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20 years of Quarantine Extraterrestrial Sample Analyses methodology

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NASA's MARS2020 space mission will sample soil containing putative traces of life and return them to Earth after 2031. Only Sample Return to Earth will guarantee access to the detailed, unique analyses we have been developing since 2001, when Mars Sample Return (MSR) was launched as a NASA – CNES project. Throughout the last 20 years, with CNES, we developed, tested and patented [1] a triple container, for our QESA (Quarantine Extraterrestrial Sample Analysis) nondestructive/multiprobe analysis methodology, imposed by COSPAR Planetary Protection requirements. Our BSL4 mini-curation/transport/containment unit, comprises 3 nested containers, leakproof-monitored, protecting both Earth and potential germs, from coming into contact [2]. XRF/XAS/XRD analyses of meteoritic samples helped estimate Minimal Detection Limits of low/high Z (P/S/K/Ca/Ti/Cr/Mn/Fe/Ni/Cu/Zn) on host minerals. For XCT, precession and rotation precision were tested for the internal mini-rotation drive and the absorption/scattering effects of triple container walls on the quality of 3D reconstruction. Results on meteoritic or Archean rocks [3-7] have proven feasibility of 2D/3D imaging of microorganisms on mineral hosts or aqueous alteration phases, potentially indicative of life on Martian meteorites; however, special requirements are mandatory when measuring in fluorescence submicron mineral grains containing organics [8].

Hyperspectral XRF/XRD mineral phase maps, 2D slice XRF fluo-tomography through grains, XAS oxidation state chemical mapping gradients, XCT full-field phase contrast tomography as well as lab-based Raman/IR tests were performed and estimated slightly worse realistic detection limits through the 3 wall containers. QESA is now ready for MSR.

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