Geophysical Research Abstracts
Vol. 20, EGU2018-4017-1, 2018
EGU General Assembly 2018

The ESA PANGAEA field geology training prepares astronauts for future missions to the Moon and beyond

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On future planetary missions astronauts will explore planetary geologic environments with the objective of resolving important scientific questions through sampling and documentation in the field. Compared to the Apollo missions, more complex and difficult environments, such as lava tubes, canyon rills and rough surfaces could be made accessible through new surface EVA technologies, making the astronauts primary actors in the effectiveness of geological tasks. Training on Earth in locations with similar geological features and operational conditions is a necessary step, required not only to identify the most promising samples, but also to communicate effectively between astronauts and support back on Earth during geological investigations of planetary bodies.
In this preparatory context, ESA has developed the PANGAEA (Planetary ANalogue Geological and Astrobiological Exercise for Astronauts) field training: a programme designed to teach astronauts effective observation and decision-making methods, as well as efficient descriptive and documentation techniques to prepare future planetary missions with geological and geo-microbiological objectives. The course is designed to provide European Astronauts and operations engineers with introductory but very practical knowledge of Earth and comparative planetary geology processes and products, astrobiology and habitability, in order to prepare them to become effective partners of planetary scientists and mission developers in designing future exploration missions, to impart them solid knowledge of current understanding of the geology of the solar system from leading European scientists. PANGAEA also is the first step in preparing European Astronauts to become effective future planetary explorers during future planetary missions, enabling them and their science advisors on ground to effectively communicate, using a common, yet geologically correct language. PANGAEA also enables Europe to develop future operational concepts for surface planetary activities, where humans and robots will need to effectively cooperate, amongst themselves and with ground scientists and engineers, making the best of Earth field geology and planetary remote observation techniques.
The PANGAEA training has been held in two editions in 2016 and 2017. The course is organised in three main sessions, each with a specific focus: 1) Lunar geology and impact cratering, with a field traverse at the Ries impact crater in Germany; 2) Erosional and sedimentary processes and Mars geology, in the analogue Permo-Triassic terrigenous sequence of the Italian Dolomites; 3) Field traverses on a volcanic environment analogue to Mars and Lunar volcanism, in the Lanzarote Geopark in Spain. The final objective of the latter session is for astronauts to prepare and execute self-directed geological and geo-microbiological traverses, applying the flexecution method, preventing sample contamination and experiencing how specific operational settings, analytical and decision-support tools and supporting technologies influence the documentation and sampling process.
Even if the next lunar surface missions are foreseen in a timeframe of 10 to 20 years, the definition of effective geological sampling, curation and documentation will require a continuous and synergetic programme of preparation and field testing. PANGAEA represents one of the fundamental reference training and testing programmes, preparing for and leading to an effective and collaborative human and robotic scientifically sound exploration of the Solar System.