SCIENTIFIC OPPORTUNITIES FOR HUMAN EXPLORATION OF THE MOON'S SCHRÖDINGER BASIN. T. Kohout[1, 2, 3], K. O'Sullivan[4], A, Losiak[5], K. G. Thaisen[6], S. Weider[7, 8] and D. A. Kring[9], [1]Department of Physics, University of Helsinki, Finland, tomas.kohout@helsinki.fi, [2]Department of Applied Geophysics, Charles University in Prague, Czech Republic, [3]Institute of Geology, Academy of Sciences of the Czech Republic, Prague, Czech Republic, [4]Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN, USA kosulli4@nd.edu, [5]Michigan State University, East Lansing, MI, USA, [6]University of Tennessee, Knoxville, TN, USA, [7]The Joint UCL/Birkbeck Research School of Earth Sciences, London, UK, [8]The Rutherford Appleton Laboratory, Chilton, Oxfordshire, UK, [9]Lunar and Planetary institute, Houston, TX, USA.

Introduction: The Schrödinger impact basin provides a rich array of scientific opportunities due to its location in a previously unexplored region of the Moon and a relatively young age. Located near the South Pole on the lunar far side, it is the second youngest impact basin (after Orientale) and, thus, remains well exposed for scientific study. Schrödinger intersects the pre-Nectarian Amundsen-Gainswindt basin (AG), as well as the inner rings of the South Pole-Aitken (SPA) basin. Modeling suggests [1] that Schrödinger's inner ring originates from a depth of 10-30 km and, therefore, might contain indigenous SPA materials. Additionally, at least three volcanic units, deep fractures, ghost craters, and secondary craters can be found within Schrödinger basin.

Main scientific objectives for human exploration within Schrödinger basin: The following major scientific goals can be accomplished within Schrödinger [2], which address many National Research Council lunar science priorities [3]:

1. Determine the age of the Schrödinger impact event.
2. Determine the age of material from Schrödinger's inner ring. In the case that SPA material is uplifted there, the SPA event can be dated allowing us to anchor the Earth-Moon impact flux curve.
3. Study material produced by various basaltic volcanic events (Upper Imbrian and Eratosthenian in age [4, 5]).
4. Study deep seated explosive volcanism (Eratosthenian or Copernican in age [4, 5]).
5. Study potential products of crustal and mantle degassing along deep fractures.
6. Study ghost craters flooded by a melt sheet.
7. Study secondary craters on the basin floor.

Landing site selection: We propose a landing site for human exploration on a relatively smooth terrain ([4, 5]) within the inner ring of Schrödinger – either on the exposed melt sheet or on one of the basaltic units. Such a location will provide access to the features outlined above and meet a planned ~20 km extra vehicular activity (EVA) limit [2]. Based on geological mapping [4] and Clementine images, we evaluated three landing sites (Fig. 1) where at least 4 of the scientific objectives can be accomplished. The white circles in Fig. 1 outline a 10 km radius of an EVA range (~20 km return trip).

The first landing site is located on the northern part of the Schrödinger melt sheet where a basaltic unit is superimposed. This relatively smooth terrain should ensure safe landing conditions. The basaltic unit might be the first sample station. It is approx. 5 km across in its shorter dimension and, thus, can be completely traversed before proceeding farther south to one of two facies of Schrödinger's melt sheet, providing a second point of interest within a single EVA. A second EVA to the southwest provides access to a second basaltic unit. A third EVA towards the west of the landing site will take crew to the second of the two melt facies and to one of the deep fractures on the basin floor. From those stations, crew can move north to Schrödinger's inner ring. Additionally, an Orientale secondary crater is located east of one of the basaltic units in a rougher terrain that could be targeted by additional EVA's .

A second landing site is located in the western part of the Schrödinger's melt sheet, near two large ghost craters that appear to have been flooded by the melt sheet during the complex formation of the basin. This provides the first opportunity for crew to study the morphology of a ghost crater and the thickness of a basin melt sheet. Towards the east, a ridged terrain of unknown origin as well as Antoniadi secondary craters can be reached. Towards the west, Schrödinger's inner ring is accessible for additional sampling of potential SPA material.

A third landing site is proposed in the southeastern part of the basin to study an explosive volcanic unit. The central volcanic crater, as well as crustal fractures through which magma may have migrated towards the surface, occur within EVA limits. Additionally, Schrödinger's inner ring is accessible to the southeast and Antoniadi secondary craters occur towards the west. One of the impact melt facies is located near the landing site and, if routes across basin fractures can be found, the other facies can also be reached. This option, however, must be evaluated with additional work.

The use high-resolution imagery, spectroscopic data, and digital elevation models can be used within a

Geographic information system (GIS) to identify locations of high interest for EVA. In addition, a GIS can be used to assess potential EVA routes and to maximize hazard avoidance by characterizing surface parameters (i.e., slope angle, slope aspect, roughness, composition, etc.) prior to surface operations [6].

