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TRAINING MARS GEOLOGY TO FUTURE ASTRONAUTS USING VIRTUAL REALITY

Abstract

In-situ investigations by NASA rovers Opportunity, Spirit and Curiosity have opened a new era in the understanding of Mars geology from the analysis of ancient rocks having revealed the presence of thick lacustrine deposits, mineral precipitates of various compositions or volcanic rocks of diverse origins. Scientific objectives for future human missions will still include geology-oriented objectives, especially with regard to the search for extinct life in ancient sedimentary deposits formed by aqueous processes during the warmer early Mars period. Many scientists involved in rover operations are experienced field geologists, with invaluable skills for the definition of rover objectives and daily operations. These skills are not common among astronauts, so they would need to be trained to Mars sedimentary environments in order to collect and analyze relevant samples, and communicate with Earth's geologist efficiently. The PANGAEA program (Planetary ANalogue Geological and Astrobiological Exercise for Astronauts) at ESA is a first step in preparing astronauts to become explorers on missions to other planets such as Moon and Mars by an experiential three weeks course in planetary field geology and geo-microbiology in earth analogue environments. In parallel to this geology training program, we have developed exercises in Mars geology using Virtual Reality named VE-GAME (Virtual Exercises of Geology for Astronauts preparing Mars Exploration), in which users are fully immersed in a virtual world reconstructed by stereo images acquired by Martian orbiters and rovers. The application provides an environment reproducing accurately what future astronauts could expect to observe on the Martian surface. The immersion in virtual reality improves the ability to understand morphological and geological features, without parallax or perspective distortions associated with two-dimensional visualization. The exercise enables the astronaut to identify and select areas of interest on his own, then individual rocks to be sampled for in-depth analyses and finally compare the results with geologists' interpretations. Indeed, it is of importance that astronauts are able to make informed decisions about the selection of rocks of interest: first because of long communication delays with Earth and second because rock selection for in-depth analyses requires a comprehensive understanding of the geological context. In addition, not all types of rocks can be sampled for deeper analyses. Thus, our tool provides astronauts with a way to practice Mars geology as if they were actually on the red planet.