**Introduction:** Ground-based geophysical exploration of the Moon has been identified as high priority science in the next decade to be accomplished by landed geophysical networks, payloads manifested on commercial landers, and with instruments deployed by crews at the lunar surface [1,2]. In particular, in-situ seismic experiments will be important for probing the near subsurface and deep internal structures of the Moon [3,4,5]. Surface waves are widely used in a variety of earth-based surveying methods for earthquake tomography, void detection, resource identification, and geophysical & engineering site characterization [6,7,8,9]. Previous active seismic experiments during Apollo 14, 16, and 17 missions deployed arrays of geophones, seismometers, and used explosive charges to study the shallow subsurface structure of the Moon [10,11,12]. Apparent body wave signals were analyzed to show an increasing velocity structure with depth, whereas no clearly identifiable surface wave signals could be resolved [10,11,12,13]. This is generally attributed to strong signal attenuation and scattering by complex near-surface heterogeneous structures [13]. However, the coarse geophone geometries used can cause spatial aliasing of the surface wave signals to occur making the fundamental mode difficult to identify [14]. Identifying surface wave and developing methods to extract information from them in the highly scattering environment of the Moon will add a valuable tool for addressing scientific objectives identified in the Artemis III Science Definition Team Report related to: characterizing near-surface regolith structures, locating & mapping in-situ resources (ISR’s), imaging volcanic & tectonic structures, and identifying & characterizing potential building sites for the subsequent Artemis Basecamp [15].

Here we use a geophysical analog study of surface waves in terrestrial complex media to demonstrate how these waves can be potentially used on the Moon. Active 3-component nodal and vertical component geophone surveys were collected over lava flows in the San Francisco Volcanic Field (SFVF) in order to interrogate and image the near-surface shear velocity structure of a volcanic lunar analog environment. Active surface wave analysis using a Multichannel Analysis of Surface Waves (MASW) shows a lack of clear dispersive surface wave signals where the fundamental mode is difficult to identify. Full-waveform inversion methods focusing on inverting dispersion spectra could be a promising tool for surface wave analysis in locations with complex near-surface structures compared to traditional dispersion curve picking methods. We seek to determine whether the irregular signals are due to “leaky mode” effects due to complex near-surface structure and address how spatial aliasing caused by coarse receiver spacing in the SFVF and Apollo 16 surveys can affect our ability to understand these structures. We employ a full-waveform inversion in order to imaging the 2D shear velocity structures in the near-surface of a volcanic lunar analog environment.
are inverted to produce the near-surface shear velocity structure instead of traditional dispersion curve picking methods [17]. We will present our results for our spatial aliasing and full-waveform inversion analysis constraining the shear velocity structure in the shallow subsurface of the SFVF.

**Preliminary Implications:** Figures 1 and 2 show the initial results of the spatial aliasing analysis using simple and complex synthetic models. In both models, it is apparent that as the spacing between receivers is increased, the effect of fundamental mode aliasing begins to dominate the surface wave signals. This effect causes difficulty when using dispersion curve picking methods, such as MASW, where the fundamental mode cannot be easily identified. Full-waveform inversion methods provide a way to invert surface wave signals without the need to pick dispersion curves and may be an effective solution for irregular dispersive sites, such as the SFVF.

As we make our way back to the lunar surface with Artemis, in-situ seismic experiments will be important for probing the near subsurface and deep internal structures of the Moon. Lunar analog studies focusing on identifying optimal active source-source-receiver geometries are crucial for understanding the constraints and logistics involved with collecting good, workable seismic data on the lunar surface. Successful employment of surface wave methods will provide insight into key scientific objectives related to characterizing near-surface regolith structures, locating & mapping in-situ resources (ISR’s), imaging volcanic & tectonic structures, and identifying potential building sites for the subsequent Artemis Basecamp.