Additionally, a precursor robotic rover can reduce the risk, requirements, and cost of a human exploration [7, 8] and provide site characterization to enhance the efficiency of human exploration by identifying the highest priority traverse stations. It could also collect and deliver samples from remote areas to the human mission landing site or conduct complementary research after the human mission departure [7, 8].

Conclusions: The Schrödinger basin provides a diverse suite of scientific opportunities because of the superposition of several geologic processes and because of its relatively young age. Any one of three possible landing sites can provide the first samples of basin melts of undisputable origin and potentially melts of SPA origin. In addition, at least two types of younger volcanism (and magmatic source regions) can be studied in the area with a small number of EVA's.

Acknowledgements: This work is part of the 2008 Lunar Exploration Summer Intern Program at the LPI, Houston, and co-sponsored by the NASA Lunar Science Institute. We thank the LPI staff for their help and support.

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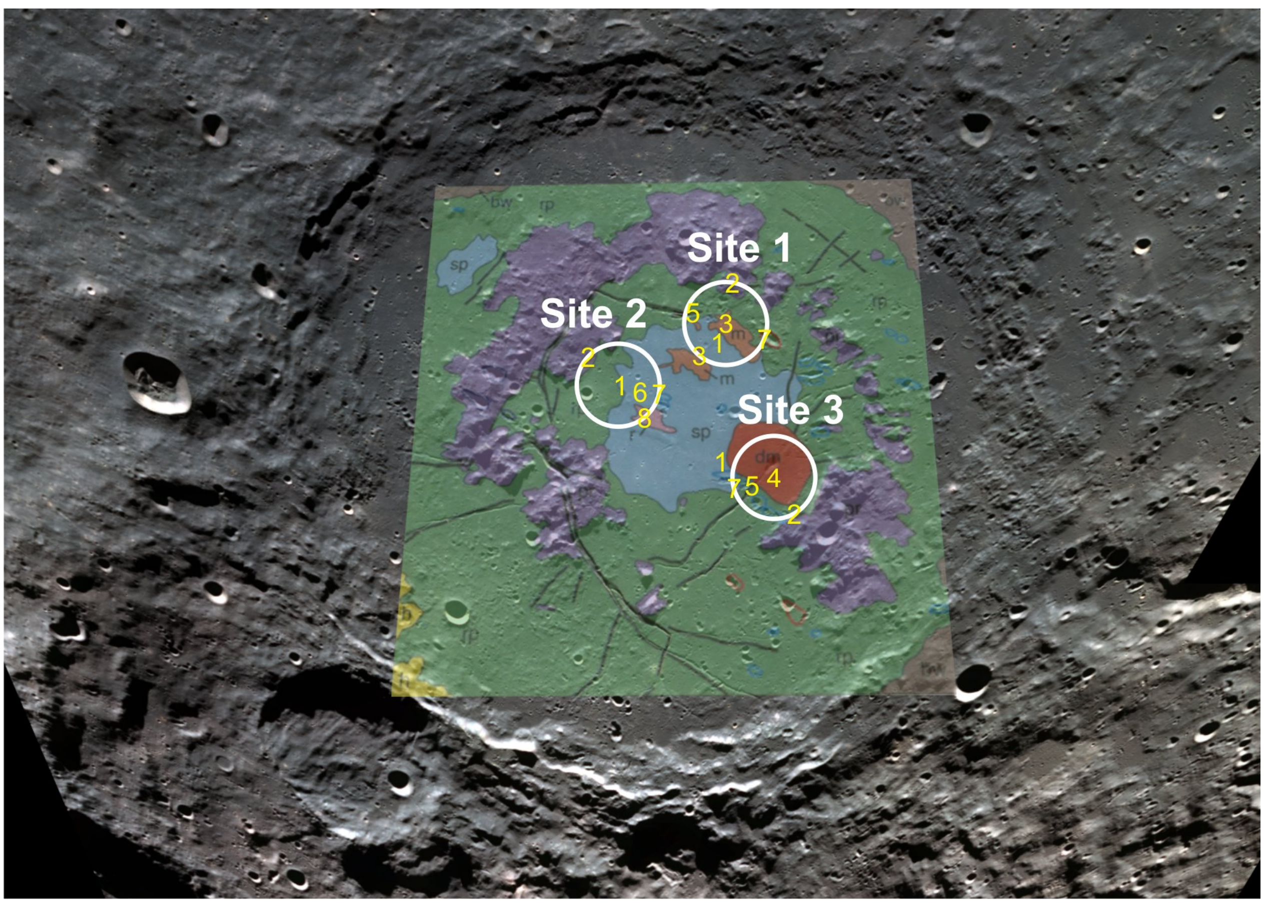

Figure 1: The Clementine image of the Schrödinger basin with the geological map from [4]. The three landing sites and corresponding 10 km EVA radius (20 km return trip) are outlined in white. The yellow numbers correspond to following scientific points of interest: 1 – Schrödinger's melt sheet, 2 – Schrödinger's inner ring, 3 – basaltic units, 4 – explosive volcanic unit, 5 – deep crustal fractures, 6 – ghost craters, 7 – secondary craters, 8 – ridged terrain.