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A permittivity probe instrument developed for the Martian surface

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We report on the development and first results from a bore-hole permittivity probe to be used on the surface of Mars. The HP3-PP instrument was initially a part of the HP3 sensor suite intended to be on board of the ExoMars Humbold surface station. After the cancelation and postponement of the original ExoMars mission it was decided to continue with the sensor development until a sufficient maturity for a flight instrument was achieved.
We will present the design of a permittivity probe covering the frequency range of 4 – 20 000 Hz with a 1 Hz resolution suitable for subsurface measurements on a mole or drill rod. Thus we can cover a larger frequency domain than with usual mutual impedance probes. In general the instrument indicates a high sensitivity to ambient H2O deposits within the samples or the variable air humidity.

First laboratory calibration measurements in a temperature and humidity controlled environment will be shown. For calibration, several measurements were performed with three different environmental stable polymers, namely polyethylene, poly-methyl methacrylate and polytetrafluoroethylene. In comparison to common literature values, an accuracy of better than 10% can be achieved already with the uncalibrated sensor. Additional calibration values for the sample permittivity are gained from a high precision impedance spectrometer.
Further laboratory measurements using natural materials like granite, basalt and, assorted Martian analogue materials will be shown.