PISCES
Pacific International Space Center for Exploration Systems

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PISCES HAWAII

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Changing Tides and Navigating the Future

PISCES Program Manager Rodrigo Romo

It is said the only constant in the universe is change, and PISCES is not exempt from it. We are facing new challenges that will lead to unique opportunities both for PISCES and the State of Hawaii. For the past three years, PISCES created a recognized and well-respected name in the international aerospace community, a name that will now allow PISCES to move forward in its new direction.

The biggest challenge PISCES faces for this coming year is a tight budget. In addition to reducing staff, it will be necessary to adopt a more efficient and streamlined mode of operation in order to succeed. PISCES' new vision is organized around three main pillars that form the foundation of its operation. Each of the pillars feed and support the other two.

These pillars are:

- *Applied Research*
- *Workforce Development*
- *Long-Term Economic Development*

It's through applied research that PISCES has recently gained attention in advanced manufacturing using basalt not only for space exploration applications but for applications in the State of Hawaii as well. Basalt research is now the main subject for grants and collaborative agreements to advance the use of this substance.

Internships and other outreach-related programs, such as STARS and MoonRIDERS, have been instrumental in all of PISCES' projects. Through the knowledge gained from

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PISCES would like to congratulate our robotic technician for his new position at Google! ***PG. 4***

Google

PISCES changes continued…

hands-on experience, local college and high school students are better prepared to meet the demands of the aerospace industry both nationally and globally. They also have a much greater chance to succeed in a highly competitive field.

Applied research is the seed that will produce the fruit of long-term economic development. While these are projects that take longer to mature and bear fruit, PISCES will continue to be involved in projects such as the Laser Communication Station, the Multi-Purpose Processing Facility, the Kona Spaceport Project, as well as energy and sustainability projects.

Through collaboration with State and national agencies and institutions, private companies and grants, PISCES will be supplementing its funding with the goal of placing Hawaii on the leading edge of aerospace and space exploration while creating STEM-related opportunities for Hawaii's future generations. Our projects are also pivotal in diversifying the State's economy.

This summer PISCES added new members to its Board of Directors. We are proud to welcome Dr. Luke Flynn, Dr. Kim Binsted, Dr. Patrick Sullivan, and Dr. Kris Zacny to our board. Their expertise and knowledge of aerospace, space exploration and technology will help PISCES solidify its position in the industry. We are looking forward to working with our new board members and to face the new challenges ahead.

EDUCATIONAL OUTREACH

EXPANDING BOUNDARIES WITH PISCES

PISCES Program Manager Rodrigo Romo spoke to two groups of visiting Japanese students about our projects last month.

PISCES Program Manager Rodrigo Romo lectured groups of visiting Japanese high school students from Aug. 26-27 at the Imiloa Astronomy Center in Hilo.

PISCES Program Manager Rodrigo Romo is seen here with the Kansai University students.

PISCES was invited as a guest speaker at the first annual Hawaiian Educational Pursuits seminar for Kansai University high school students.

Kansai is a "super global high school" and allows participating students to spend their summer or spring holidays in a foreign country learning the local language. In addition to language lessons, the host universities provide extracurricular activities, field trips, and the experience of living in the local community.

Claudia Ziroli-Coyl recently started Hawaiian Educational Pursuits after working with the University of Hawaii at Hilo Conference Center. While working with UHH she helped to develop an outdoor educational travel program called Hawaiian EDventure, where she worked with the students of Kansai University for several years.

This year, Claudia decided to branch out and start her own educational tour program for the students, and was excited to expose them to a variety of subjects during the seminar.

Rodrigo talked to the students about the history of exploration, Mars and Moon research, and the science behind creating our Vertical Take-Off/Vertical Landing pad.

For more information on the organization you may visit their website at hawaiianeducationalpursuits.com.

APPLIED RESEARCH

Expanding our Research in Basalt Sintering

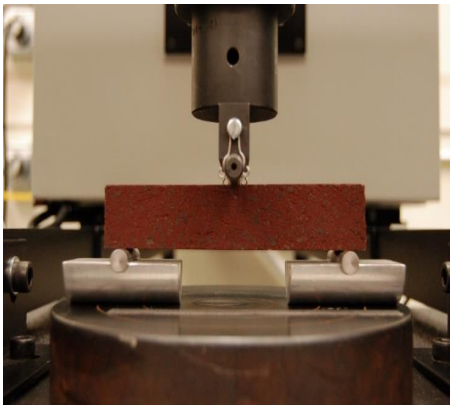
Data produced during PISCES' Vertical Take-Off/Vertical Landing (VTVL) pad project has opened a range of opportunities to further explore the possibilities of basalt for space and Earth applications. One of the primary objectives of the VTVL pad project that took place earlier this year was to produce a paver made only with Hawaiian basalt. That paver had to be capable of withstanding the impact of a 960-pound rocket motor, as well as the temperature of the jet plume.

