

# PISCES Robotic Village: Developing a World Class Site for In-Situ Resource Utilization System and Technology Integration.

R.Romo, R.M. Kelso, J.C Hamilton, C. Andersen



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# Background:

- PISCES is formed in 2007 with Frank Showengert as its first Executive Director (former director at NASA's Research Partnership Centers) under the University of Hawai'i Hilo.
- June 2012, Governor Abercrombie signed act 169 into Law supporting the expansion of PISCES aerospace technology testing facilities.
- PISCES is transferred from UHH to the State Department of Business Economic Development and Tourism (DBEDT).
- Rob Kelso (former NASA Space Shuttle Flight Director) is appointed as PISCES' new Director.



Mission:

*“To serve as a world-class research and education/training center enabling both public and private aerospace agencies from around our planet to develop, test, and validate in Hawai‘i pioneering technologies that can advance robotic and human missions to space, as well as enhance the quality of life on Earth.”*



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# Current Projects:

- Robotic Village
- NASA/PISCES Advanced Laser Communications
- 3D Additive Manufacturing
- Sustainable Concrete
- Dust Removal Technologies
- PRISM (Pisces Robotic International Space Mining Competition)



# PISCES & ISRU in Hawai'i

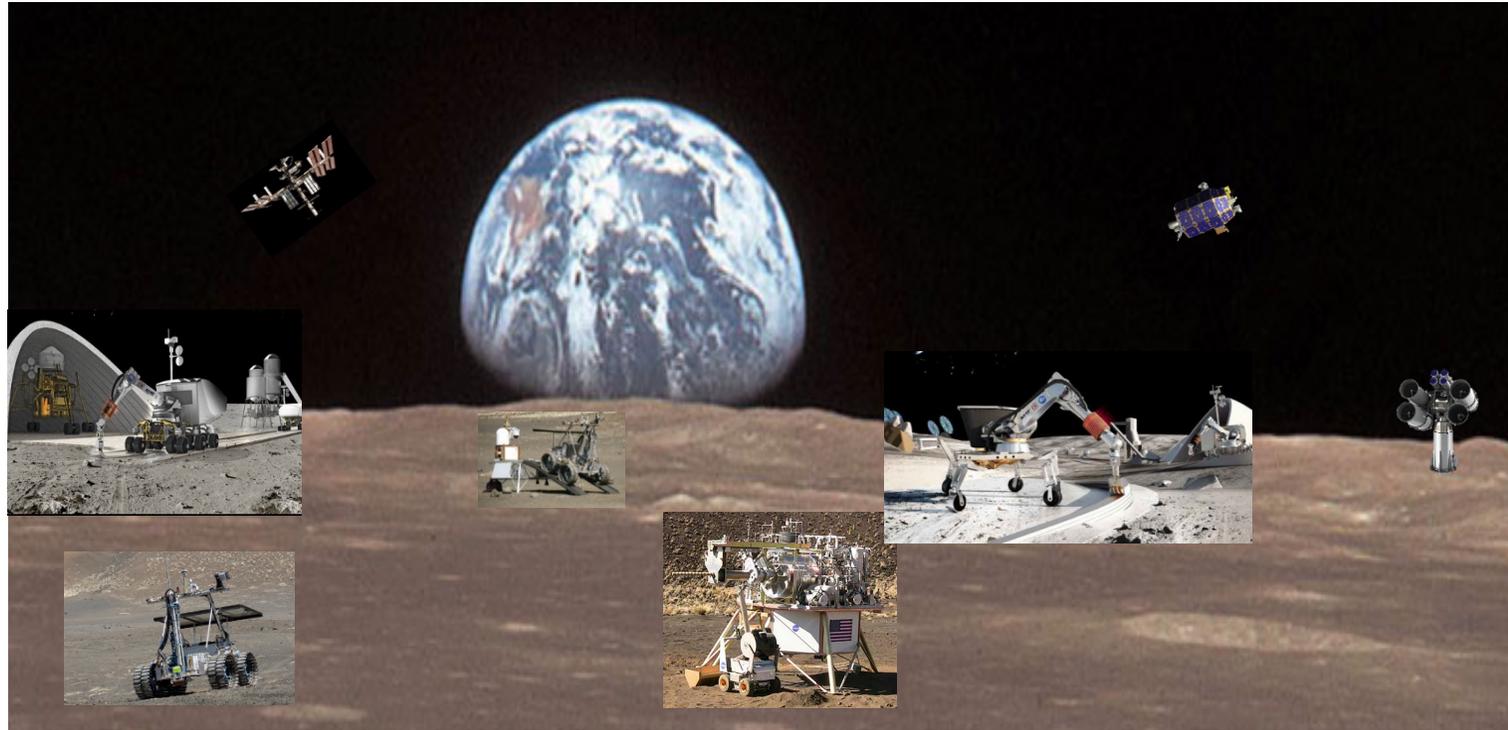
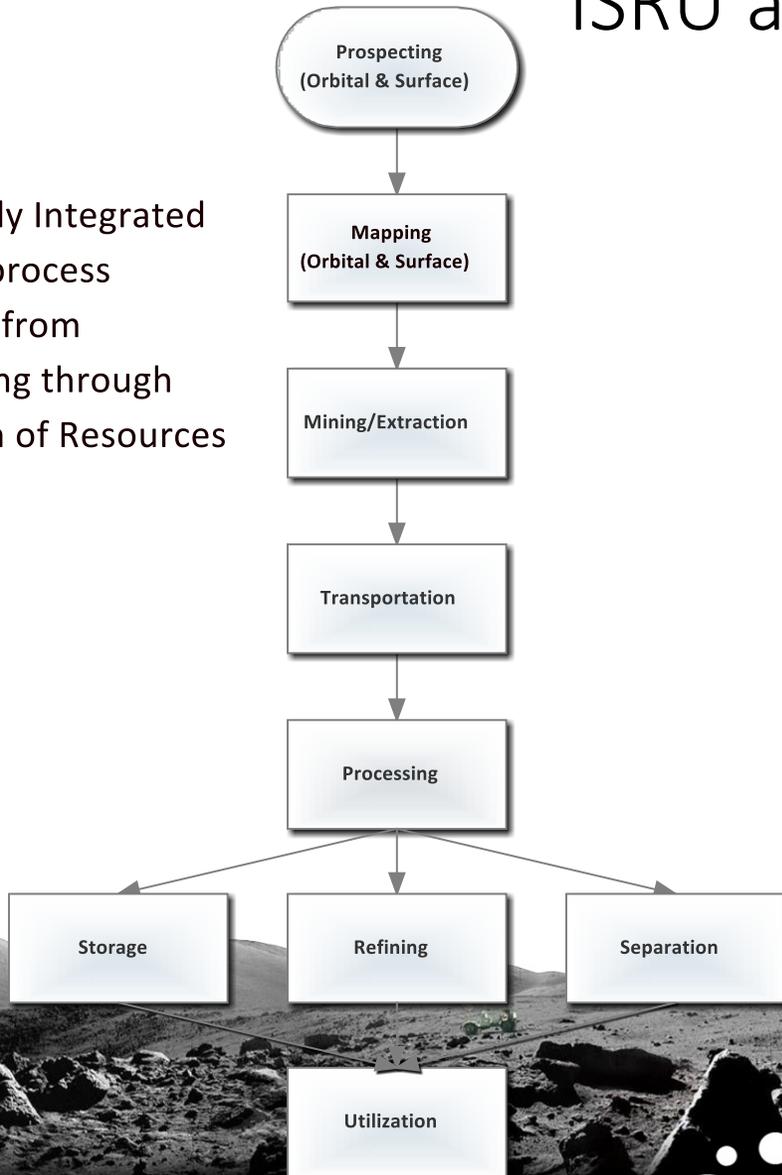
- “Dust to Thrust & Rocks to Blocks; Living off the Land”
- Robotic Village as a Multi-Phase Project aimed to explore & develop technologies that take advantage of Hawaii’s resources for space colonization & local applications (Reduce, Reuse, Recycle, Repair, Reclamation).
- Space: Mine & Synthesize from In-situ resources fuel products, building materials, sustainability foundations (water, H<sub>2</sub>, O<sub>2</sub>, etc)
- Hawai'i (Construction, Energy, Food & Water, Education): Reduce or eliminate cement & asphalt needs, move towards energy sustainability, water cleanup & reutilization, provide learning opportunities for mid to upper school



# ISRU and the Robotic Village.

## ISRU

A Vertically Integrated series of process that span from Prospecting through Utilization of Resources



# Why Hawai'i ?

- Geochemical composition and morphology of regolith found on Mauna Kea almost identical to that on Moon and Mars.
- Geological characteristics of test sites provide ideal analog conditions to test equipment.
- Series of previous tests have concluded that Mauna Kea test sites provide the ideal test bed for robotic and ISRU testing.
- Located between Asia, South Pacific and North America.

