GEOSPACE: AN APPROACH TO ACCESSIBLE AND INCLUSIVE PLANETARY SCIENCE EDUCATION. M. S. Cabalceta[1], M. L. Meier[2], A. Thompson[3], A. Baker[4], A. Marshall[1], A. J. Williams[1], J. L. Piatek[5], Y. Arroyo[1], T. Collins[6], S. Thatcher[7], E. Gallant[8], S. Elardo[1], D.A. Williams[9]. [1]Department of Geological Sciences, University of Florida, Gainesville, FL 32611 (mcabalceta@ufl.edu), [2]Department of Environmental Sciences, University of Idaho, Moscow, ID 83844 (meier3789mckayla@gmail.com), [3]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331, Department of Astronomy and Planetary Science, Northern Arizona University, Flagstaff, AZ, [5]Department of Earth and Space Sciences, Central Connecticut State University, 1615 Stanley St, New Britain, CT 06050, [6]Knowledge Media Institute, The Open University, Milton Keynes MK7 6AA, United Kingdom, [7]Engineering and Environmental Science, The City University of New York, College of Staten Island, 2800 Victory Blvd, Staten Island, NY 10314, [8]Hawaiian Volcano Observatory, Hilo, HI 96720, [9]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287.

Introduction: The fields of planetary science and geology aim to learn as well as educate about our Solar System. With this, it is important to focus on pedagogy and universal design to improve accessibility and inclusivity in the fields. The NSF-funded GeoSPACE Field Course is a multi-organization program centered around teaching planetary science using Earth analogs and spacecraft datasets. GeoSPACE specifically focuses on studying volcanology through geophysical and petrological lenses. The 2-week field course, which offers both in-person and remote attendance options, takes place in the San Francisco Volcanic Field (SFVF) in Arizona. The SFVF is a mixed composition volcanic complex in which students can explore a variety of features that have been identified on other planetary bodies, such as lava flows and cinder cones. Geospace's innovative approach makes field work accessible to students with disabilities and others historically excluded from field education.

Dual Approach Method: GeoSPACE provides a field course for every student, in-person or remote. A dual approach to the field course offers a multi-option program that all students can incorporate into their academics. Both groups of students work during the 10-day course as a continual feedback loop, grasping the geologic history of each volcanic feature and how they relate to volcanism on other planetary bodies.

Remote Participation. Remote students, referred to as "Mission Control," analyze planetary datasets to assess each field site prior to visits by the in-person students. They use different types of remote sensing data to create hypotheses for how features formed and questions for in-person students ("astronauts") to investigate when they explore the sites. Mission Control also looks at volcanism on other planetary bodies, such as Mars and the Moon, that is similar to the sites the astronauts visit. Using the research on Earth analogs and findings from other bodies, Mission Control prepares briefing presentations on each site for the astronauts to give them background information and set goals for them to achieve.

In-Person Participation. Students attending the field course in person travel to analog locations within the SFVF. These "astronauts" explore each site, investigating the formation of the feature and questions posed by Mission Control. Astronauts collect samples, look at the surroundings, and use different geophysical tools to assess the site's geologic history. These students

