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PLANETARY PROTECTION: MICROBIAL ANALYSIS OF THE EXOMARS 2016 SPACECRAFT AND ITS HOUSING CLEAN ROOMS

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Spacecraft are built and tested in highly controlled cleanrooms to ensure the cleanliness required for full functionality of sensitive components and scientific (life-detection) instruments. In case, a spacecraft targets planets and moons of astrobiological interest, additional requirements with respect to microbial cleanliness have to be fulfilled. These requirements are defined by the COSPAR planetary protection policy, to which all space-faring nations adhere. Avoiding the failure of the current and future missions by the introduction of terrestrial microbial contamination is of utmost concern. In particular, the bioburden, including the heat-shock surviving (spore-forming) cultivable microbial community is in the focus of space agencies due to its potential capability to survive a spaceflight. For ExoMars 2016, controlled cleanrooms have been used for the assembly, integration, and testing of the spacecraft. In our study, we have investigated the microbial bioburden and biodiversity of a newly built cleanroom in Turin via ESA standard assay (bioburden detection), different cultivation assays targeting oligotrophs, anaerobes and alkaliphiles, and molecular methods, including next generation sequencing and quantitative PCR. The aim was to document the changes in the composition of the microbial community from the commissioning on during the 3 years of utilisation when more and more spacecraft parts and components, ground support equipment and people populated the cleanroom. Our study showed that, during operation, the clean room harbored a very specific microbial community, composed of mainly human-associated microorganisms. In general, the detectable levels of bioburden and other microorganisms were very low and did not raise any concern. In this presentation, we will present details of the microbial analysis of the ExoMars 2016 mission during the three years before launch in March 2016.