

# THE PACIFIC INTERNATIONAL SPACE CENTER FOR EXPLORATION SYSTEMS

## TAKING THE HIGHER ROAD

BY: ROB KELSO, PISCES DIRECTOR

For the last 3-1/2 years, I have been honored and very privileged in Hawaii to serve the State as the Executive Director for PISCES. At the inaugural Board of Directors' meeting for PISCES in November 2012, I stated that a major strategic goal of the organization was to develop PISCES as a

recognized applied space-research organization in order to enable other important future opportunities through a strong brand.

During that time, we at PISCES have made huge strides at becoming a world-class 'center-of-excellence' in applied science

and associated technology testing for the surfaces of Moon and Mars. In the last 6-months, PISCES led a highly-visible, major engineering project with the NASA Kennedy Space Center to create the first robotically-constructed vertical takeoff/vertical landing pad from

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basalt...the same material found on the Moon and Mars. PISCES built and tested this pad where others had only talked

about it. **CONTINUE ON PG. 2.**

## BASALT: FOR SPACE AND EARTH

Basalt underlies most of the earth's surface more than any other rock type and much of

the earth's ocean basins are underlain by basalt. It is also



found in large quantities on the Moon and Mars. **CONT. PG. 2**

## FORMER MOON RIDERS STUDENT ACCEPTED TO CALTECH

For 18-year-old Caleb Bishop, a recent graduate of Kealahou High School on the Big Island of Hawaii, accomplishing his dream of attending the California Institute of Technology was made possible through his experience with the Pacific International Space Center for Exploration Systems (PISCES) and their MoonRIDERS program.

He said PISCES greatly impacted his future.

"I think it was huge because CALTECH is very into research, of course. I'm sure seeing that I worked with a NASA facility on unpublished research was vital for them accepting me," he said.

Caleb graduated in May with a 4.2 GPA and is planning to major in electrical engineering when he starts school in the fall. After graduation, he intends to secure a job at an engineering firm.

MoonRIDERS stands for PISCES Moon "Research Investigating Dust Expulsion Removal Systems." **Continued on pg. 3.**

## LETTER CONTINUED...

Further, I have spent enormous efforts to reach out to our local and state business and economic development leaders in crafting approaches for attracting aerospace industry markets to Hawaii. PISCES has made many contacts outside the State that will bring high tech, clean jobs into Hawaii and to the Island. A new business industry cannot grow overnight, it is a matter of building relationships and convincing industries through partnerships over some period of time.

Many years ago, I learned that "people do business with people." This theme is true for Hawaii and true for all the important strategic partnerships crafted by PISCES through the years. There are many very good reasons for aerospace to bring the kind of clean high tech jobs that are needed for the island to develop a new industry sector.

PISCES is well on its way working with aerospace's major players and engaging the local business and academic community to realize these opportunities.

Given the excellent branding and reputation of PISCES outside the State, PISCES is now transforming itself to better assist the State in economic development/business development through the creation of new high technology industries for Hawaii. Some of these emerging market sectors include: commercial small-satellite launch capability for Hawaii, space tourism and unmanned aerial vehicles. PISCES is beginning to use its reputation to help build these new economic development opportunities.

At the May 11th Board of Directors meeting, PISCES and the Board began serious

discussion on the future of PISCES and how to bring about this proposed transformation as outlined originally in the State's Act 169 that brought PISCES under the wings of the State Department of Business, Economic Development & Tourism.

With a further reduced funding allocation from the State's legislative session for FY17, PISCES will nonetheless continue to build an environment to a point where planted seeds of economic growth in aerospace will mature to fruition. PISCES will continue to operate within funding limitations to the best of its ability to strive to develop these emerging economic development markets for the good of the State.

## Basalt continued....

The Moon's surface is controlled by basaltic lava flows and flood basalts. These areas of the moon are known as "Lunar Maria." The term "Maria" is Latin for "seas" and stands for when early astronomers mistook these places on the moon for actual bodies of water. Other areas of the Moon have been resurfaced by extensive basalt flows, which may have occurred

and been developed by major impact events in space.

Here in Hawaii basalt is produced by the oceanic hotspot that created the islands. A hotspot is a plume of hot rock that comes up through the mantle from the earth's core. Repeated eruptions from the ocean floor created what we now know as the chain of Hawaii islands. The basalt on some of the lava fields in Hawaii

has very similar composition to the samples analyzed from Mars and the Moon. This makes Hawaii an ideal location for testing in-situ resource utilization (ISRU) technologies and processes and learn how to utilize the basalt on the moon or mars for different purposes. Before humans can settle in another moon or planet, some infrastructure will have

**BASALT CONT. PG.3**

## BASALT Continued...

to be built by robots, the materials used for construction and the elements used for fuel and life support systems will have to be extracted and processed locally by robots.