PISCES engineers perform the initial assessment of the VTVL pad displacement of sintered basalt pavers after firing a 960-pound rocket engine. Picture to the left courtesy of 'ENA Media Hawaii.

Working with scientists at NASA's Swampworks in Florida, PISCES Operations Manager Christian Andersen was able to manufacture 100 12" x 12" interlocking pavers that were used in the engine test. While the engine test uncovered some weaknesses in the design of the pavers, the strength of the material as well as its resistance to the direct impact of the engine plume surpassed expectations.

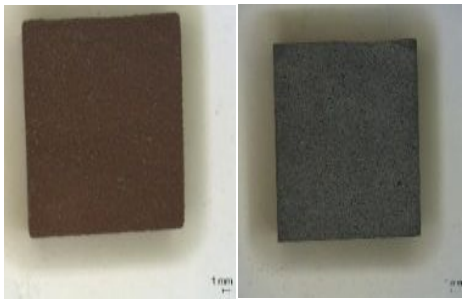
Structural analysis of the sintered basalt pavers showed the material produced had higher flexural and compressive strength than residential concrete.

A close inspection of the impacted paver after the rocket engine test showed the amount of material lost at the impact point was negligible, indicating the sintered basalt paver successfully endured the impact from the engine plume at a short distance. Thermocouple data showed the material also has high thermal insulating properties.



A sintered basalt paver sample is seen here being analyzed at NASA's Engineering Directorate Laboratories and Test Facilities Division, Kennedy Space Center FL. Picture courtesy of NASA.

During the manufacturing of the basalt pavers, PISCES Operations Manager Christian Andersen tested different sintering temperatures. One of the samples produced was sintered at a temperature 27°C higher than the pavers used in the VTVL test. The properties from this sample (27-C) have triggered interest in further studies and development from NASA, as well as within PISCES. NASA received a sample of this new material and ran structural and chemical analyses. They determined the materials used to produce 27-C were indeed the same materials used in the production of the VTVL pavers. Their results showed the 27-C sample has a higher density than the VTVL sample. The density of the new material is *1.55 times higher* than the density of the original pavers. Preliminary results indicate the 27-C sample is approximately 10 times stronger than the VTVL samples.



Sample of VTVL sintered basalt (left) and 27-C sample (right). Picture courtesy of NASA.

Some potential applications for basalt in space include additive construction, thermal or radiation insulation, construction materials and others. In Hawaii, basalt could replace some of the cement that is imported to the State for multiple uses. ***See more photos on pg. 4***

WORKFORCE DEVELOPMENT

PISCES Robotics Technician Teddy DeRego will be leaving PISCES for a job at Google!

PISCES Robotics Technician Teddy DeRego recently accepted a job offer from Google!

Teddy is graduating from the University of Hawaii at Hilo. He is a Big Island native and Kamehameha Schools graduate. He's been working with PISCES for more than a year, and will take his experience to the next level as a software engineer with this well-known company.

Teddy learned about PISCES through our other robotics technician, Casey Pearring, a UHH graduate.

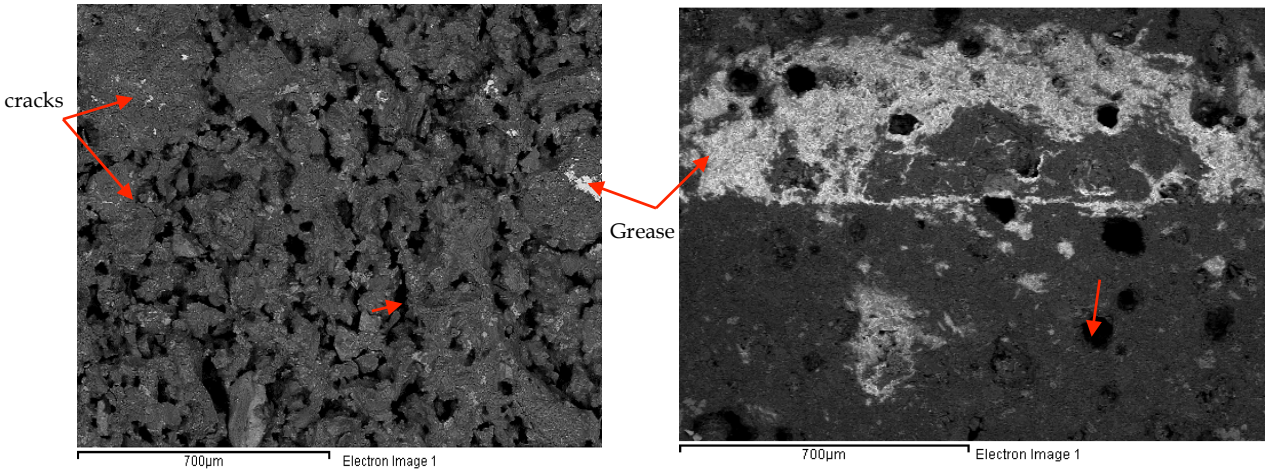
"I was a little nervous because I'd never done robotic software before," he says about applying for the job.

