

Supplementary Information

Grand Canyons on the Moon

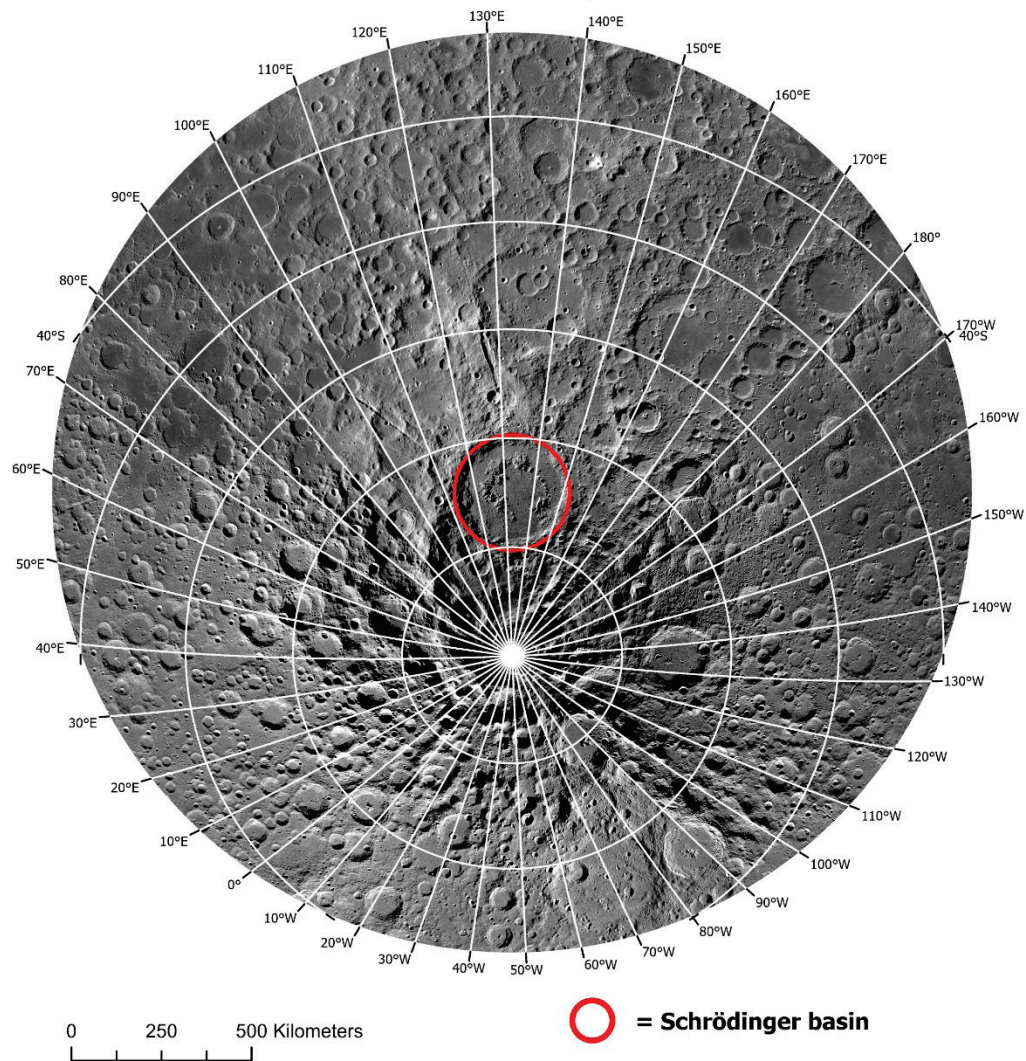
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Supplementary Figure 1. Location map of the Schrödinger impact basin relative to the lunar south pole.