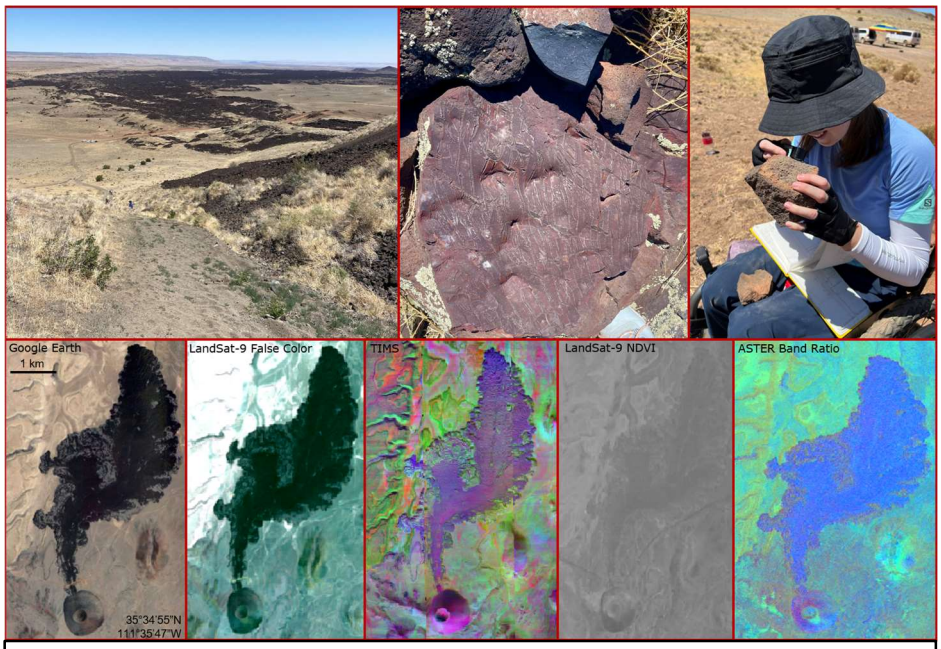

Figure 1. Example of one analog site (SP Crater, Arizona) analysis, including in-field observations of flow pattern and textures (top images) and remote sensing of spectral data of the cinder cone and lava flow (bottom images).

communicate their findings with Mission Control throughout the day using video-conferencing and social media, augmented by portable local area networks when cell coverage is limited.

Daily Schedule Outline: Both participation methods are used throughout the 10-day course. Mission Control meets with the astronauts each morning to brief them on what they'll be seeing during the day and what questions they should be looking to answer. During the field day, in-person students explore the different analog sites and relay their activities and data from the sites using Discord, Google Drive, Zoom, and YouTube Live web broadcasts. While astronauts are investigating the SFVF, Mission Control uses a variety of remote sensing data to evaluate the next days' sites and comparable volcanism on the Moon and Mars. At the end of the day, remote and in-person participants discuss their findings from the field site(s) that day to conclude an overall view of how the feature(s) formed on Earth and other planetary bodies, along with how they fit into the formation of the SFVF.

Techniques and Data Analysis: In addition to teaching about planetary volcanism, GeoSPACE also introduces students to different geophysical analysis techniques. Remote students explore each site using a variety of open access data and programs that are highly compatible with most operating systems. Students use Google Earth, JMARS, Mars Trek, Moon Trek, and LROC QuickMaps to examine sites on Earth, Mars, and the Moon. Each site is investigated using multiple types of data, including visible imagery, geophysical parameters (temperature, particle size, slope, etc), and spectral data. The datasets the students use to look at the Earth analogs are comparable to those from orbiters and rovers on other bodies. By assessing a variety of datasets on multiple mapping platforms, remote students can understand geologic features beyond what can be seen in person (see *Figure 1*).

In-person students use a variety of tools to collect data about the sites, including imagery and global positioning. Students focus on taking images of features, from large scale lava flows to microscale mineralogy. Additionally, students use a drone to capture aerial imagery of the sites and cover great distances than can't be traveled. Working with the Earthscope Consortium (formerly UNAVCO), students run a GPS survey combined with imagery to assess a mystery site. From there, remote and in-person participants use their combined data to create 3D models of outcrops and rock samples, and generate a geologic map and stratigraphic column.

Accessibility and Inclusivity: GeoSPACE is applicable to all students (undergraduate and early graduate) in the planetary and geological sciences who aspire to learn about volcanism within our Solar System. Having both in-person and online components allows for attendance by students with differing levels of mobility, executive function, and lifestyles.

Differing from the traditional field course, GeoSPACE funds students to attend, covering transportation, meals, lodging, and a stipend. Some universities do not have field courses nor funding for students to attend, while GeoSPACE removes the financial burden. Additionally, field courses specific to planetary sciences are uncommon, whereas GeoSPACE is applicable to planetary science and all areas of geology. In the summer of 2023, GeoSPACE will offer a credit option to fulfill geology major requirements.

The remote portion of the field course allows flexibility to accommodate student's schedules and responsibilities. Field courses for many students are not compatible with their home and work responsibilities. Students may have outside jobs, care-giving responsibilities, and/or classes during standard field course timeframes. The remote portion of the course is intentionally flexible, allowing students to attend when available and work independently as well in groups. All group activities are recorded, so that every student can replay the videos when they have availability. Remote students are given specific tasks to accomplish individually while also having Discord set up for support at any time.

The in-person portion of the field course can be tailored to fit every student's ability. Students can access all the field sites directly, as carefully selected to be disability accessible or via technology. Studentshave the opportunity to decide on their physical limitations for the day, with several options to challenge themselves as well. Many field courses aren't disability-conscious, and typically do not consider student's limitations and comfort. Additionally, in-person students do have the option to attend virtually on days of exhaustion, sickness, or otherwise unsure about the day's activities.

Conclusions: The GeoSPACE Field Program provides an inclusive, diverse, and accessible field course on planetary volcanology. Remote and in-person student work together throughout the field course to learn about volcanism on Earth, Mars, and the Moon and gain new data analysis skills. Using this dual participation method, GeoSPACE creates a field course adaptable for all students interested in planetary geology.

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