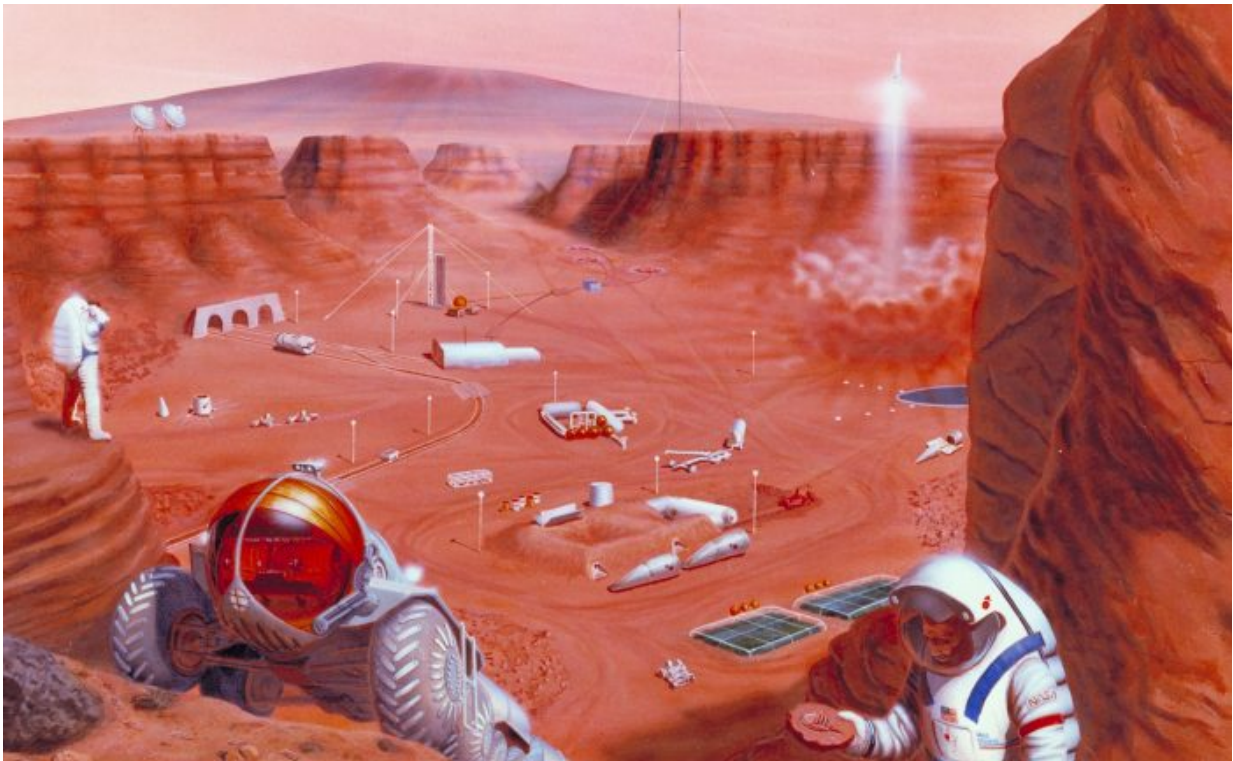


Geologic studies are a big part of upcoming space missions

September 14 2016, by Matt Williams



Future missions to Mars and other locations in the Solar System may depend heavily on the skills of planetary geologists. Credit: NASA Ames Research Center

In the coming decades, the world's largest space agencies all have some rather big plans. Between NASA, the European Space Agency (ESA), Roscosmos, the Indian Space Research Organisation (ISRO), or the

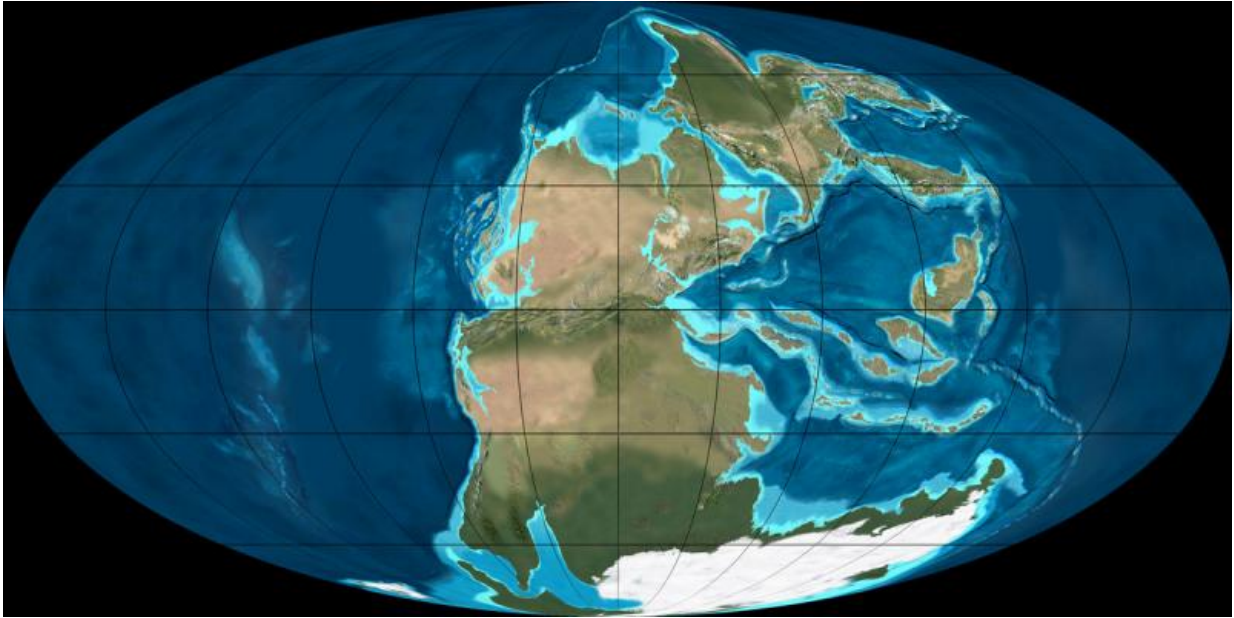
China National Space Administration (CNSA), there are plans to return to the moon, crewed missions to Mars, and crewed missions to Near-Earth Objects (NEOs).

