SURVEYING HIGH VS LOW FREQUENCY REFLECTORS IN THE GEMINA LINGULA REGION. A. Braeley[1], J.L. Whitten[1], B. A. Campbell[2], E. R. Jawin[2], G. A. Morgan[3], [1]Tulane Univ., New Orleans LA 70118, [2]Smithsonian Institution, National Air and Space Museum, Center for Earth and Planetary Studies, Washington D.C., 20013, [3]Planetary Science Institute, Washington DC, (abraeley@tulane.edu)

Introduction: The north polar layered deposits (NPLD) are a region of water ice and dust intermixed together at the north pole of Mars. The layers of the NPLD are interpreted to have been the result of deposition and sublimation primarily as a function of the orbital obliquity of Mars from the past 4 million years [1]. As a result, the NPLD layers are thought to preserve a history of the Martian climate. There may be a correlation between radar reflectors and the orbital obliquity. Optical data show visible stratigraphic layers exposed in trough walls [1], and it is thought that these reflectors correspond to layers seen in radar data [2]. The resolution between radar, and optical images is not the same, however. On this principle alone one cannot directly correlate a radar reflector with a visible stratigraphic layer. SHARAD radar resolution represents vertical resolution on the order of several meters [4], while optical imagery is <1 meter [10].

The NPLD radar reflectors correspond to dielectric constant boundaries due to subsurface variations in porosity and material composition. At such boundaries radar "reflectors" would appear as layers in radar returns [3]. Examples of such boundaries might be variations in dust and ice content in the NPLD as well as where such layers meet underlying bedrock. The reflectors in the NPLD exhibit characteristics that, when analyzed through wavelengths of different sizes, sometimes show different scattering characteristics than simple attenuation as a function of depth.

Using radargrams (two-dimensional cross sections of the subsurface arranged as columns along the scanned track with the vertical axis representing time), this work is an effort to characterize portions of the top "packet" of reflectors in the Gemina Lingula region. Particularly, we focus on where high and low frequency radargrams reveal reflectors that do not appear in both frequency channels, either at all, or with differences of reflector brightness (i.e., power). This work is focused on producing a map of the areal extent of specific reflectors in two frequency bands of SHARAD and reveal information about the correspondence between reflectors and materials properties of layer packets in the NPLD. Future work will continue this investigation into deeper packets of reflectors (Fig. 1).

Data and Methods: The SHARAD radar sounder instrument, on the Mars Reconnaissance Orbiter, uses a 15-25 MHz signal which can penetrate hundreds of meters through geological materials [3]. The signal is swept (or chirped) over a range of frequencies in an 85-microsecond pulse. We can split the 10-MHz bandwidth return into several sub-band frequency channels (called a "split-chirp"). Using a high frequency wavelength of 13.3 meters, and a low frequency wavelength of 17.1 meters, we can observe these differing reflection characteristics to observe variations between the high to low frequencies.

Using radargrams for both high and low frequencies, individual reflectors were analyzed and compared across both frequency bands. Attention was paid to where reflectors appear in one frequency band, but not the other. Reflectors appearing either entirely, or prominently across just one band are traced in blue for high-frequency reflectors, and in red for the low-frequency reflectors (Fig. 2). The blue traces therefore represent low-frequency reflectors that do *not* appear in the high-frequency band, and the red trace represents a high-frequency reflector that does not appear in the low-frequency band.

Preliminary Results: Radar sounding of the Gemina Lingula region of the NPLD show patterns of complex layering as well as ice composition [1, 2, 4, 5, 6]. "Packets" of reflectors (Fig. 1) are vertically clustered reflectors that are assumed to reflect variations of relative dust deposition and ice formation and loss. Radar reflection models [7, 8] give estimates of such dust content, and some research has been done to correlate the various reflectors with observations of albedo differences (assumed to be exposed layering) within NPLD trough walls [9].