Schrödinger Basin

SCALE: 1:15,000,000

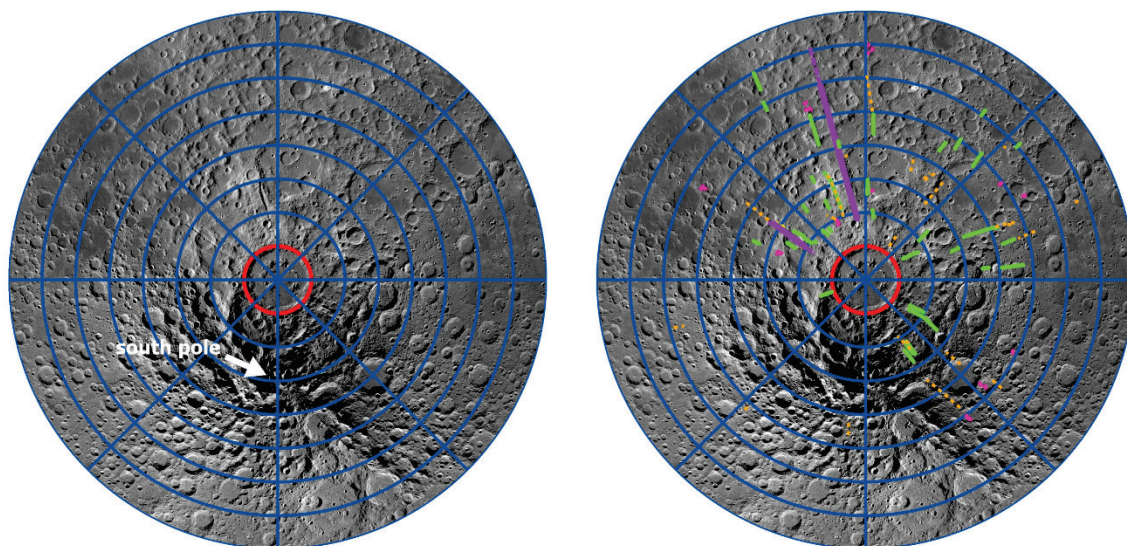
LAMBERT AZIMUTHAL EQUAL AREA PROJECTION
CENTERED AT -75° , 132.5°



Supplementary Figure 2. Map of radiating secondary craters around the Schrödinger basin.

Secondary Cratering around Schrödinger Basin

SCALE: 1:27,500,000
LAMBERT AZIMUTHAL EQUAL AREA PROJECTION
CENTERED AT -75° , 132.5°



 = Schrödinger basin
North radiates from the south pole.

