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PISCES
NEWSLETTER

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Applied Research

Researching Hawaiian Basalt with X-Ray Vision

PISCES Geology Tech Kyla Defore prepares Hawaiian basalt samples for X-ray analysis.

That's no ordinary orange suitcase pictured above. It has superpowers.

PISCES Geology Tech Kyla Defore and Planetary Scientist Jeff Taylor were in a lab at UH Manoa last month zapping volcanic rocks with an X-Ray Diffraction (XRD) machine. The XRD—also called a diffractometer—beams radiation at tiny granules of Hawaiian basalt and returns comprehensive data to a computer about their elemental composition: namely, mineral and crystal content.

The work is part of an Applied Research project at PISCES that will determine the ideal composition of volcanic rock needed for uniform sintering and additive manufacturing—processes that can produce novel (and sustainable) building materials for use on Earth, and on the Moon and Mars where similar resources are available.

Kyla returned to PISCES headquarters with the XRD in mid-December where she and PISCES intern Kye Harford have been busy analyzing various basalt samples using the device. Once completed, the data will compose a comprehensive catalog of various types of Hawaiian basalt found on the Big Island of Hawaii. The results will also be published and shared at aerospace conferences in 2019.

Kyla Defore and Dr. Taylor at UH Manoa.

Message from the Program Director

Aloha Kakou,

I hope you had a peaceful and joyful holiday season. As we head into the new year, I'm reflecting on 2018 and seeing the many changes that have happened here in Hawaii. We saw the eruption of Kilauea's Lower East Rift Zone completely alter the landscape between Leilani Estates and Kapoho. Many homes and businesses were lost, as well as other places that were close to people's hearts. The eruption appears to have ended the Kilauea activity that has been going on since the 80s; now a new stage of the volcano has begun.

2018 also brought many exciting events in the space industry. Early in the year, SpaceX launched its Falcon Heavy for the first time using two recycled Falcon 9 cores as side boosters. The launch was followed by a synchronized, side-by-side landing of the boosters in an incredible feat of engineering.

(Cont. on page 3)

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Workforce Development

STEM Fair Engages Students with Science & Tech Careers in Hawaii

Top left: A student interested in engineering learns about PISCES' Materials Science research during PUEO's Mentorship Program fair on Dec. 12.

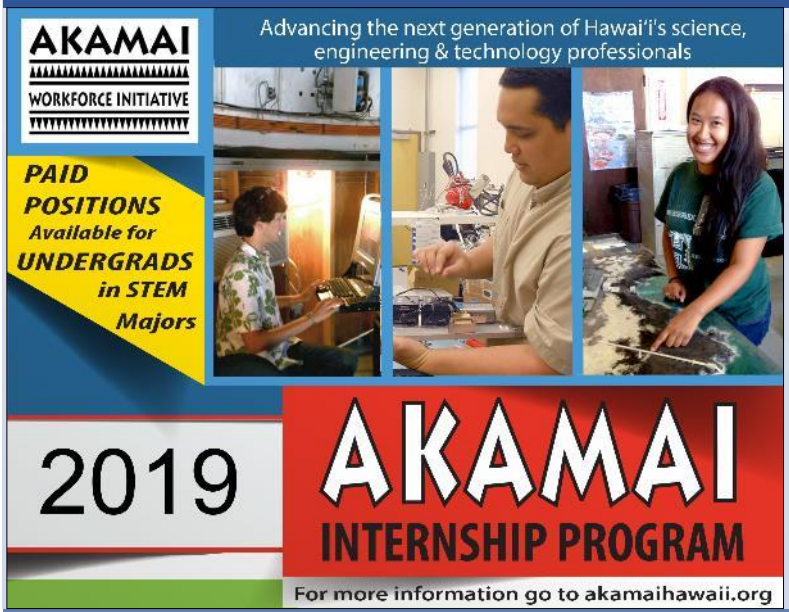
Telescopes, robots and additive manufacturing were among the highlights of a career fair organized by PUEO's STEM Mentorship Program at UH's Institute for Astronomy (IFA) in Hilo last month. Students from Keaau to Honokaa talked with scientists, engineers and outreach specialist in various STEM careers to find out about career opportunities on the island.

The event was organized by PUEO (Perpetuating Unique Educational Opportunities)—a Keaukaha nonprofit focused on creating opportunities for underserved youth—as part of its new mentorship program.

PISCES has been working closely with PUEO and its sister nonprofit, RISE (Realizing Individual Strength through Excellence), to offer an afterschool robotics club for Keaukaha students. Two college student mentors from the club brought their custom-built robots to share with event visitors.

Mentors from the University of Hawaii at Hilo, Gemini Observatory, East Asian Observatory, Subaru Telescope and IFA attended and supported the event.

Applications Open for 2019 Akamai Internship Program



Applications for the 2019 Akamai Internship Program are now open. Akamai offers Hawaii college students the opportunity to gain hands-on work experience at an observatory, company or science/tech facility in Hawaii. The eight-week summer program offers placements for both community college and four-year university students in a variety of majors. Recent graduates are also eligible.

Interns are matched to a project and mentor according to their interests. They also receive coaching on communication skills and present their final work at a symposium. The internship includes a stipend and housing (if needed), as well as any interisland travel costs.

To apply, students must be at least 18 years old and a resident of Hawaii. The deadline to apply is Feb. 14, 2019. Learn more and apply at: www.akamaihawaii.org.

Economic Development

Market Study for Hawaii Basalt Fiber Manufacturing Facility Complete

Above: Through a process involving pressure and heat, volcanic basalt rock can be molded into durable products like fabric and rebar. The trick is making it cost effective.

