SUGGESTED LANDING SITES TO STUDY KEY PLANETARY PROCESSES ON THE MOON: THE CASE OF SCHRÖDINGER BASIN. A. L. Souchon[1,2], J. Flahaut[3], P. Sharma[4], C. E. Jilly[5], J.-F. Blanchette-Guertin[6], and D. A. Kring[7], [1]DTP/IRAP, Observatoire Midi-Pyrénées (OMP), CNRS, Toulouse, France (souchon@dtp.obs-mip.fr), [2]Observatoire Midi-Pyrénées (OMP), Université Paul Sabatier (UPS), Toulouse, France, [3]Laboratoire des Sciences de la Terre, UMR CNRS 5570, Ecole Normale Supérieure de Lyon / Université Claude Bernard, Villeurbanne, France, [4]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, [5]Hawaii Institute of Geophysics & Planetology, University of Hawaii at Manoa, Honolulu, HI 96822, [6]Department of Earth and Ocean Sciences, University of British Columbia, Vancouver BC V6T 1Z4, Canada, [7]Lunar and Planetary Institute, Houston, TX 77058.

Introduction: Science Concept 3 of the National Research Council report for NASA's Vision for Space Exploration [1] aims to locate landing sites where key planetary processes can be studied through the diversity of crustal rocks. Five Science Goals were devised to guide that study: (i) determine the extent and composition of the primary feldspathic crust, KREEP layer, and other products of differentiation; (ii) inventory the variety, age, distribution, and origin of lunar rock types; (iii) determine the composition of the lower crust and bulk Moon; (iv) quantify the local and regional complexity of the current lunar crust; and (v) determine the vertical extent and structure of the megaregolith. We surveyed the lunar surface to identify suitable landing sites and found hundreds of sites that address individual Science Goals [2, 3, 4, 5], but only a few that will maximize the science return relevant to multiple Goals within Concept 3.

Suggested landing sites: The top 14 preferred locations for sample return are listed in Table 1. They have been chosen to obtain a wide array of samples, following criteria of diversity in terms of geochemistry (PKT, SPAT, FHT, see [6]), location (nearside/far side), lunar chronology, and lithology. Of particular scientific interest is Schrödinger basin, which can address every Goal within Concept 3, and for which 2 landing sites are suggested.

Table 1: List of the 14 preferred landing sites addressing three or more of the Science Goals within Concept 3 (in alphabetical order). Regions are the Procellarum KREEP Terrane (PKT), the South Pole-Aitken Terrane (SPAT), and the Feldspathic Highlands Terrane (FHT).

site name	lat. (°)	lon. (°)	diam. (km)	region
Antoniadi	-69.7	-172.0	143	SPAT
Aristarchus	23.7	-47.4	40	PKT
Birkeland	-30.2	173.9	82	SPAT
Copernicus	9.7	-20.1	93	PKT
Finsen	-42.0	-177.9	72	SPAT
Jackson	22.4	-163.1	71	FHT
King	5.0	120.5	76	FHT
Moscoviense	26.0	148.0	445	FHT
Orientale	-19.0	-95.0	930	FHT
Schrödinger	-75.0	132.4	312	SPAT
Theophilus	-11.4	26.4	110	FHT
Tsiolkovsky	-21.2	128.9	185	FHT
Tycho	-43.4	-11.1	102	FHT
Vavilov	-0.8	-137.9	98	FHT

Geological setting of Schrödinger basin: Schrödinger basin, being the second youngest basin on the Moon, will provide some of the best preserved basin features on the lunar surface for scientific study, and will offer a glimpse into the still enigmatic region of the South Pole-Aitken basin. This terrane has never been directly sampled, and any meteoritic clasts from this region remain uncertain.

Differentiation products: Schrödinger provides access to nearly every key depth in planetary differentiation models. The large basin lies within the thin crust of the SPAT, and its large size implies that it will likely have incorporated mantle material in its melt. Mantle material, the crust-mantle boundary, and lithologies produced by the SPA event may also be exposed within the stratigraphic uplift of the peak ring. Schrödinger is also uniquely positioned to determine how the SPA basin-forming event modified the crust over most of the Moon's southern hemisphere, where it may, for example, have consumed any urKREEP residual layer from the Magma Ocean.