In all cases, geological studies are going to be a major aspect of the mission. For this reason, the ESA recently unveiled a new training program known as the Pangaea course, a study program which focuses on identifying planetary geological features. This program showcases just how important planetary geologists will be to future missions.

Pangaea takes its name from the super-continent that that existed during the late Paleozoic and early Mesozoic eras (300 to 175 million years ago). Due to convection in Earth's mantle, this continent eventually broke up, giving rise to the seven continents that we are familiar with today.

Francesco Sauro – a field geologist, explorer and the designer of the course – explained the purpose of Pangaea in an ESA press release:

"This Pangaea course – named after the ancient supercontinent – will help astronauts to find interesting rock samples as well as to assess the most likely places to find traces of life on other planets. We created a course that enables astronauts on future missions to other planetary bodies to spot the best areas for exploration and the most scientifically interesting rocks to take samples for further analysis by the scientists back on Earth."



The super-continent Pangea during the Permian period (300 – 250 million years ago). Credit: NAU Geology/Ron Blakey

This first part of the course will take place this week, where astronaut trainer Matthias Maurer and astronauts Luca Parmitano and Pedro Duque will be learning from a panel of planetary geology experts. These lessons will include how to recognize certain types of rock, how to draw landscapes, and the exploration of a canyon that has sedimentary features similar to the ones observed in the Murray Buttes region, which was recently imaged by the Curiosity rover.

The geology panel will include such luminaries as Matteo Messironi (a geologist working on the Rosetta and ExoMars missions), Harald Hiesinger (an expert in lunar geology), Anna Maria Fioretti (a meteorite expert), and Nicolas Mangold (a Mars expert currently working with NASA's Curiosity team).

Once this phase of the course is complete, a series of field trips will follow to locations that were chosen because their geological features resemble those of other planets. This will include the town of Bressanone in northeastern Italy, which lies a few kilometers outside of the Brenner Pass (the part of the Alps that lies between Italy and Austria).

In many ways, the Pangaea course picks up where the [Cooperative Adventure for Valuing and Exercising Human Behaviour and Performance Skills](#) (CAVES) program left off. For several years now, the ESA has been conducting training missions in underground caverns in order to teach astronauts about working in challenging environments.



Rock samples on display at ESA's Pangaea training course, which is intended to help astronauts in identify planetary geological features for future missions to the Moon, Mars and asteroids. Credit: ESA/L. Bessone

This past summer, the latest program involved a team of six international astronauts spending two weeks in a cave network in Sardinia, Italy. In this environment, 800-meters (2625 ft) beneath the surface, the team carried out a series of research and exploration activities designed to recreate aspects of a space expedition.

As the teams explore the caves of Sardinia, they encountered caverns, underground lakes and examples of strange microscopic life – all things they could encounter in extra-terrestrial environments. While doing this, they also get the change to test out new technologies and methods for research and experiments.

In a way that is similar to expeditions aboard the ISS, the program was designed to teach an international team of astronauts how to address the challenges of living and working in confined spaces. These include limited privacy, less equipment for hygiene and comfort, difficult conditions, variable temperatures and humidity, and extremely difficult emergency evacuation procedures.

Above all, the program attempts to foster teamwork, communication skills, decision-making, problem-solving, and leadership. This program is now an integral part of the ESA's astronaut training and is conducted once a year. And as project leader Loredana Bessone explained, the Pangaea course fits with the aims of the CAVES program quite well.



Sedimentary outcroppings in the Bressanoe region (left), compared to sedimentary deposits in the Murray Buttes region on Mars (right). Credit: ESA/I. Drozdovsky (left); NASA (right)

"Pangaea complements our CAVES underground training," she said. "CAVES focuses on team behaviour and operational aspects of a space mission, whereas Pangaea focuses on developing knowledge and skills for planetary geology and astrobiology."

From all of these efforts, it is clear that the ESA, NASA and other space agencies want to make sure that future generations of astronauts are trained to conduct field geology and will be able to identify targets for scientific research. But of course, understanding the importance planetary geology in space exploration is not exactly a new phenomenon.