## Mars Soil Similar To Volcanic Sand On Hawaii's Mauna Kea, NASA Curiosity Rover Finds

10/30/12 05:15 PM ET EDT **AP**

**FOLLOW:** [Video](#), [Curiosity Soil](#), [Hawaii Soil](#), [Mars Hawaii](#), [Mars Rover](#), [Mars Rover Curiosity](#), [Mars Soil](#), [Mars Soil Hawaii](#), [Mars Volcano](#), [Volcanic Soil](#), [Science News](#)

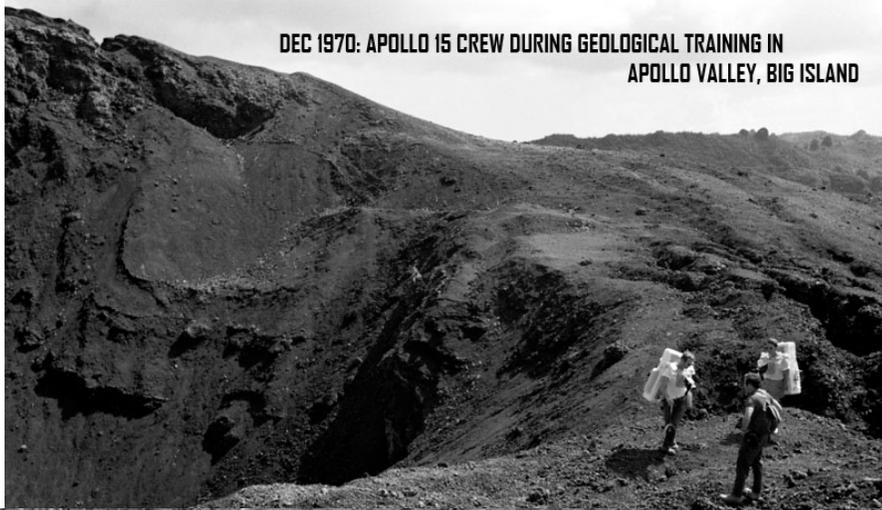
PASADENA, Calif. -- Scientists say the Martian soil at the rover Curiosity's landing site contains minerals similar to what's found on Hawaii's Mauna Kea volcano.

The finding released Tuesday is the latest step in trying to better understand whether the environment could have been hospitable to microbial life.

Curiosity recently ingested its first soil sample and used one of its instruments to tease out the minerals present. An analysis revealed it contained feldspar and olivine, minerals typically associated with volcanic eruptions. Mission scientists say the Martian soil is similar to volcanic soil on the flanks of Mauna Kea.



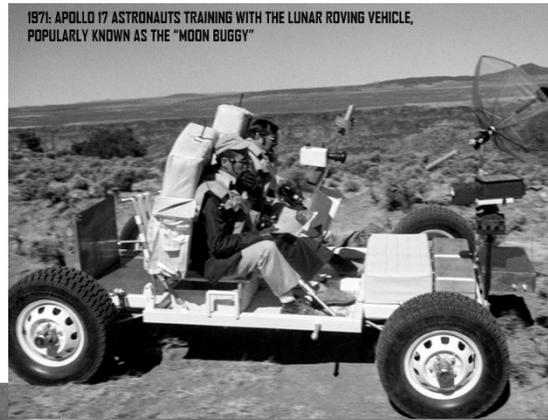
# From Apollo.....