Last spring, PISCES organized a state-funded market study to find out if a Continuous Basalt Fiber (CBF) manufacturing facility on Hawaii Island could benefit the local economy. SMA, a defense and aerospace consulting firm, was contracted to conduct the feasibility study. The results are now publicly available and include data on:

- the global market demand for CBF;
- global manufacturing capabilities;
- the average market price for CBF products;
- the estimated cost of building/operating a CBF plant in Hawaii County;
- a business model to operate a CBF facility;
- the estimated cost comparison between CBF manufactured in Hawaii and elsewhere.

Similar to fiberglass and carbon fiber, CBF is manufactured by crushing and melting volcanic basalt, then drawing it into long strands through an extruder. The finished product can be made into heat-resistant fabrics, non-corrosive rebar, and other novel building materials. PISCES' research has found that Hawaii's basalt meets the specific chemical profile needed to manufacture high-quality CBF.

The study found that high energy costs in the islands—due in no small part to their isolated geography which poses additional logistical problems—would create challenges. Even so, the chemical composition of Hawaii's basalt could yield a high-quality, profitable product if private investors were to fund an operation. According to the study results, such a facility would generate roughly 81 jobs paying an average salary of $75,000.

The CBF manufacturing industry is currently valued at around $100 million worldwide and expected to double in the coming decade. The largest producers reside in China and Russia.

To a request a copy of the Basalt Fiber Market Feasibility study findings, please contact us at dbedt.pisces@hawaii.gov.

Message from the Director Cont...

To top that, we saw Elon Musk's Tesla roadster cruising through space. Small rocket companies like Rocket Lab also made great advances in their technologies, bringing the small vehicle launch industry into reality. In another great accomplishment, NASA completed another successful landing on Mars with its InSight lander to study the interior structure of the Red Planet.

Throughout the year, talks about returning to the Moon dominated space conferences and the political arena. Reflecting this trend, Henk Rogers—PISCES' Board Chairperson and the owner of the HI-SEAS habitat on Mauna Loa—announced plans to run lunar base simulation missions at HI-SEAS. Under this model, the missions will be shorter than the previous long-duration Mars simulations and focus on technologies and human needs for living on the Moon.

2018 was also a good year for PISCES. We received crucial funding support from the Hawaii Legislature, enabling us to hire a geologist which has made a significant contribution to our continuing basalt research. The study we contracted to research the feasibility of a basalt fiber manufacturing facility in Hawaii County was completed and I look forward to sharing the results with potential investors. Our research on sintered basalt has also created interest in commercializing it in the form of tiles.

In our Workforce Development efforts, our student interns continue to excel and our 2018 STARS (STEM Aerospace Research Scholars) Program for young women was the most successful yet, serving students from islands throughout the state.

We are headed into 2019 with a bright outlook. I look forward to continuing our mission to advance the aerospace industry in Hawaii, helping to position the state as a leader in space exploration.

A hui hou,

R. Romo

Rodrigo Romo
PISCES Program Director

Guest Spotlight

VR Offers Earthlings a Lifelike Lunar Experience

Ronald McCandless, CEO Lunar Experiences

Ron McCandless is an aerospace engineer and the founder of Lunar Experiences, a gaming company that aims to bring the experience of space to the public through virtual reality technology. By creating a realistic, immersive environment for users to interact with, he envisions inspiring the next generation through the wonders of space exploration.

Excitement for space exploration is on the rise and an increasing number of people are streaming launches and engaging on social media with the Mars rover and other missions. But only a very select few will get the opportunity to experience space travel first-hand—either as highly qualified astronauts or as paying space tourists. If you don't have at least $250,000 to queue up for a Virgin or Blue Origin tourist flight around the Earth, or hundreds of millions of dollars (like entrepreneur Yusaku Maezawa) to have SpaceX fly you and your friends around the Moon, you're currently out of luck.

What we need is a way to enable anyone to experience the excitement and inspiration of space exploration for the cost of a nice night out on the town. That's what Lunar Experiences plans to do, using gaming technology and a combination of virtual, augmented and mixed reality (VR/AR/MR) platforms to bring space to those on Earth—and to help the nascent space tourism industry. Consider playing a game with your friends on the lunar surface using actual spacecraft footage. Or piloting a spaceflight around the Moon as a pre-mission training exercise. How about controlling rovers and drones on the lunar surface via teleoperation from the comfort of your family room, helping to explore challenging underground lava tubes where astronauts might one day live. These off-world experiences can be simulated using real data from the Moon sent by coming private missions using laser communications technology, and smartly processed for various simulations, games, racing and other similar experiences.

Lunar Experiences is building a multitude of capabilities to accomplish these long-term goals. The best way to start, however, is testing these technologies and experiences here on Earth.

Situated on a lunar-like surface and with nearby lava tubes, the HI-SEAS (Hawaii Space Exploration Analog Simulation) habitat is a great location to test our partner rover and drone technologies, and to simulate teleoperation recruiting gamers as potential future controllers. With the 50th anniversary of the Apollo 11 moon landing coming this summer, Lunar Experiences is partnering with PISCES and others to engage space enthusiasts and gamers, and test out rovers from Cuberover of Pittsburgh, PA and drones from the University of Arizona's SpaceTREx Lab. HI-SEAS provides a remote, yet safe environment where we can not only test these technologies that are one part of our long-term vision, but involve the public using games and social media.

In celebration of Armstrong, Aldrin, and Collins visiting the Moon, this summer we'll be looking forward to a time when humans, rovers, robots and drones will all work together on the Moon while involving people back on Earth as participants through advanced virtual reality. This is the future that we intend to build, starting with our partners at PISCES and at HI-SEAS.

CubeRover, a spin-off of Astrobotic, Inc., has created a cost-effective, mobile robotic platform to allow universities, companies and others access to the Moon. Courtesy photo.