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ASTROLAND: AN INNOVATIVE PERMANENT ANALOG HABITAT TO EXPLORE THE CAPABILITIES OF SUBSURFACE HABITABILITY AND OPERATIONS IN MARS

Abstract

Previous research shows that establishing habitats underground in Martian caves, specifically lava tubes, would efficiently address many of the risks derived from the Martian environment. The lack of magnetic field will leave the crew at the mercy of cosmic ray and solar radiation Mars' thin atmosphere won't be able to filter the UV rays, and the extreme temperature cycles and dust storms would constitute a big hazard for both humans and equipment. However, we would be able to minimise these problems by building permanent habitats underground. Not to mention the interest on caves based on the spread consensus in the astrobiology community pointing those cavities as the most plausible locations where life could have be retracted when life conditions on Mars started to become harsher.

Research on human Mars missions, including most of the analog studies conducted on Earth, has focused mainly on surface operations, so more research and data is needed to address the specific requirements and challenges of subsurface habitability and operational performance. For that reason, Astroland has developed and operates the first permanent Mars cave analog extreme environment in a real cave near Santander, Spain, which has a max height of 60 m and a length of 1.5 km. Completely isolated from external interferences, the cave hosts Astroland's own Martian analog habitat, named Ares Station, fully equipped to enable to test EtE missions concepts: Research laboratories, made-to-measure astronaut suits, technical clothing for the various missions, hydroponics lab, autonomous power and water production systems, 3D printers, kitchen, leisure areas, gym, survival kits, food supplies specifically adapted for each crew member, plus the provision to expand modules.

All the field operations on (simulated) Mars are monitored and supported from a dedicated Mission Control Center located in Santander, enabling the implementation of different levels of autonomy for the crew and the support of a wide team of SMEs if needed.

After 15 tests campaigns and 2 main missions, Astroland's concept and infrastructure has achieved the maturity level to support long duration research analog missions to test and validate technology and operations roadmaps, as well as to establish a research hub for international cooperation.