



HAWAII'S PORTAL
TO SPACE

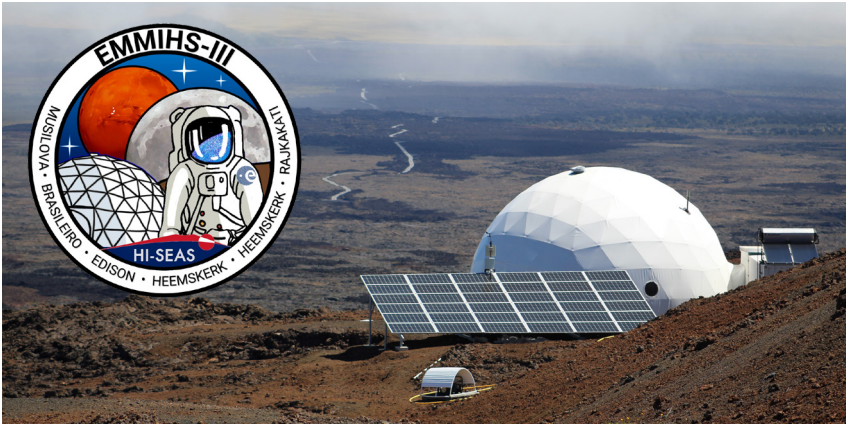


NEWSLETTER

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PISCES Prepares for Simulated Moon/ Mars Mission at HI-SEAS Habitat



Above: The Hawai'i Space Exploration and Analog Simulation (HI-SEAS) is a dome-shaped habitat nestled on the rugged volcanic landscape of Mauna Loa where teams of scientists research space exploration through simulated off-world missions.

PISCES will join a simulated astronaut mission later this month as part of a European Space Agency (ESA) initiative researching the technological and social challenges of living beyond Earth. Geologist and Materials Science tech Kyla Edison will be one of six crewmembers staying inside the HI-SEAS (Hawai'i Space Exploration and Analog Simulation) habitat on Mauna Loa volcano for two weeks, living and working like an astronaut on another world.

Beginning on Jan. 18, the crew will have little contact with the outside world and practice protocols simulating the life of a lunar/Martian explorer. They will cook with freeze-dried foods, conduct research and wear spacesuits whenever they exit the habitat's "air-lock" for EVAs (Extra Vehicular Activities).

Kyla plans to research how basalt sintering for in-situ resource utilization (ISRU) is affected by high-altitude environments. She will analyze samples from neighboring lava flows for crystal and mineral composition . . .

(Continued on page 3...)

Letter from the Director



Aloha Kākou,

It's a new year and on behalf of everyone at the PISCES 'ohana, I'd like to wish you and yours a happy and prosperous new year. We're entering 2020 with a lot of exciting possibilities, as well as a new set of challenges. But I'm confident that this will be a successful year.

Looking back at 2019, some of our notable accomplishments included the completion of a market feasibility study for a continuous basalt fiber manufacturing plant in Hawai'i County, and working with a group of potential investors interested in the project. Our basalt research also stirred quite a bit of interest in the space exploration community, and with private parties who were interested in exploring the commercial applications of sintered basalt tiles and other products.

This year we aim to improve the efficiency of basalt sintering and better understand its properties.

(Continued on page 5...)

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Waiākea Student & STARS Alumnus Begins Geology Internship



Left: Summer-Dawn Chamberlain (left), a STARS program graduate, works alongside PISCES Geologist Kyla Edison to understand how basalt grain size data can be translated into visual formats.

“Participating in the STARS program this last summer really boosted my confidence and made me even more excited to begin my career in science.”

A Waiākea High School student who attended the [STARS \(STEM Aerospace Research Scholars\) program](#) last summer is now interning with PISCES to hone her research skills and land her a job in the sciences some day. Summer-Dawn Chamberlain is learning the fundamentals of planetary geology and how it applies to PISCES’ basalt sintering research.

The internship is earning her credit through the Waiākea High School Public Services Academy which engages students in a variety of community-oriented activities including college and career awareness. Summer is particularly interested in physics and astronomy and wants to pursue a career in astrophysics, but her interests also extend into the space exploration.

Summer was among the 12 students who graduated from the STARS program in

2019, a week-long summer STEM program for Hawai’i high school girls coordinated by PISCES. She said attending STARS helped her believe she could become a scientist.

“Participating in the STARS program this last summer really boosted my confidence and made me even more excited to begin my career in science,” she said. “I think that to a high schooler, the idea of becoming a scientist can be really daunting. But to be able to converse with and hear the stories of so many different people from so many different fields really showed me how flexible your path can be, and how many options you have.”

Summer’s internship will continue through January. She hopes to gain skills and new experiences that will help her transition to a career in the sciences.

2019

PISCES Year in Review

↑ ECONOMIC DEVELOPMENT

- Pacific Spaceport Complex
- Basalt Fiber Manufacturing
- Sintered Basalt Testing for Commercialization
- Innovation & Manufacturing Center

👤 WORKFORCE

DEVELOPMENT



- Graduated 12 high school students during 6th-annual Women's STARS Program
- Mentored four college interns in robotics & materials science projects

🔬 APPLIED RESEARCH

- NIAC proposal in ISRU
- Basalt characterization
- Sintered basalt development

📢 OUTREACH & EDUCATION

- Attended & supported **38** community & outreach events

PISCES Prepares for Moon/Mars Simulation cont...



and experiment with sintering the samples at various temperatures using a mini kiln to determine which produce a viable material for ISRU applications beyond Earth (e.g. launch/landing pads, shelter, berms, tools, etc.). Kyla speculates that the 8,200-foot altitude will likely affect the sintering temperature needed to fuse basalt. Overall, she hopes to find an optimal thermal profile that produces a durable material, and gain insight into how the process might be adapted in space.

