategy

Blaine Baggett
Director for Communications and Education

Janis L. Chodas
Director for Safety and Mission Success

Diane L. Evans
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Dave Gallagher
Director for Astronomy,
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Cozette M. Hart
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Leslie Livesay
Director for Engineering and Science

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Chief Information Officer
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Victoria Stratman
General Counsel, Caltech

Jonas Zmuidzinas
Chief Technologist

National Aeronautics and Space Administration

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Pasadena, California

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