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TRAINING ASTRONAUTS FOR EXPLORATION: ESA CAVES AND PANGAEA

Abstract

CAVES and PANGAEA are two ESA training courses that prepare astronauts for the exploration challenges presented in current and future spaceflight missions. CAVES (Cooperative Adventure for Valuing and Exercising human behaviour and performance Skills) uses natural cave systems to train astronauts in expeditionary and human behavioural performance skills to help prepare them for space exploration. These systems impose several stressors that are analogous to space exploration environments, such as the absence of natural light, isolation, confined spaces, limited hygiene and comforts, lack of common reference points, and three-dimensional progression requiring significant safety considerations, making them ideal analogues for this kind of training. Much like preparing for a space mission, trainees must learn new sets of mental and physical skills over a relatively short space of time, and then work together in a multicultural team to implement these skills in an environment with real-perceived risk. CAVES has been running since 2011, and has trained 34 astronauts from Europe, US, Japan, Russia and China. In 2019, the course ran for the first time using a new location in Slovenia's historic Karst region. PANGAEA (Planetary ANalogue Geological and Astrobiological Exercise for Astronauts) is a geological and astrobiological field training course from the European Space Agency (ESA) that trains astronauts for the task of performing science-focused surface exploration in complex geological environments. While the course intends to impart core theoretical and practical knowledge of these disciplines, significant focus

is given to skills in areas relevant to future missions, such as scientific decision-making, the ability to provide clear scientific descriptions of geological features and efficient documentation. For this reason, although portions of the course are taught in classrooms, developing independent field skills in analogue geological environments is a key part of the training. PANGAEA has been running since 2016, with participants including ESA and Roscosmos astronauts/cosmonauts, mission designers and engineers. The course forms part of the basic and pre-assignment training for European astronauts, and is open to trainees from other agencies. Whilst CAVES and PANGAEA's primary focus is training, where appropriate and complementary, technologies being developed for future missions are used and tested by the trainees. For example, the Electronic FieldBook (EFB) was developed in the context of PANGAEA and CAVES to support scientific data collection, and is now being investigated for use during future missions to the Moon and Mars.