Recently PISCES along with NASA, ODG, Honeybee Robotics and the Hawaii County R&D created a lunar vertical takeoff-vertical

landing (VTVL) pad only using basalt. The pavers used as the bullseye of the VTVL were made with sintered basalt which proved to have better physical properties than residential concrete and almost equivalent to commercial concrete. The dust mitigation apron around the landing pad was made with different size basalt rocks.

Other areas of potential research for basalt utilization include the extrusion of basalt fibers which can then be used to make rebar, fabric, mesh, tape and other products which can be used and manufactured in space as well as on earth.

**D**id you know?

Basalt was the first rock formed by Earth that weighed just enough to rise above the earth's crust, and helped to form the first parts of continents and mountains. The first basalt on our planet formed about 4.4 billion



years ago. Also, 70 percent of the Earth's surface rests on basalt crusts. Hawaii is made up almost entirely of volcanic basalt and the rock is currently being used in construction for foundations, statues and more!

## FORMER MOONRIDERS STUDENT ACCEPTED TO CALTECH CONTINUED...

Caleb's role in the MoonRIDERS project revolved around the Electrodynamic Dust Shield, or "EDS" technology that is used to repel the fine planetary dust found on places like the Moon, Mars and asteroids, off of space equipment.

Caleb was in charge of explaining the physics behind the EDS.

"EDS is used and is going to be used for propelling dust off a number of things," he explained. "It is composed of three electrodes that are given positive and negative voltages. At any one point one of the three will have a positive voltage and the other two will have negative voltages and the potential differences between the electrodes will create electric fields that will interact with lunar dust particles."

The EDS was developed by Dr. Carlos Calle's Electrostatics and Surface Physics Laboratory at NASA Kennedy Space Center. Part of Caleb's role involved meeting with KSC every week to discuss the project. He also assisted with testing the device and helped with image and data analysis.

Congratulations Caleb on getting into CALTECH and for your hard work on the MoonRIDERS project!

## PISCES WELCOMES NEW INTERN



The Pacific International Space Center for Exploration Systems (PISCES) is pleased to announce they have accepted Aaron Roth, a former Waiakea High School student, as their summer intern!

Roth is currently studying computer science at Arizona State University.

This summer he plans to use his knowledge and skills to work on PISCES' stereoscopic cameras for their robotic rover.

"I'm pretty excited about this opportunity," he said.

One day Roth hopes to work with NASA and believes that the opportunity to work with PISCES is a step in the right direction.

## PISCES ANNOUNCES CHANGES TO BOARD

### MEMBERS

PISCES recently acquired three new board members.

Patrick Sullivan, Chairman and founder of Oceanit, and Kris Zacny, Vice President and Director of Honeybee Robotics, began their terms on April 20. Kim Binsted, a professor in the Information and Computer Sciences Department at the University of Hawaii and principal investigator on HI-SEAS (Hawaii Space Exploration Analog and Simulation) will begin on July 1.

Meanwhile, Gov. George Ariyoshi will finish his term on the PISCES Board of Directors on June 30, 2016. Binsted is the new Senate nominee who will fill his place.

# ROBOT MADNESS

The University of Hawaii at Hilo's Robotics Club went to NASA Kennedy Space Center for the 7<sup>th</sup> annual robotic mining competition!

The competition ran May 16<sup>th</sup>-20<sup>th</sup> and was set up for college students to design and build a mining robot that can travel over a simulated Martian surface, excavate regolith and deposit as much of it as possible into a bin, all within 10 minutes.

Team Vulcan was among 50 other college teams from around the country. The team travelled with John Hamilton, club faculty adviser and a logistics manager at the Pacific International Space Center for Exploration Systems (PISCES).

There were six students on the team from Hawaii this year. The students have spent months



creating their mining robot named "Spock."

The battery-operated, 125-pound rover is about the size of a large lawn mower, but would eat any yard maintenance device alive with its rugged four-wheel-drive design. Using "wlegs," or spoked "wheel legs" made of wooden pegs, the rover has superior traction and mobility on rugged, rocky surfaces. The frame is made of light-weight aluminum and houses a cleanly-welded shovel to scoop dirt and gravel using an actuator from an electrical wheel chair!

The team placed 21<sup>st</sup> out of 45 teams.



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