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Testing technologies and operational concepts for field geology exploration of the Moon and beyond: the ESA PANGAEA-X campaign

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After the successful implementation in the last years of the CAVES and PANGAEA training programmes, ESA has decided to develop and offer to internal actors, partner agencies, and external investigators a new analogue test campaign, focused on testing technologies and operational concepts for field geology and exploration. The campaign has been called PANGAEA-eXtension and has been implemented for the first time on the island of Lanzarote, Spain in November 2017, immediately following the last session of the PANGAEA training. The location has been chosen because of the unique geological features present on this arid volcanic island and to build on the extensive expertise developed with the PANGAEA astronaut training. Two main objectives have been identified for the campaign: testing of technologies and operations for geological and geo-microbiological sampling, and testing of technologies for exploration, mapping, navigation and communication in low lighting conditions, lava tubes and rough terrain. Both these objectives are within the general aim to acquire knowledge on how to develop exploration and field geology strategies for planetary missions, with a specific focus on lunar settings.
Fifteen experiments have been proposed by eleven different research institutions and companies, involving four different space agencies, allowing to develop a testing programme with an ambitious set of inter-related goals, with outcomes applicable either or both to human and robotic exploration. Operational concepts for geological sampling during spacewalks have been compared, while testing new analytical and mechanical instruments supporting sample collection in realistic environmental and situational conditions. A series of technological applications have been used to achieve navigability and geologic information on the testing sites through 3D scanning and drone photogrammetry. Other tests included navigation of rovers in difficult terrains and lava tubes in automated and tele-operated mode. In these latter subsurface environments microbiological sampling has been combined with in-situ portable DNA sequencing of cave microbiota, remote sensing and 3D mapping, and testing underground communication instruments. Geophysical technologies have been used to identify underground voids and to characterize the geologic substrate.
All these tests and experiments have been performed with the participation of European astronauts and the assistance of ESA experts with the aim of evaluating potential applications and developments for future missions and trainings.
The synergies created by the PANGAEA-X campaign have demonstrated to be extremely useful for ESA in the framework of future human and precursor planetary robotics missions, as well as synergetically providing novel portable analytical instrumentation and a continuously increasingly relevant operational scenario for future CAVES and PANGAEA training events.