COMPARISION OF DIELECTRIC CONSTANT OF APOLLO 17 SAMPLES WITH MINI-RF & TALS.

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Introduction: NASA's Lunar Reconnaissance Orbiter (LRO) has returned its first RADAR (Mini-RF) imagery of the Apollo moon landing sites. In this paper the Dielectric Constant of Apollo 17 samples [1] have been calculated using SAR data with suitable model and these results are compared with the DC of the re-tuned Apollo 17 samples and the Terristrial Analogue of Lunar Soil (TALS) [2] to check the applicability of DC model over lunar surface.

Electrical parameter: Microwaves can be used for measurement of dielectric constant in laboratory which can be further used to estimate emmisivity. Natural surfaces emit radiations in the microwave region of the EM spectrum as a function of their material properties and surface roughness. DC is one of the important electrical parameter of the lunar surface and provides basic data necessary for further exploration. Here Campbell inversion model [3] is used for estimating dielectric constant from the vertical and horizontal backscattering coefficient given by Mini-RF (LH and LV hybrid polarized backscattered data). This model works for rock-poor dust surface and when radar measurements are made in linear horizontal and vertical polarizations.

$$\varepsilon_{\min} = \left(\sin\varphi \Big/ \sin\left[\cos^{-1}\left(\frac{\sigma^0_{HH}}{\sigma^0_{VV}} \right)^{0.25} - \varphi \right] \right)^2 \qquad \text{----1}$$

Where, φ is the angle of incidence.
σ◦HH= Horizontal backscattering coefficient
σ◦VV = Vertical backscattering coefficient

The equation 1 shows Campbell Model's applicability to the fully polarimetric mode. Since Mini-RF is working in the hybrid polarimetric mode and in the literature no such models are available which can be used for estimating DC from Mini-RF data. Here authors have tried to validate the model for hybrid polarimetric data.

Results: The Dielectric Constant of the Apollo 17 samples which has been measured in laboratory and also has been calculated using eq.1 from the model has been summarized in the table 1.

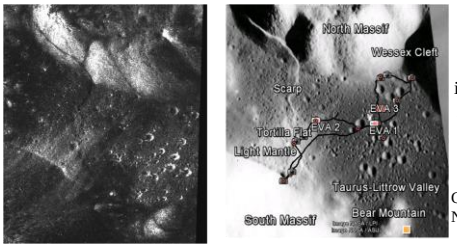

Fig. 1(i) Mini-RF image & (ii) Optical image of Apollo 17 Landing Site

Courtsey: Image NASA/LPI

From the results it can be concluded that Campbell model can be applied over some portion over lunar equitorial region since the dielectric constant values are almost equal to the DC values of the Apollo 17 samples and the DC values of TALS as shown in Table 2. Generation of appropriate model for dielectric constant estimation is important since it will help in identifying landing sites for future explorers, locate potential resources, describe the moon's radiation environment and demonstrate new technologies. For future work this model can be applied over other Apollo sites and results will be validated and also compared with measured DC of TALS.

Apollo 17 traversed path	**Ground based Apollo Results**		**DC from Campbell**
	Sample no.	DC	
Boulder	72441	3.12	3.158173
Camelot Crater	75080	2.40	2.461078
Near to Trident crater	75080	3.50	3.317966
Shorty crater	74220	2.60	2.112405
Shorty crater	74241	2.20	2.103984

Table 1. Comparion of DC from Campbell Model and Apollo 17 Ground based Results

Temp. (°C)	**DC from Apollo 17 Returned Samples (avg.)**	**DC from Campbell model using Mini-RF data (avg.)**	**Data obtained from our measurement 23 °C**
23° C	2.764	2.629	3.61–4.22

Table 2. In this table the measured DC of Terristrial Analogue of Lunar Soil (TALS) that was measured at room temperature at ICRS is given for comparision with the estimated values of DC using Campbelland Apollo 17 samples that were brought from the landing site.

References: [1] G.R. Olhoeft, D.W. Strangway "Dielectric Properties of First 100 meters of Moon" Earth & Planetary Science letters,24(1975) 394-404 [2]OPN Calla, Inder Singh Rathore "Study of complex dielectric properties of lunar simulants and comparison with Apollo samples at microwave frequencies" Advances in Space Research 50 (2012) 1607–1614 [3] B.A. Campbell, J.A. Grant, and T. Maxwell "Radar Penetration In Mars Analog Environments", Lunar and Planetary Science XXXIII (2002) 1616.