The reflectors observed inside the NPLD do not appear to correlate with the layers observed in optical images of the NPLD. When the radargrams are broken down into sub-bands of high and low frequency reflectors we can see that layers are sometimes observable in only one sub-band of radar but not the other. Troughs in

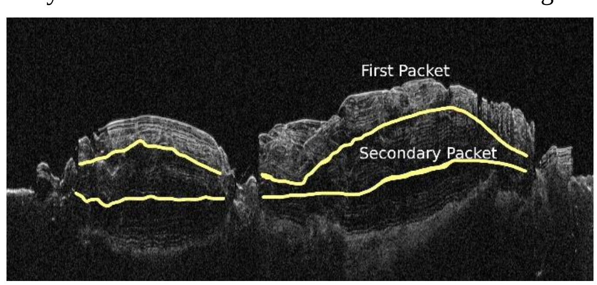

Figure 1: Example "packets" of reflectors within the NPLD using the full radar bandwidth of SHARAD. This radargram is SHARAD ID S_02291901.

the Gemina Lingula region frequently bound the reflectors on either side. Although unique reflectors can be found in both frequency bands, the low frequency band reveals more unique reflectors. Additionally, the low-frequency band reflectors also tend to extend until being bounded by trough features. The high-frequency reflectors sometimes, but do not always appear to correlate spatially with trough features (Fig. 3). The relationship between radar reflectors and optical layers cannot be inferred to be the same. The resolution of radar changes as the wavelength changes, and as shown with the mapping of sub-bands of SHARAD radar reflectors, there are complex dynamics that merit further study, as geospatial correlation differs between high and low-frequency reflectors.

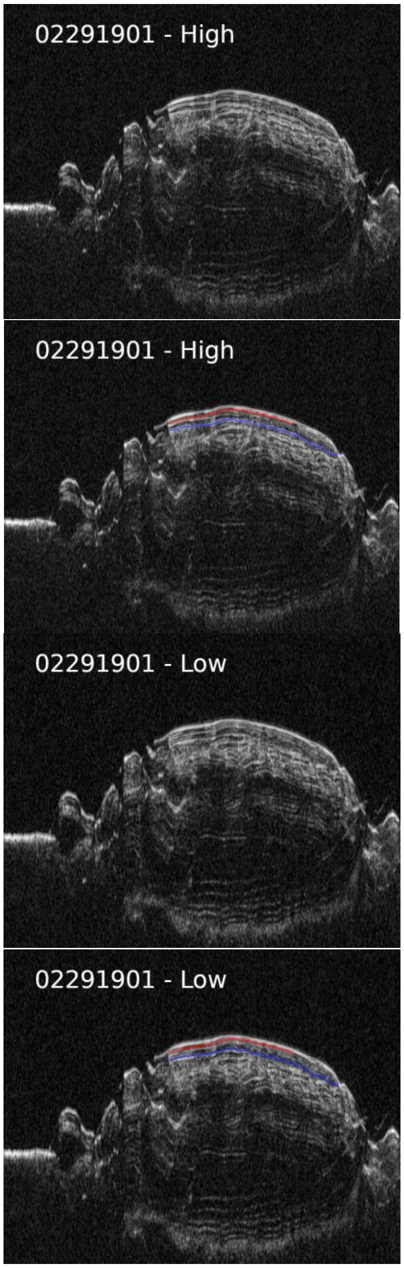

Figure 2: The four images above show the low and high frequency bands with their respective unique reflectors traced below each band radargram. The blue traces are unique reflectors in the high frequency channel, while the red trace is unique to the low frequency. The radargrams above are from SHARAD track 022919_01.

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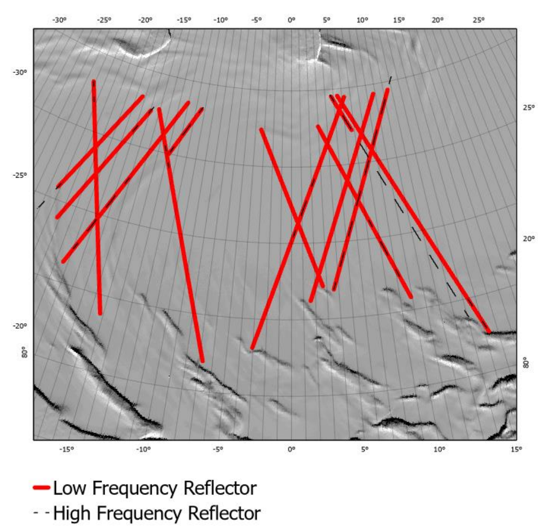

Figure 3: A section of Gemina Lingula showing the locations of uniquely low-frequency reflectors. The reflectors are bounded by the presence of troughs.