But soon enough, he was hired and settled right in. Our engineers put him to work with the ambitious project of developing the graphical user interface (GUI) for our rover… from scratch!

"I learned a lot about hardware," he says. "Working with PISCES was a unique experience."

Congratulations Teddy! PISCES wishes you the very best of luck in your life and career.

Sintered Basalt Photos…



Scanning Electron Microscope Images of samples sent to NASA's Engineering Directorate Laboratories and Test Facilities Division, Kennedy Space Center Fla. *Left:* VTVL paver sample. *Right:* 27-C sample. Pictures courtesy of NASA.

PISCES GUEST SPOTLIGHT

HI-SEAS MAKES HISTORY

Pictured above are the six individuals who spent the past year in the Mars habitat on Mauna Loa as part of the HI-SEAS project.

A group of scientists who have spent a year in isolation atop of Mauna Loa emerged into the public eye on Aug. 28.

The six scientists participating in the Hawaii Space Exploration Analog and Simulation (HI-SEAS) experiment made history last month when they became the first individuals to successfully endure a yearlong Mars simulation experiment.

The six members in the project include Tristan Bassingthwaighte, crew architecture; Cyprien Verseux, crew biologist; Andrzej Stewart, chief engineering officer; Sheyna E. Gifford, chief medical and safety officer and journalist; Christiane Heinicke, chief scientific officer and crew physicist; Carmel Johnston, crew commander.

The University of Hawaii operated the NASA-funded study under the investigation of PISCES board member Dr. Kim Binsted. Dr. Binsted is a professor in the Information and Computer Sciences Department at the University of Hawaii, and is a co-investigator at the UH-NASA Astrobiology Institute. She joined our board in July.

During the study, each scientist focused on various projects while learning to ration supplies and coexist harmoniously.

Cut-off from the rest of the world for the past 365 days, these scientists really experienced what it would be like to endure a long space mission.

For more information visit www.hi-seas.org.

The Mars habitat on Mauna Loa.

PISCES ANNOUNCEMENTS

PISCES welcomes new board members

PISCES is pleased to announce the addition of three new members to our Board of Directors. We're excited to have these talented and supportive individuals on our team.

Kim Binsted, ***term beginning July 1, 2016 and ending June 30, 2020*** – Dr. Binsted is a professor in the Information and Computer Sciences Department at the University of Hawaii, a co-investigator at the UH-NASA Astrobiology Institute, and the principal investigator on HI-SEAS (Hawaii Space Exploration Analog and Simulation). Dr. Binsted's research focuses on artificial intelligence, human-computer interfaces, and long-duration human space exploration. She's worked on numerous collaborative projects between the University of Hawaii and NASA in the area of human space exploration. Dr. Binsted's extensive leadership experience with and broad knowledge of space-related research and development programs will be a great asset to the Board of Directors of PISCES.

Kris Zacny, ***term beginning April 20, 2016 and ending June 30, 2019*** – Dr. Zacny is the Vice President and Director of Exploration Technology at Honeybee Robotics. His professional expertise includes robotic terrestrial and extraterrestrial drilling, excavation, sample handling and processing, geotechnical systems, and sensors. Dr. Zacny has served as principal investigator or co-investigator on more than 70 NASA and Department of Defense funded projects. Dr. Zacny's extensive research experience in robotics and engineering, and broad knowledge of federally funded space-related research and development programs will be great assets to the Board of Directors of PISCES.

Luke Flynn, ***term beginning July 8, 2016 and ending June 30, 2019*** – Dr. Flynn is the Director of Hawaii Space Grant Consortium, the Hawaii NASA EPSCoR Program and the Hawaii Space Flight Laboratory. He is also a tenured specialist at the Hawaii Institute of Geophysics and Planetology, School of Ocean and Earth Science and Technology at the University of Hawaii at Manoa. Dr. Flynn's professional experience includes building and launching small spacecraft from Hawaii, managing large research grants and contracts, and engaging in space education and workforce development activities. Dr. Flynn's broad knowledge of federally funded space-related research and development programs, his practical experience with operating a space flight program and engaging in workforce development activities will be great assets to the Board of Directors of PISCES.

Patrick Sullivan, ***term beginning April 20, 2016 and ending June 30, 2018*** – Dr. Sullivan is the Chairman and founder of Oceanit, a self-funded research and development technology incubator that has developed extensive technical infrastructure in Hawaii. He has significant experience on boards and commissions, including former board seats on the Ocean Research Advisory Panel, Parker Ranch, and the High Technology Development Corporation. Dr. Sullivan's extensive entrepreneurial, business, and scientific experiences will be great assets to the Board of Directors of PISCES.