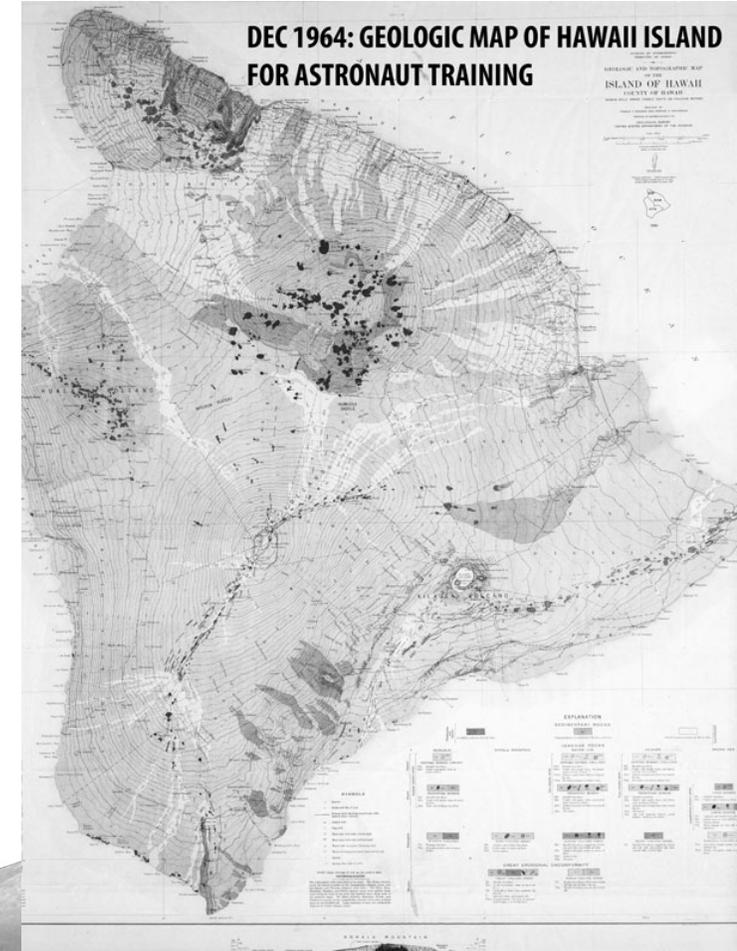
DEC 1970: APOLLO 15 CREW DURING GEOLOGICAL TRAINING IN APOLLO VALLEY, BIG ISLAND



DEC 1970: APOLLO 15 GEOLOGICAL TRAINING



1971: APOLLO 17 ASTRONAUTS TRAINING WITH THE LUNAR ROVING VEHICLE, POPULARLY KNOWN AS THE "MOON BUGGY"



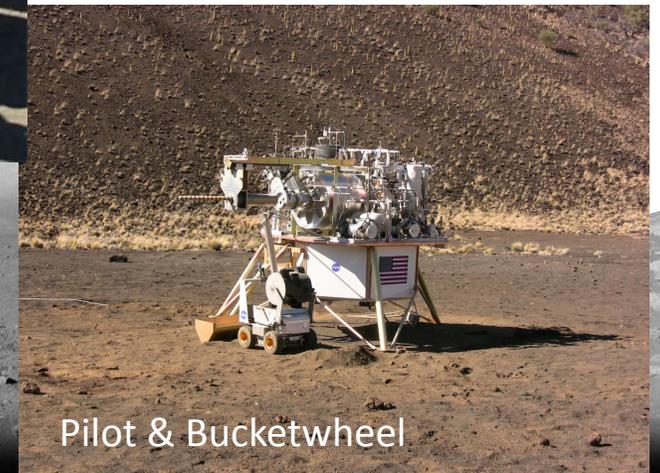
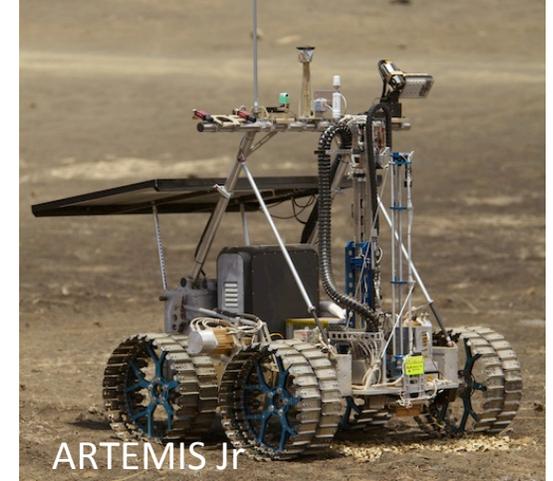
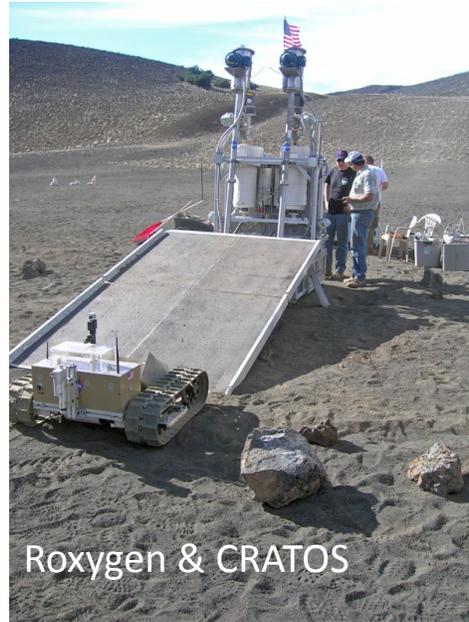
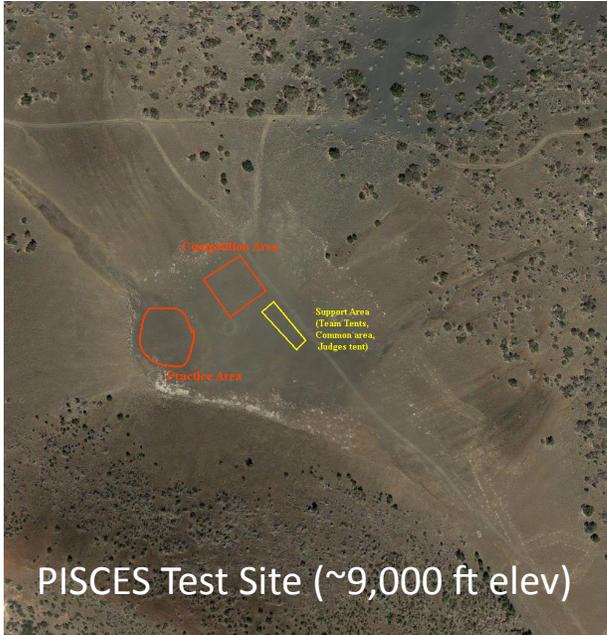
DEC 1964: GEOLOGIC MAP OF HAWAII ISLAND FOR ASTRONAUT TRAINING



