Habitability of planets: How biological planetary analog field research, planetary simulation in the lab and space exposure platforms in low Earth orbit are supporting future exploration missions with the aim to search for life on other planets

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One of the main challenges in astrobiology and planetary research in the near future is to realize space missions to study the habitability of Mars and the icy moons of the Jovian and Saturnian system. Mars is an interesting object to search for fossilized life because of its past water driven wet history. River beds, sedimentary deposits indicating the presence of lakes [1] as well as a supposed but highly debated presence of a former ocean on the north hemisphere [2] are clearly showing that the atmosphere must have been much denser and the conditions much more habitable than nowadays. Even today still water activity is present in specific niches on the surface of Mars [3]. This leads to the conclusion that the search for habitable environments on Mars and the presence of bio-traces of extinct or extant life is a reasonable enterprise to be conducted in the next space missions. Besides the planet Mars other planetary objects in our solar system are promising candidates to find life as there are the icy moons. The Jovian moon Europa is one promising candidate, where water driven resurfacing activity of its icy crust must regularly happen because of the low amount of impact craters on the surface as well as the clear observations of cryo-volcanos which can only be explained by the presence of a liquid water ocean beneath the surface. Fissures and cracks with colored salty deposits coming from the inner side of the supposed global ocean are also clearly showing that this ocean can be a habitable environment [4] and where it would be good to search for present life. The Saturnian moon Eneladus seems also to be a promising candidate to search for life. On this moon high water plumes come out of an ocean covered by its ice crust [5]. Some observations by the probe of Cassini also have shown, that besides the presence of water and salts a high number of simple and complex organics was observed within these plumes. Also for the Saturnian moon Titan an ocean is supposed beneath the icy crust and this moon has not to be neglected in future astrobiology-driven exploration missions. Because of these very important observations of the last decades international and interdisciplinary scientific teams are working on new types of space missions with the main task to search for life. To realize these space missions, the scientific teams are combining work performed in planetary analog field sites with work in the lab and analysis performed in planetary simulation facilities as well as combined with research done in space on specific exposure facilities as there are satellites and the International Space Station (ISS). The technology developments and scientific approaches gained by this specific combined work performed in very extreme habitats try to solve problems which might occur if we would like to detect life on the other planets and moons in our solar system. For that, technology is used and tested in planetary analog environments like in the deep sea as well as in dry and cold deserts and different life detectors are developed and used during these field campaigns before testing them in space and using further in the next space exploration missions to Mars and the icy moons. Taken into account the international planetary protection guidelines which clearly formulate to first prevent contamination of a planets and moons and their special regions which might be habitable before sending probes on the surface, important work for cleaning and sterilizing the complex technology is necessary and sometimes a big challenge for engineers to fulfill these guidelines.

References:

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