The mission (dubbed EMMIHS-III) will be the third organized by ESA's EuroMoonMars initiative. The first simulation launched in February 2019; the second in December 2019. Crews of the previous missions conducted geological and drone surveys, lava tube exploration and space technology tests.

HI-SEAS is a proven testing ground for Mars analog simulations and has hosted five long-term studies ranging from four months up to a year. The latest missions are shorter but have a broader focus, including both the moon and Mars. They are being conducted in partnership with ESA's International Lunar Exploration Working Group (ILEWG), the International Moonbase Alliance (IMA) and HI-SEAS.

Above: Kyla Edison, PISCES geologist, photographs a lava tube burrowed into the jagged lava flows of Mauna Loa volcano near the HI-SEAS habitat.

PISCES' ISRU Research Featured in *The Orbital Mechanics* Podcast



Last month, PISCES' research in In-Situ Resource Utilization (ISRU) was featured in a weekly space exploration and spaceflight engineering podcast, [The Orbital Mechanics](#). The episode featured geologist Kyla Edison discussing her work in basalt sintering and how it applies to space settlement beyond Earth.

During the [Dec. 10, 2019 episode](#), Kyla described how she gathers and analyzes volcanic basalt samples from Hawai'i Island to find the best candidates for sintering (or melting), creating remarkably durable building materials while cataloging varying basalt types. The sintering process could be used to produce construction materials beyond Earth, sparing the costly expense of transporting resources through space.

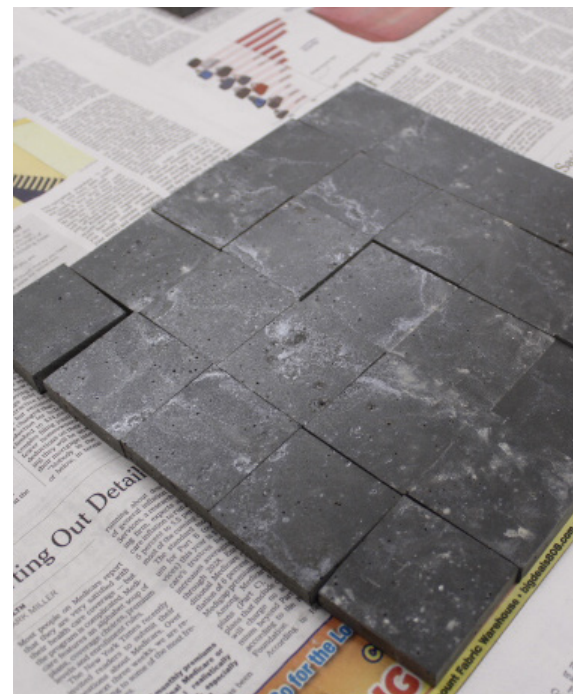
"[The Big Island of Hawai'i] turns out to be a really good analog site for the moon and Mars," Kyla said during the interview. "The geology here—the rocks in particular—are chemically and mineralogically almost identical to what you would find on the moon and Mars. So I can use this place as kind of like a simulation to make materials to apply to the Moon and Mars."

Kyla first met a member of *The Orbital Mechanics* team during the International Aeronautical Congress in Washington, D.C. last year and shared some of the basalt tile samples she created. The tiles—which the hosts thought resembled "polished concrete"—piqued the group's interest and Kyla agreed to an interview.

The Orbital Mechanics released its first

episode in December 2014, and has grown in its scope and reputation, completing nearly 250 episodes this month. The team includes David Fourman, cohost and editor; Ben Etherington, cohost and producer; Richard Durdan and Dennis Just, cohosts.

"While we've had big name guests like Dr. Marc Rayman and Andrew Rader on the show, we still find that some of the best knowledge comes from the quiet heroes of aerospace," said Etherington, who founded the podcast. "Our show has always been about engineering and design, and we'll never tire of hearing about the smallest details."



Above: Test results show PISCES' sintered basalt tiles are stronger than commercial concrete and can withstand extreme temperatures without cracking or changing form.

Letter from the Director *cont...*

We will also work to identify a broader range of commercial applications for basalt-derived products.

In the universe of space exploration, 2020 promises to be an exciting year. NASA's Mars 2020 rover is set to launch to the Red Planet in late summer. NASA's Artemis lunar program will continue to work on developing landers and technologies to put astronauts back on the lunar surface by 2024. And private companies like SpaceX and Boeing expect to complete test flights for their crewed space vehicles known as Starship and Starliner, respectively.

Here in Hawai'i, we're excited to begin organizing the first Hawai'i International Space Exploration And Robotics Challenge (HI-SEARCH). Inspired by NASA's Lunabotics Competition, this event will bring college teams from around the world to compete with space excavation robots

on Hawai'i's lunar-like volcanic terrain.

In other exciting news, our geologist Kyla Edison is gearing up to participate in a HI-SEAS mission on Mauna Loa this month. During this off-world simulation, Kyla will research the properties of basalt sintering in a space-like environment while living like an astronaut for two weeks.

In other research projects we are working with various groups to collaborate on new proposals including launch and landing pad materials testing and robotics field testing.

I'm looking forward to the year ahead and seeing what new horizons unfold as we continue our research and development for the aerospace sector in Hawai'i, and for the global human effort of space exploration.

*Hau'oli makahiki hou,
Rodrigo Romo
PISCES Program Director*

2020



Happy New Year!