Pacific International Space Center for Exploration Systems
PISCES
Newsletter
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Economic Development

Firm Sought to Conduct Feasibility Study on Basalt Fiber Manufacturing in Hawaii

To launch a potential new industry in the State of Hawaii, PISCES is seeking a qualified organization to conduct a comprehensive market feasibility study for a Continuous Basalt Fiber (CBF) operation on Hawaii Island. The goal of the study is to determine whether such a facility could benefit the local economy.

PISCES has issued a Request for Proposals (RFP) as of Dec. 12, 2017, which is available to view online at pacificspacecenter.com/rfp. Completed proposals must be received no later than noon HST on Jan. 22, 2018. The deadline for receipt of Offeror questions is noon HST on Jan. 5, 2018.

CBF is derived from volcanic basalt through a heat-intensive process that requires no chemical additives or aggregates to produce. Industrial applications for CBF are based on a range of desirable properties including durability, fire retardance and high compressive strength. It is considered superior to alternatives like E-glass and S-glass in corrosion and abrasion resistance, thermal stability, heat insulation, vibration and chemical resistance. CBF can replace asbestos in most applications, and be used to make structural mesh, fabric, insulating material and basalt rebar. Currently, the global CBF market is valued at more than $100 million and expected to grow to $200 million by 2020.

Through testing, PISCES has confirmed that Hawaii Island's basalt meets the specific chemical composition needed to produce CBF. Analysis shows that worldwide, only a limited number of mines and quarries possess the correct type of basalt.

With a wealth of basalt and a host of possibilities for sustainable product manufacturing, Hawaii could see new manufacturing jobs and business opportunities through a CBF operation.

The study is part of PISCES' Applied Research and Economic Development objectives, developing space-related ISRU (in-*situ* resource utilization) manufacturing technologies that can benefit the State of Hawaii.

Message from the Program Director

Hau'oli Makahiki Hou!

And before we knew it, 2017 was over. We accomplished a lot this year at PISCES and as a result, have built a stronger organization. I would like to quickly review some of the major successes and events that happened this year and thank those who helped make them possible.

In 2017 we were awarded four grants that allowed us to continue our research in sintered basalt (NASA STTR Grant in collaboration with Honeybee Robotics & USC); fund our Summer Internship Program (Hawaii State DLIR Grant), fund our Women's STARS Program (Hawaii Technology Development Corporation Grant) and do research using Unmanned Aerial Systems (UAS) for little fire ant control (Hawaii County R&D Grant).

Cont. on next page…

In this Issue:

Outreach & Education

PISCES Rover Gets Spotlight for 'Space Craft' Show

Helelani sits outside the HI-SEAS habitat on the slopes of Mauna Loa prior to filming an episode of "Space Craft" with Science Journalist Loren Grush.

PISCES' planetary rover 'Helelani' and the HI-SEAS (Hawaii Space Exploration Analog Simulation) habitat will be featured in an upcoming episode of The Verge's Space Craft, highlighting aerospace and space exploration research efforts in the State of Hawaii. Space Craft is a space science and technology series produced by The Verge—a multimedia company that explores how technology will impact life in the future. Throughout the series, show host Loren Grush gets a first-hand look at the world of space exploration and human space training exercises through astronaut VR programs, Martian space suits and zero-gravity flights and more.

During her Hawaii Island adventure, Loren took the controls of our rover Helelani for a mock-Mars mission at HI-SEAS on Mauna Loa on Dec. 12, 2017. Captured by a two-man camera crew and guided by PISCES Program Director Rodrigo Romo, Loren piloted the rover from a laptop within the habitat, traversing Mauna Loa's rugged Martian-like terrain and capturing data of the surrounding environment.

On the following day, Loren and her crew focused on capturing footage of the HI-SEAS habitat and learning about the ongoing series of NASA-funded, long-duration human mission simulation studies conducted within the geodesic dome.