PISCES

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# ..to today, Hawai'i has been used as an ideal test site for Space Exploration Technologies

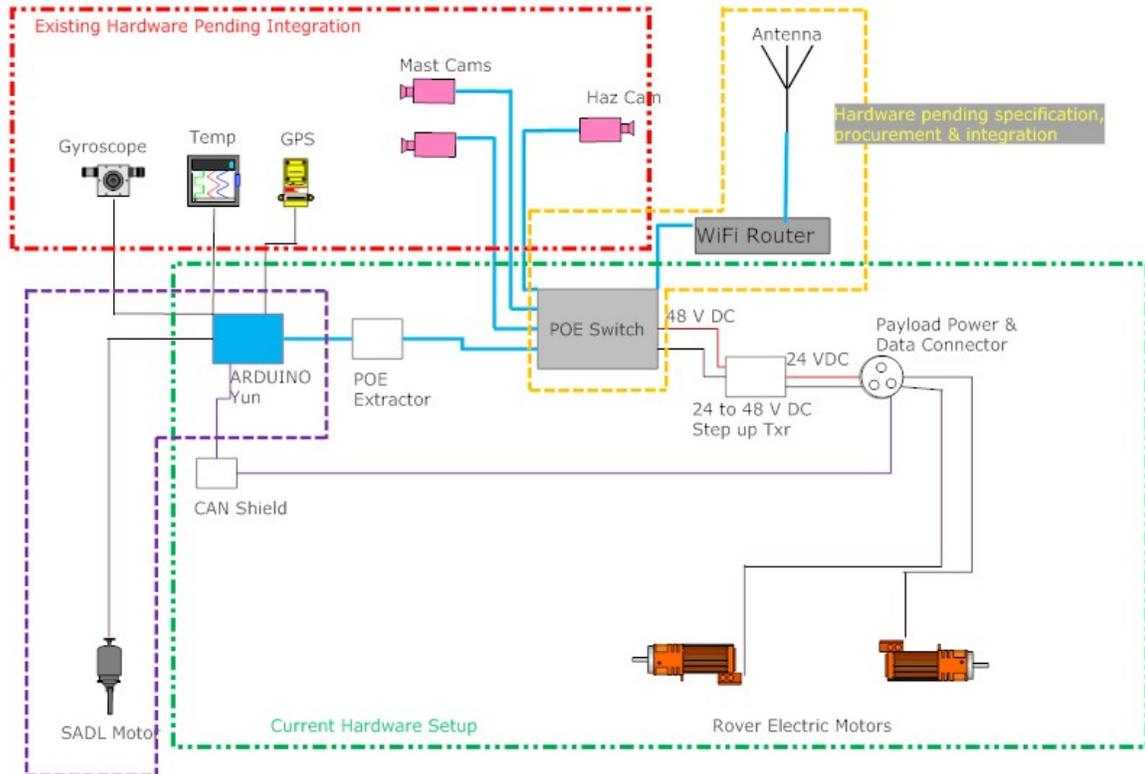


# PHASE I: PISCES Planetary Rover Analog

- Robotics Test & Check Out Lab Facility
- ODG Alpha-Argo Rover: Command & Control, System Integration & GUI being developed to operate remotely on real time and time delay mode.
- Open architecture Payload Platform Design with capability of over 200lbs of payload.
- Summer internship program with students from UH-Hilo, UH-Maui, Western Washington University.
- Field tests planned for July 2014.
- Potential Partners: ODG, NASA (KSC, JSC, AMES, Glenn ), Lockheed Martin, Hawai'i Techworks, Hilo - Waiakea & HPA HS Robotics, UHH, Blue Planet Research AFRL, Maui Makers.
- Rover will be a high visibility tool that will allow PISCES to promote STEM objectives locally.



# Basic Command & Control Capabilities



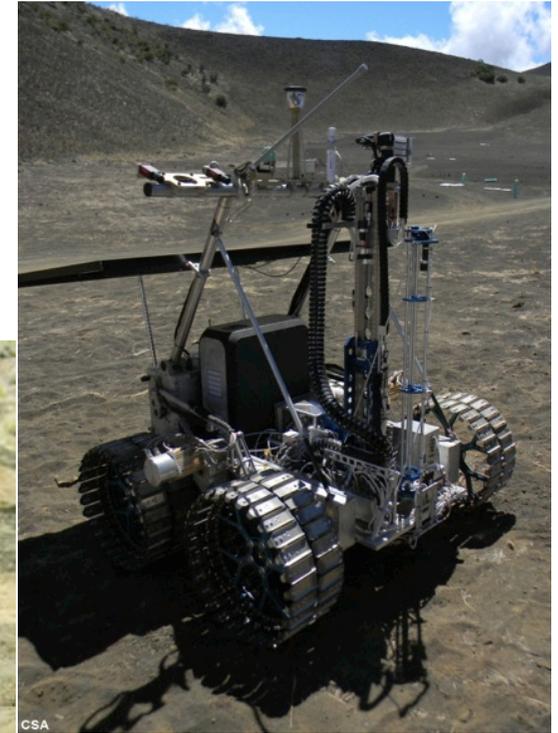
The screenshot shows a comprehensive control and monitoring interface. Key features include:

- Status:** Real-time indicators for Ignition (On), E-Brake (Brake Off), and WiFi Connection (Connected). Battery levels are shown at 100% and 60%. WiFi Signal is at 60%. Connected IP is 127.0.0.1, Ping is 0ms, and Users Connected is 0.
- Diagnostics:**
  - L Battery:** Contact Connected, Voltage 24 Volts, Current 0 Amperes.