0 500 1,000 Kilometers

Main Crater Rays

Type

-  Main Ray
-  Extended Ray

Additional Crater Rays

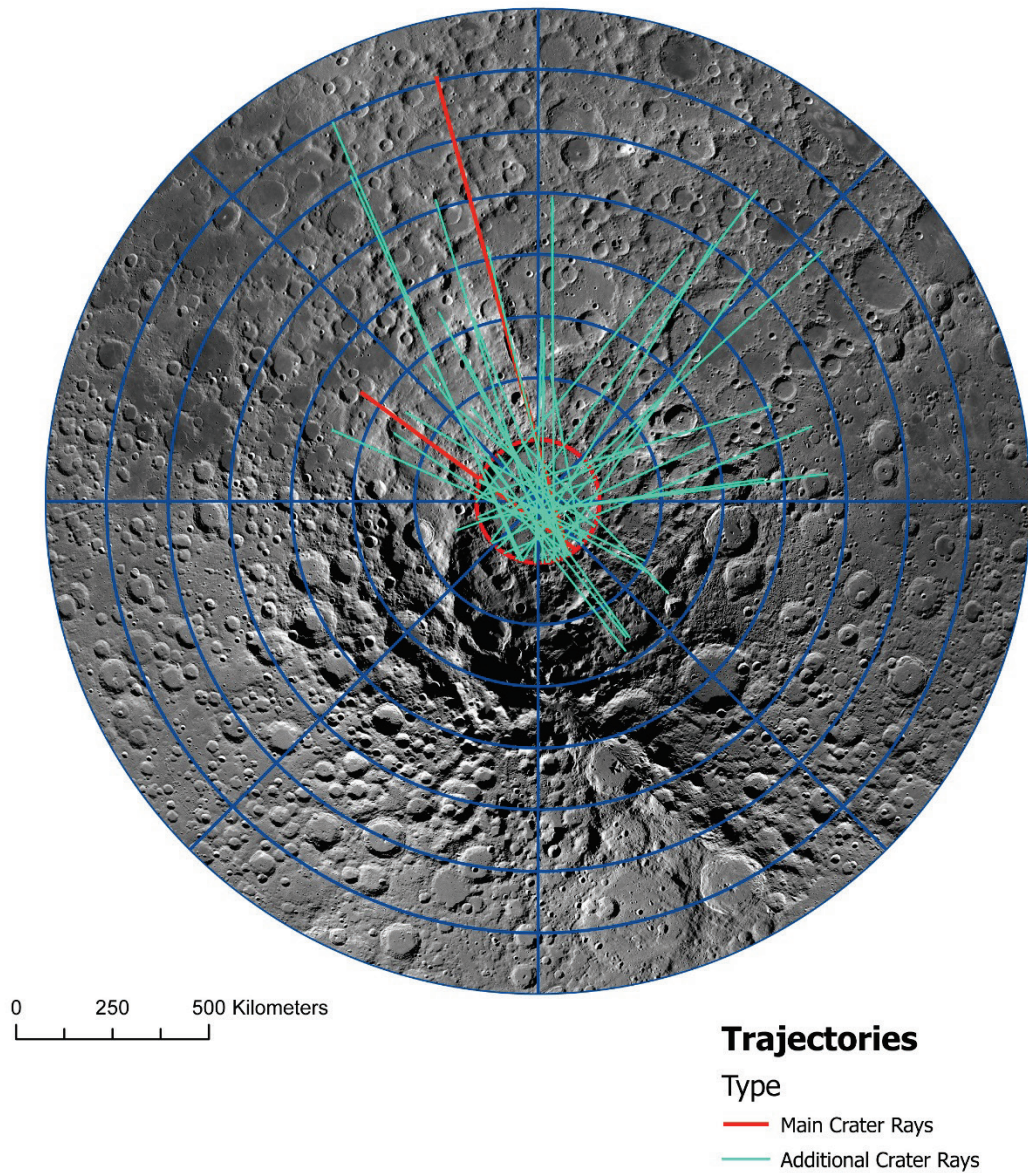
Type

-  Crater Rays
-  Possible Crater Rays
-  Crater Clusters

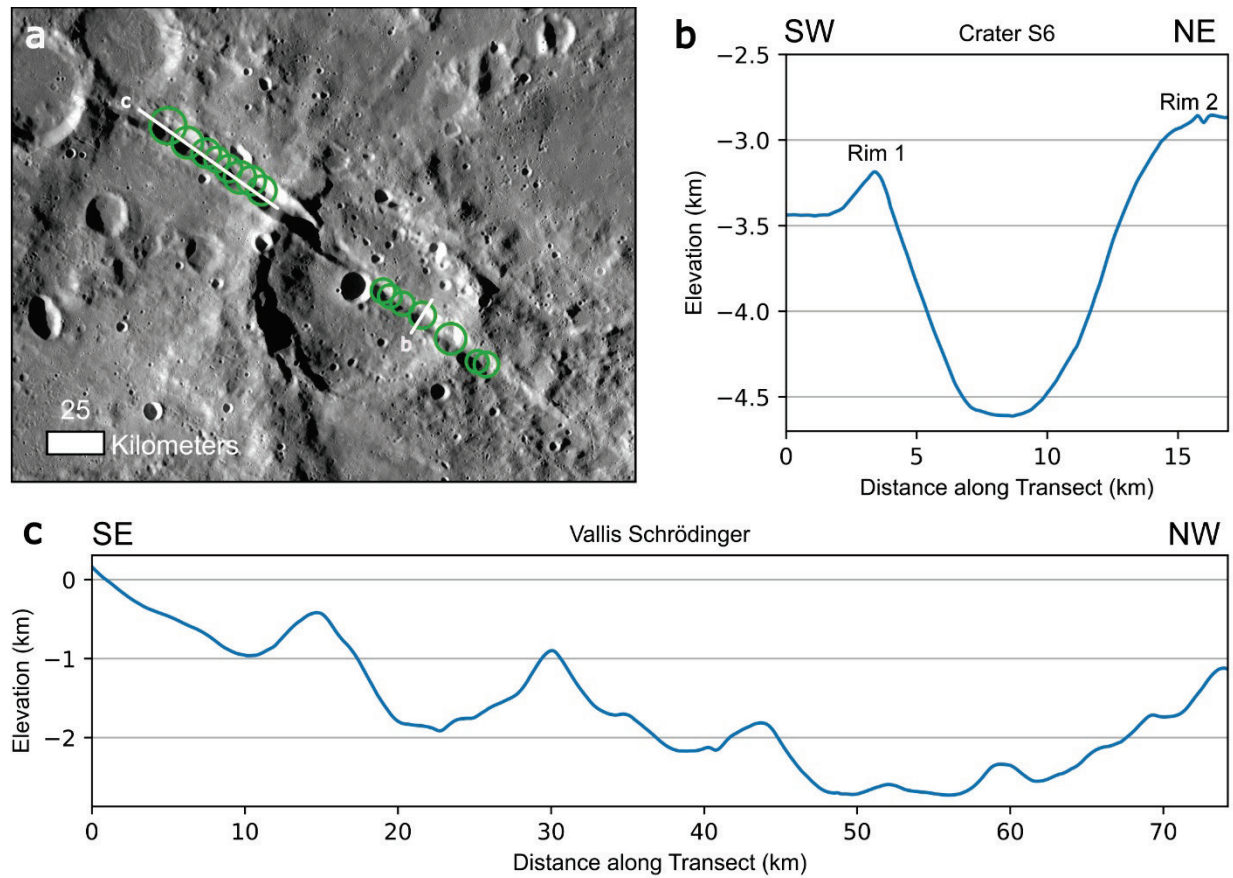
Supplementary Figure 3. Map of the intersection of linear features with the interior of the basin.