Footage from the "Mars mission" featuring Helelani and HI-SEAS is expected to appear in an episode of Space Craft next Spring on The Verge's YouTube channel.

Top: Driving Helelani outside HI-SEAS using a handheld remote. Bottom: Rodrigo and Loren at 'mission control' inside the habitat.

Program Director's Message *cont...*

We also welcomed Kyla Defore to the PISCES ohana as our Geology Technician. Kyla was a three-time PISCES intern and important staff participant during the 2016 and 2017 STARS Program. Her academic background and personal passion for Geology has already made a significant impact in our Applied Research work to develop basalt as a feedstock for ISRU manufacturing.

We were invited to participate in several significant space conferences during 2017: the annual Space Symposium in Colorado where I was fortunate to sit on a panel discussing human colonies on Mars; the 1st International Moonbase Summit held here in Hawaii; and the Second International Basalt Forum held in Moscow which I participated in via teleconference.

In 2017, we also continued our mission to inspire youth through events like Astro Day, Astro Day West Hawaii, Ellison Onizuka Day, Journey Through the Universe Week and March for Science. We also expanded these efforts by partnering with the Pacific Aviation Museum Pearl Harbor, supporting their 'Discover Your Future in Aviation' events in Ka'u and Honolulu. Additionally, our planetary rover Helelani was featured in three different STEM-related TV/YouTube shows including two segments on Xploration Station's Xploration Outerspace and C-NET.

Our Summer Internship Program employed five local students working in Robotics and Materials Science. Many of our former interns are continuing to excel in their academic and professional lives, landing employment at prestigious organizations across the country *(cont. on page 3).*

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Workforce Development

Former Intern Returns to Build UAV During Holidays

USC Boulder student and former PISCES intern Lily Leyva buddies up for a photo with the DJI UAV she built and programmed in late December/early January.

While many people were taking time off for the holidays, former PISCES intern Lily Leyva was hard at work assembling PISCES' new UAV (unmanned aerial vehicle). The octo-copter is part of a project with the County of Hawaii's Dept. of R&D to create a fire ant bait dispersion system in tree canopies.

Lily had returned home to Hawaii Island for the holidays after completing her first semester at University of Colorado at Boulder where she is studying Aerospace Engineering. She interned with PISCES during Summer 2017, assembling and programming a 3D printer, designing planetary building Blocks and conducting geology field work. The Kea'au High School alumna is also a 2016 STARS Program graduate.

Though she had no experience building UAVs, Lily's knack for engineering and natural ingenuity had the vehicle fully assembled and partially programmed within days. She said she enjoys learning and trying new things, and that the project has been a lot of fun for her.

The next step in the project will be to design and integrate a fire ant bait dispersion payload aboard the UAV and conduct field tests to confirm the system's effectiveness.

Applications are open for 2018 AKAMAI internships! Visit: akamaihawaii.org.

Program Director's Message *cont...*

Significant work was done this year in various projects with the potential to significantly impact the State of Hawaii's economy. The main projects we participated in were the East Hawaii Small Satellite Launch Facility, the Multi-Purpose Processing Facility, a Laser Communication Ground Station and securing funding for and soliciting a market feasibility study to develop a Continuous Basalt Fiber (CBF) manufacturing operation in Hawaii.

Despite our many accomplishments at PISCES this year, we still face challenges ahead. I believe the value of our work and outcomes are being increasingly recognized by the Legislature, and we have formed strong alliances with members of the House and Senate, in addition to the continuing leadership support we receive from the Department of Business, Economic Development & Tourism (DBEDT). However, the supplemental funds we requested were not approved. We will once again need to secure funds through various research grants to continue with our programs and projects.

Although this presents a challenge, I have strong confidence in every member of our team at PISCES to persevere, and we will begin 2018 in a stronger position than we went into 2017.

I look forward to the coming year and sharing the continuing progress of our exciting projects and programs with you.

May 2018 be a successful year for you and your families!

