DEVELOPMENT AND INITIAL TESTING OF A VENUS-ANALOG SEISMIC EVENTS CATALOG. R. R. Herrick[1], Y. Tian[1], M. E. West[1], and T. Kremic[2], [1]Geophysical Institute, University of Alaska Fairbanks, Fairbanks, AK 99775-7320 (rrherrick@alaska.edu), [2]NASA John H. Glenn Research Center (tibor.kremic@nasa.gov)

Introduction: A network of seismometers on Venus could characterize the planet's internal structure and provide knowledge of the nature and level of current geologic activity, but the desired observation period of at least weeks far exceeds the ~1-hour lifetimes of previous landers in the harsh Venusian surface conditions. NASA Glenn Research Center (GRC) has been engaged in development of high-temperature electronics with the goal of enabling deployment of long-lived instruments on the Venus surface. They are working through various aspects of instrument design and testing for a seismometer [1]. The instrument will likely have a variety of limitations and restrictions. In particular, the instrument will likely be battery powered with little or no memory capability, and both data transmission and continuous operation will rapidly expend the battery. Part of the design process is testing approaches to solve these problems against anticipated seismicity.

Project Overview: With funding from NASA EPSCoR's Rapid Response Research and Research Infrastructure Development grant programs, we have developed a partnership with GRC and the Alaska Earthquake Center (AEC) to conduct a one-year research project to do the following:

1. <u>Evaluate the expected level and nature of seismic activity on Venus.</u> Initial estimates of the total level of Venus seismicity exist [2,3] that are simple scalings from terrestrial activity. We will expand on this effort and incorporate current knowledge of elastic plate thickness, lithosphere/upper-mantle properties, tectonic style, geodynamic/resurfacing scenarios, and other Venus-Earth differences to generate endmember estimates of the level and nature of expected seismicity.
2. <u>Construct catalog of terrestrial analog events.</u> AEC has access to its own database of ~700,000 published (named, described) events and other world-wide databases. Based on the results of Task 1, we will create a catalog of events that spans expected event types, a range of magnitudes, and different detector properties. The environment and tectonics of Alaska provide a rich set of seismic signals: there are recordings from a variety of plate-boundary and intraplate events, volcanic eruptions, landslides and other mass-wasting signals. Chemical explosions from mining activities (AEC also has the larger explosions of North Korea's nuclear tests) provide a set of impulsive signals ideal for benchmarking trigger algorithms and serving as proxies for Venusian meteoroid airbursts.
3. <u>Assess how potential design restrictions affect interpretability.</u> We will apply restrictions such as the following to records in the catalog developed: convolve the record with potential Venus sensor design response functions and noise levels; apply current seismometer designs for an amplitude "trigger" that turns on data collection; and apply data collection limitations imposed by battery life and data transmission capabilities. We will then evaluate the effects on desired outcomes from future Venus seismometers, including: obtaining the overall seismicity level for Venus; describing the source and energy of individual seismic events; and assessing the distances and locations of events.

Initial Work: Work on the project began in August, and by the VEXAG meeting we expect to have results from Task 1 nearly completed. Our plan of work on this task is as follows:

- Summarize the current state of knowledge.
- Break out Earth seismicity in a variey of ways, including: plate boundary versus intraplate seismicity; different plate boundary types; continental collisions versus ocean-continent; by depth; volcano seismicity, and by volcano type (especially felsic versus mafic). Certain regions, such as the African plate, may be good analog locations.
- Detail how Venus differs from Earth and how that might affect the level, location, and nature of seismicity. Examples of relevant issues include: effect of higher surface temperature on the brittle-ductile transition; implications of the lack of an asthenosphere; the apparent lack of organized plate tectonics; and implications of various geodynamic scenarios for surface-interior history. We will also consider the implications of better surface-atmosphere coupling.
- Apply scaling factors to Earth's divided up seismicity (above) to develop overall picture of Venus seismicity.
- Determine the expected role, if any, that meteoroid airbursts, which should be more common on Venus than Earth, have in Venus seismicity.
- Incorporate "lessons learned" from predictions versus reality for the InSight mission to Mars.

References: [1] Kremic et al. (2020) *Planet. Spa. Sci., 190,* 104961 [2] Lorenz R. E. (2012) *Planet. Spa. Sci., 62,* 86-96. [3] KISS (2015) *Probing the Interior Structure of Venus*.