



# RESOURCE: Resource Exploration and Science of OUR Cosmic Environment



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## OVERVIEW

In Situ Resource Utilization (ISRU) near the sites of robotic and/or human missions may enable sustainable and affordable exploration of the SSERVI (Solar System Exploration Research Virtual Institute) Target Bodies. Key to using space resources is knowing their location, quantity, distribution, and extractability. In addition, operations and hardware associated with each ISRU prospecting, excavation, transportation, and processing step must be examined, tested, and integrated to enable effective ISRU.

We abide by the mantra that **“science enables exploration and exploration enables science”**.  
To that end, RESOURCE includes the following four tasks:

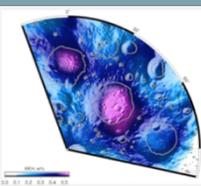
### Partners



RESOURCE is funded by NASA's SSERVI (Solar System Exploration Research Virtual Institute). SSERVI is jointly supported by the NASA Science Mission Directorate (SMD) and NASA Human Exploration & Operations Mission Directorate (HEOMD).

### Task 1: Assess and characterize resource inventories of SSERVI Target Bodies

- Develop semi-quantitative mineral potential models for water ice; validate approach in terrestrial analog environments
- Scientific analysis and numerical modeling to identify the form, character, & distribution of planetary resources
- Develop predictive capabilities for resource identification



Water equivalent hydrogen from LRO LEND (Sanin et al. 2016)

### Task 3: Assessing concepts of operations, capabilities and related human-robotic interactions in support of lunar robotic ISRU exploration

- Assess concepts of operations to optimize human-machine collaboration and human factors task allocations for lunar robotic prospecting missions
- Examine human-robotic interactions & optimize mission architectures for ISRU missions
- Design Virtual Reality & Augmented Reality systems for lunar polar rover mission scenarios

### Task 2: ISRU technology development and testing

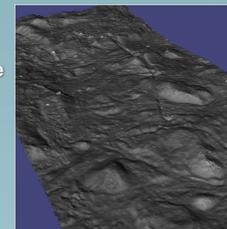
- Develop next-generation lunar resource prospecting payload instrumentation
- Demonstrate water extraction from ice cemented ground
- Analyze lunar mining and demonstrate technologies for the collection and processing of extracted water



Honeybee Robotics drill testing

### Task 4: Future ISRU robotic mission support activities (lunar test case)

- Produce data products for lunar rover mission traverse planning
- Develop advanced mission planning tools for scheduling and ground data systems
- Integrated field testing of ISRU prospecting hardware and software elements



3D modeling from stereo and Shape from Shading: Perspective view of the floor of Jackson Crater on the Moon (Beyer et al. 2018)

### Citizen Science / Science Activation / Public Engagement

- 1) Student and postdoctoral researcher involvement.
- 2) Provide content for the OpenSpace data visualization project at the American Museum of Natural History (AMNH).
- 3) Provide women Subject Matter Experts (SMEs) to support the SETI Institute's "Reach for the Stars: NASA Science for Girl Scouts".
- 4) Deliver topical seminars through multiple online platforms.
- 5) Team with Howard University, a Historically Black College & University (HBCU), to help develop highly effective teachers who then elect to serve in either urban schools or in education systems with a predominantly marginalized student population.