Rock types variety: Detections by [7, 8] of pure anorthosite (PAN) are located within the peak ring of Schrödinger (Fig. 1), making these uplifted regions particularly of interest. Other rock types also appear to be pervasive within Schrödinger basin. Pyroclastic deposits are located in the southeast region, positioned near a peak ring outcrop [9] (Fig. 1). Mg-suite rocks may be sampled as well, as spectral analysis of plutonic rocks (such as gabbro, norite, troctolite, gabbronorite, anorthositic troctolite, anorthositic gabbro) by [10] suggests the possibility of exposure. However, care must be taken in interpreting the results of this analysis, as such findings could correspond also to lower crust material. Multiple sources of olivine in the ejecta of craters that penetrate into the peak ring have been recently detected [11] (Fig. 1). Assuming that such detections could be invasive throughout the entirety of the peak ring structures, locations that can expose fresh parts of the peak ring appear to be of high scientific interest.

Lunar crust complexity: Schrödinger basin is a Type I gravity anomaly [12, 13], in which the magnitude of the free-air and Bouguer anomalies are the same, thus categorizing it as a good location for setting up geophysical instruments such as seismometers. In addition, the complex terrain can offer clues into the unique lithology and regional complexity of the SPAT. The placement of seismometers will also help determine the extent of the megaregolith in the region [2].

Suggested landing sites within Schrödinger basin: We begin with the conservative assumption that traverses will be limited to radii of 10 to 20 km from a landing site. Two particularly interesting sites have been studied (Fig. 1), using a various array of available images (Lunar Orbiter, Clementine, LOLA, LROC).

First site: It is located in the southeast part of the basin, near a peak ring outcrop that lies within a field of pyroclastic deposits. Here astronauts may sample volcanic glass from the deposits, as well as PAN and olivine detected around a nearby crater that penetrated the peak ring. There are also possible bedrock exposures within the slopes of the peak ring. Four stations within a 10 km radius of the landing site are suggested. Station 1 is located at a rille, where samples should be taken, and the collapsed rille walls should be analyzed for any exposed layering structures. In addition, as this is a volcanic feature, one should look for unique volcanic lithologies that might occur here. Stations 2 and 3 are located at the base of peak ring massifs. Optimally, samples should be taken on a traverse from one station to the next, to determine how material may differ on a small scale. In particular, outcroppings and possible exposures should explicitly be sampled. Station 4 lies within a large field of pyroclastic deposits, where samples of volcanic rocks and regolith should be taken for comparison with other samples.

Second site: It lies on the peak ring in the northern part of Schrödinger basin. A fresh crater (about 7 km in diameter) occurs directly on the ring and is believed to expose bedrock and possible layering within the crater walls. As the peak ring is thought to have uplifted mantle material, possible urKREEP, and both lower and upper crust, this preserved exposure could provide a plethora of useful information with regard to NRC's Concept 3. This crater is also a site of olivine detections [11], and nearby PAN detections [7, 8].

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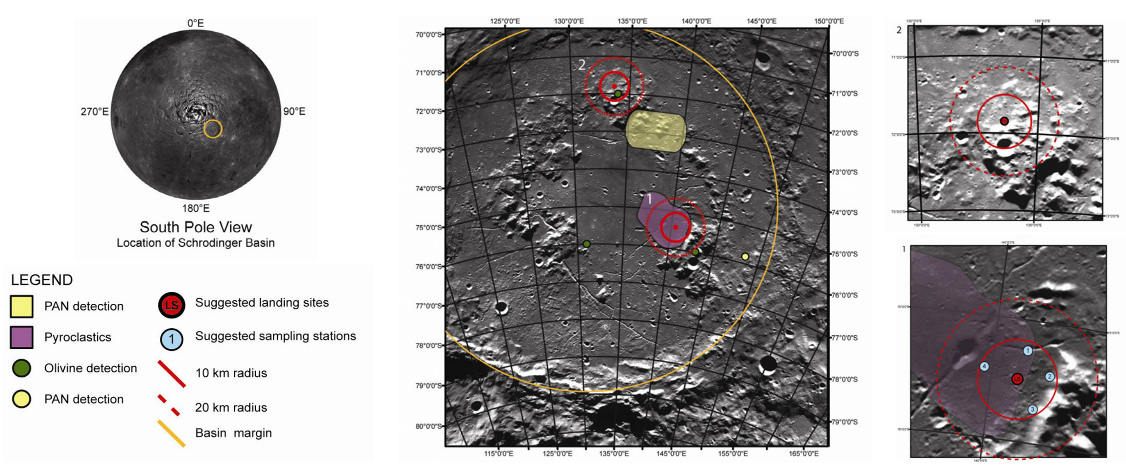

Figure 1: Schrödinger basin and suggested landing sites (background: Clementine UVVIS mosaic).