SCHRODINGER CAT: A MOBILE INSTRUMENT SUITE TO EXPLORE A VOLCANIC VENT AND PERMANENTLY SHADOWED REGION IN THE SCHRODINGER IMPACT BASIN, FAR SIDE, MOON.

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Introduction: The Schrödinger Ceres All-terrain Traverse or Schrödinger CAT experiment, is an in-situ investigation of the geology of the Moon – in particular of its impact, volcanic, and volatile history - via the deployment of a mobile instrument suite at Schrödinger Cone, a large volcanic pyroclastic deposit and vent with permanently shadowed regions (PSRs) in Schrödinger Basin on the lunar far side **(Fig.1)**. Schrödinger CAT will advance our understanding of the global characteristics and evolution the lunar crust, the nature and origin of lunar surface volatiles, and the mineral and volatile resource potential of the Schrödinger Cone site.

Schrödinger Basin (D~312 km) is one of the latest impact basins to form on the Moon. It straddles the edge of the vast and ancient South Pole-Aitken (SPA) Basin, and therefore excavated and incorporated into its impact breccia deposits SPA ejecta, including deep lunar crustal and upper mantle materials. The Schrödinger pyroclastic vent has likely been the single largest source of indigenous volatiles in the south polar region of the Moon over the past 1 to 3.7 Ga.

Goals: The main goals of the Schrödinger CAT experiment are to:

Goal A: Understand the geologic evolution of the Moon, from the Heavy Bombardment and mare formation epochs to later volcanism and volatile production;

Goal B: Understand the origin, evolution, distribution and state of volatiles on the Moon;

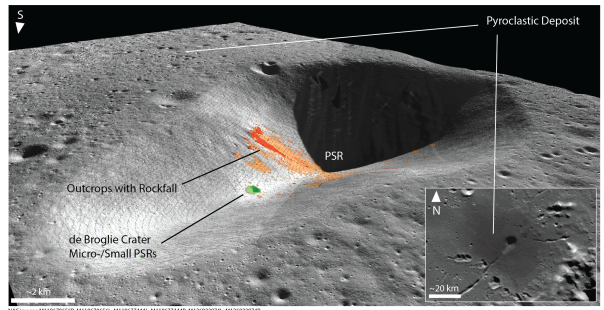
Goal C: Understand the in-situ resource utilization (ISRU) potential of the Moon.

Hypotheses: Hypotheses to be tested in the Schrödinger CAT investigation include:

H1: Deep lunar crustal and upper mantle materials were incorporated into breccias at Schrödinger Basin.

H2: Pyroclastics at Schrödinger are compositionally different from those sampled at the Apollo 17 site, implying significant lateral compositional heterogeneity in the lunar crust;

H3: Volatiles are present in both sunlit and PSRs at Schrödinger Cone, and include both exogenous and endogenous volatiles.



NAC images M110670656R, M110670656L, M110677444L, M110677444R, M126023874L, M126023874R

Figure 1: Schrödinger Vent. Perspective view of the vent at the summit of the Schrödinger Cone pyroclastic deposit. Note the permanently shadowed regions (PSRs), large and small, in the vent, as well as outcrops with rockfalls (red and orange) on both sides of the vent walls. **Insert:** Context image showing the vast Schrödinger Cone pyroclastic deposit on the floor of Schrödinger Basin.

Objectives: To test these hypotheses and several others, the Schrodinger CAT mobile instrument suite will explore the diversity of materials exposed at the surface or present in the shallow regolith at Schrödinger Cone, including the pyroclastic deposits and PSRs in the vent area. The Schrodinger CAT Experiment at Schrodinger Cone has three objectives:

O1: Characterize surface geologic features and relationships (boulders, outcrops, block fields, crater ejecta, strata, textures,...)

O2: Characterize the composition of surface and shallow subsurface (<1m) materials (including H2O, -OH, other volatile and non-volatile material abundances).

O3: Characterize the mechanical properties and dynamics of surface materials.

Mobile Instrument Suite: The Schrodinger CAT Experiment will use the 30 kg-class CR-3 rover of Ceres Robotics, a NASA-selected Commercial Lunar Payload Services (CLPS) provider.

The Schrödinger CAT instrument suite comprises three instrument subsystems:

OCCAM (Omnidirectional Color CAMeras) is the CR-3 rover's 4-camera multipurpose RGB color imaging system serving also as the rover's navcams and hazcams. OCCAM includes a high-resolution color camera mounted on a mast with a pan and tilt mount. OCCAM is developed by Ceres Robotics (PI: M. Sims).

NIRVSS (Near-Infrared Volatile Spectrometer Subsystem). NIRVSS is developed at NASA Ames Research Center (PI: A. Colaprete)

NSS (Neutron Spectrometer Subsystem). NSS is developed at NASA Ames Research Center (PI: R. Elphic).

Both NIRVSS and NSS are identical to their mature counterparts already manifested on NASA's VIPER mission. Objectives O1 and O3 will be met by using mostly OCCAM; O2 by using mostly NIRVSS and NSS.

Operations: The Schrödinger CAT mobile instrument suite will be deployed from a lander near the southwestern end of the Schrödinger Cone vent. After accessing the lunar surface, the rover will first explore the vent rim area, then begin a multi-kilometer shallow descent into the Schrödinger Vent to de Broglie crater, a small (D~150 m) impact crater with a small PSR. Schrödinger CAT will investigate de Broglie in detail and nearby blocks and boulders associated with the high albedo outcrops with rockfalls visible along the slopes of the Schrödinger Vent. Surface operations will take place over 10 Earth days.

Significance: By investigating the evolution of the Moon, inventorying its resources, and paving the way to sample return, ISRU, and human exploration, the Schrödinger CAT experiment is relevant to several major NASA and NSF lunar goals, objectives and programs. Schrödinger CAT will complement NASA's VIPER mission in that it will assess resources away from the lunar poles, in a pyroclastic deposit and in PSRs which might contain a significantly greater fraction of endogenic volatiles.

The Schrödinger CAT investigation will also inform the planning of future sample return, in-situ resource utilization (ISRU), and human exploration missions to Schrodinger Crater. Schrodinger CAT would for instance tell us if an eventual sample return mission to Schrodinger Cone would likely deliver pyroclastics incorporating materials sampling an extensive cross-section of the lunar crust and materials with significant resource-potential, including volatiles.

Teaming

The Schrödinger CAT investigation includes hardware systems to be provided by Ceres Robotics and NASA Ames Research Center. Project management and science operations support will be provided by Ceres Robotics. The Schrödinger CAT Science Team includes investigators from the US and Germany.