In fact, the study of planetary geology is rooted in the Apollo era, when

it became a field separate from other fields of geological research. And geology experts played a very pivotal role when it came to selecting the landing sites of the Apollo missions. As Emily Lakdawalla, the Senior Editor of The Planetary Society (and a geologist herself), told Universe Today in a phone interview:

"The Apollo astronauts received training in field geology before they went to the moon. Jim Head at Brown University, who was my advisor, was one person who provided that training. Before there were missions, the Lunar Orbiter program returned photos that geologists used to map the surface of the moon and find good landing sites."



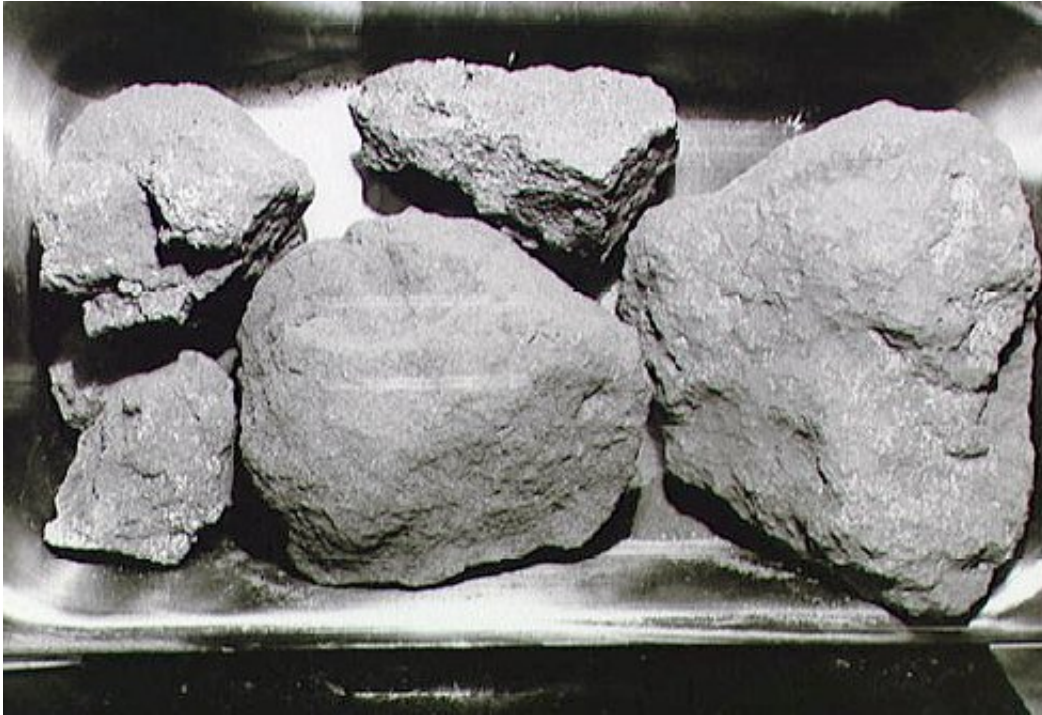
The six-member CAVES team in Sardinia, Italy, observing an underground pool. Credit: ESA/V. Crobu

This tradition is being carried on today with instruments like the Mars Global Surveyor. Before the Spirit and Opportunity rovers were deployed to the Martian surface, NASA scientists studied images taken by this orbiter to determine which potential landing sites would prove to be the valuable for conducting research.

And thanks to the experience gained by the Apollo missions and improvements made in both technology and instrumentation, the process has become much more sophisticated. Compared to the Apollo-era, today's NASA mission planners have much more detailed information to go on.

"These days, the orbiter photos have such high resolutions that its just like having aerial photographs, which is something Earth geologists have always used as a tool to scope out an area before going to study it," Lakdawalla said. "With these photos, we can map out an area in detail before we send a rover, and determine where the most high-value samples will be."

Looking ahead, everything that's learned from sending astronauts to the moon – and from the study of the lunar rocks they brought back – is going to play a vital role when it comes time to explore Mars, go back to the moon, and investigate NEOs. As Lakdawalla explained, in each case, the purpose of the geological studies will be a bit different.



Moon rocks from the Apollo 11 mission. Credit: NASA

"The goal in obtaining samples from the moon was about understanding the chronology of the moon. The timescale we have developed for the moon are anchored in the Apollo samples. But we think that the samples have been sampling one major impact – the Imbrium impact. The next moon samples will attempt to sample other time periods so we can determine if our time scales are correct."

"On Mars, the questions is, 'what are the history of water on Mars'. You try to find rocks from orbit that will answer that questions – rocks that have either been altered by water or formed in water. And that is how you select your landing zone."

And with future missions to NEOs, [astronauts](#) will be tasked with examining geological samples which date back to the formation of the

solar system. From this, we are likely to get a better understanding of how our solar system formed and evolved over the many billion years it has existed.

Clearly, it is a good time to be a geologist, as their expertise will be called upon for future missions to space. Hope they like tang!

Source: [Universe Today](#)

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