  - R Battery:** Contact Connected, Voltage 24 Volts, Current 0 Amperes.
  - L Motor:** Brake Off, Speed 0 RPM, Current 0 Amperes.
  - R Motor:** Brake On, Speed 0 RPM, Current 0 Amperes.
- Environmental Data:** Gyroscope (two circular gauges) and Temperature (60°F).
- Control Elements:** Suspension Control (Left/Right buttons) and Directional Control (Up, Down, Left, Right buttons).
- Views:** Four camera views (Front, Aerial, Rear, Mast) with zoom sliders. Aerial view shows coordinates: N 36° 10'29" W 115° 08'11".



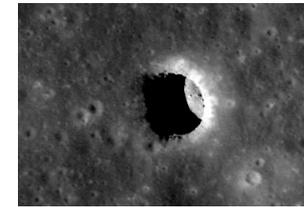
# Objective of PISCES ROVER

- To provide a field test ready mobile platform onto which different types of payloads can be integrated and tested.
- Provide access to command and control to Users at remote locations.
- To provide a platform on which different power sources can be tested and evaluated.



# Upcoming Phases

- Hydrogen Fuel Cell & MUP
- Oxygen Extraction from Regolith
- Basalt Sintering for Landing/Launching Pad by Rover.
- Water Extraction from Regolith Field Test Rover mounted hardware
- Solar Technology
- Lava Tube /Skylight Mapping & Exploration



# Conclusion

Goal: To make the PISCES Robotic Village in Hawai'i the gateway for ISRU technology development and integration through multi agency and multi national collaboration.

*Mahalo nui loa, A Hui Hou*



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