A hui hou,

R. Romo

PISCES Program Director

Guest Spotlight


Madhu at the proposed moon base site on Hawaii Island.

Madhu Thangavelu, *USC School of Architecture*

Vision for the 'Mahina Lani' Moon Base Simulator in Hawaii

In early October, Henk Rogers, the Chairman of the PISCES organization and the owner of the HI-SEAS Mars base simulator, invited a group of lunar experts to gather at the Mauna Lani Resort to discuss various subjects relating to our Moon with the intent of creating a new vision for a permanent lunar settlement. Among the group were an artist extraordinaire, architects, engineers and lunar scientists. It was delightful to see a large group of enthusiastic high schoolers in the mix of attendees, who we hope were inspired and will be deeply involved in creating and operating a lunar settlement.

The meeting was inaugurated by former governor George Ariyoshi, and several state officials who attended to support the event and promote future related projects. Buzz Aldrin was the guest of honor and he assured everyone that our Moon is the next logical destination after ISS for NASA activities to prepare for a much more ambitious Mars expedition.

It was indeed exciting to hear about the agreements signed by NASA and Roscosmos at the IAC in Adelaide to build the lunar orbiting Deep Space Gateway that concluded just before Rogers' International Moonbase Summit (IMS), as well as the plans to return to the Moon laid out at the first meeting of the newly constituted National Space Council in Washington D.C., which happened at the same time. Talk about a confluence of lunar meetings in quick succession!

There were several meetings throughout 2017 at NASA, ESA, JAXA, CNSA and Roscosmos, including the ESA Moon Village workshop at the International Space University in Strasbourg that just concluded in early November. That meeting was followed yet again by the Global Exploration Coordination workshop at NASA Ames Center that has now set the Deep Space Gateway project into the forefront of the international coordination framework. In short, lunar experts are having a hard time keeping up with meetings and developments, but enjoying it all the same.

At the end of the IMS in Hawaii, we were invited to visit the HI-SEAS Mars simulation habitat that is being readied for the third long-duration simulation starting in January 2018. Prior to the HI-SEAS visit we toured the pristine 100-acre site not far from the HI-SEAS site that is being set aside by the US Army for building a high-fidelity lunar base simulator. To the visionary, the architect or the engineer alike, the drive up to the site, the magnificent and desolate high-altitude scenery, the lack of vegetation and the black lava terrain of weathered, cracked and broken basalt rock is truly alien. A bit of photoshopping and cropping to tweak the skies and there you have it—a pristine lunar terrain! It should not come as a surprise that Apollo crewmembers rehearsed field exercises in these parts of Hawaii.

The IMS concluded with a resolution to create and operate a high-fidelity lunar base simulator at the site offered by the US Army. Simulators are key to understanding and refining the technologies and operations of systems in complex endeavors like planetary settlements.

The Mahina Lani Simulator (the official name of the proposed lunar base in Hawaii) should be quite an exciting and fast-paced project for several reasons. Organizers have already been granted an extensive site that has lunar terrain semblance and characteristics, possess valuable experience through constructing and operating the HI-SEAS facility, and have US Army support with heavy equipment to help facilitate the groundwork. And, as was repeatedly mentioned at the IMS, Hawaii sits in a geographic sweet spot, globally accessible without overly long flights and transits, both from Asia and the Americas. We have already made international headway by linking space projects with Japan through the JUSTSAP program, which has now evolved into PISCES through support from the State of Hawaii.

Human space activity in particular has always been a very refined, energy and resource conscious endeavor, mindful of footprint and pollution, progressive and forward-looking in nature. Human space systems have been at the forefront of clean and renewable technologies from the very beginning. It is our hope that the Mahina Lani vision and concept will have the support of all the world's space agencies and find enthusiastic, visionary and forward-looking partners and investors to make this a truly Cosmopolitan effort for the whole world to take part in—especially for the next generation who yearn for a future that is globally sensitive and environmentally friendly.