Trajectories of Additional Crater Rays

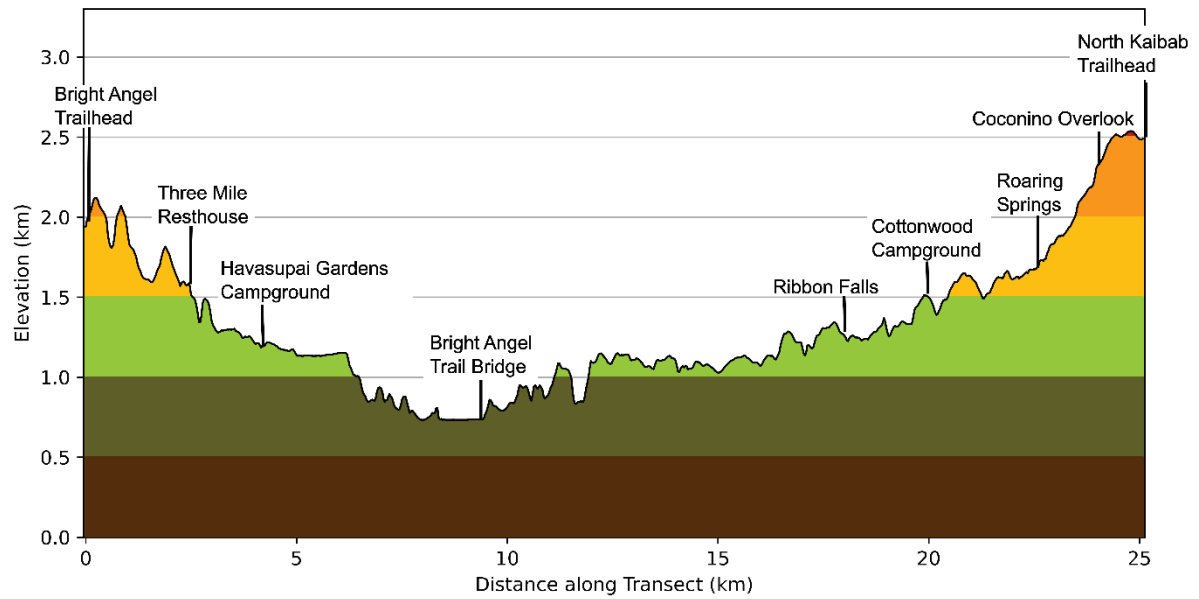
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LAMBERT AZIMUTHAL EQUAL AREA PROJECTION
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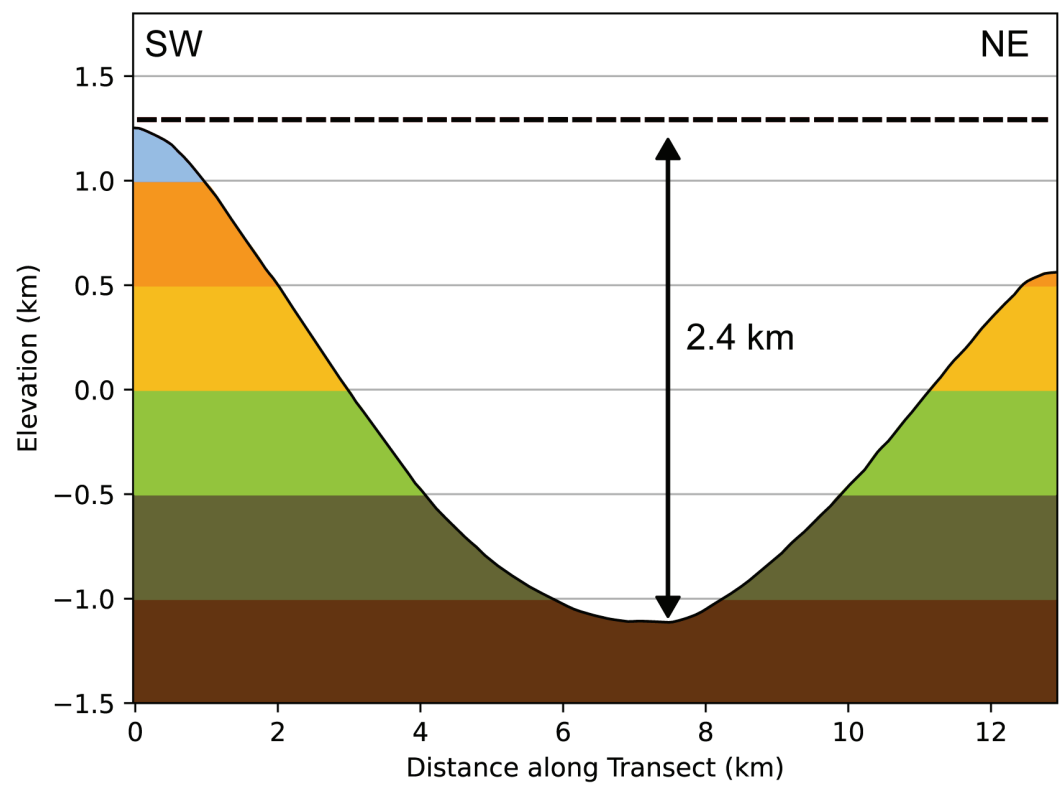
Supplementary Figure 4. Topographic transects along Vallis Schrödinger illustrating secondary crater rims and crater floors.



