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Dielectrical characterisation of clay soils for Mars radar investigations

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The latest data on the mineralogical composition of sedimentary deposits in some past lacustrine environment on Mars have identified the presence of different type of clay minerals. These clay deposits are of paramount interest in planetary exploration because they are strictly linked to the presence of water and to the capability of the analyzed environment to develop life and, as a consequence, to preserve fossilized life marker. The subsurface stratigraphy and geometry of sedimentary deposits on Mars is being investigated by the SHARAD (SHAllow RADar) instrument, a ground penetrating radar on board of Mars Reconaissance Orbiter (MRO). A reliable selection of dielectric parameters of the subsurface material is crucial for a correct calculation of the radar response collected by SHARAD including the depth of the observed radar interfaces which are likely linked to different geological formations and sedimentary strata. The dielectric properties of the rocks is strictly related to the mineralogy, density, water and/or ice content of the rock or soil.
For small grain size sediments, like clay minerals, the dielectric properties have a strong impact to the penetration depth of the radar signal.
In this study we focused on the evaluation of the dielectric constants of natural clayey sediments, considered as analogues to the Martian ones, to have an instrument to refine the sounding depths on Mars; moreover we focused on the relationship between dielectric properties and mineralogy, water content and temperature.
We have collected several clayey material samples from different geological settings and analysed the mineralogical content and the dielectric constant was measured using the Time-Domain Reflectometry (TDR) technique.
The samples were previously dried out and grinded and then we added water measuring his percentage content.
The TDR measurements were done modifying both the water content and the temperature to observe the variation in the dielectric behavior.
We obtained a meaningful set of measurements which allows a comparison of clay composition, water content and dielectric properties and provide clues for the clay identification with SHARAD data.