Supplementary Figure 5. Grand Canyon cross-section annotated with the names of points along the trail.



Supplementary Figure 6. Vallis Schrödinger cross-section.



Supplementary Table 1: Crater Diameter and Distances

Vallis Schrödinger

Crater ID	Crater Diameter (km)	Distance 1 (km)	Distance 2 (km)	Distance 3 (km)	Distance 4 (km)
S2	10.7	333	253	447	263
S3	9.7	337	257	451	267
S5	13.3	352	272	466	282
S6	11.4	368	288	482	298
S7	10.1	378	298	492	308
S8	10.0	384	304	499	315
S9	10.4	388	308	503	319
S10	12.5	456	376	571	387
S11	12.4	462	382	578	394
S12	13.7	467	387	582	399
S13	11.5	473	393	589	405
S16	10.7	480	400	595	411
S17	12.4	485	405	601	417
S18	13.4	495	415	610	426
S21	15.7	506	426	621	437

Vallis Planck

Crater ID	Crater Diameter (km)	Distance 1 (km)	Distance 2 (km)	Distance 3 (km)	Distance 4 (km)
P3	14.2	448	368	565	377
P7	6.2	539	459	656	468
P8	6.6	547	467	664	475
P9	8.1	557	478	674	486
P11	7.4	569	489	686	498
P22	5.7	585	505	702	514
P35	6.7	635	555	753	565
P36	5.6	643	563	761	572
P37	5.8	659	579	777	589
P38	5.3	714	634	831	643
P39	5.3	717	637	835	647
P40	6.1	728	648	846	658
P41	4.2	733	653	851	662
P42	4.8	903	823	1021	833
P43	6.9	907	827	1025	837
P44	5.3	921	841	1039	851
P45	4.4	926	846	1044	856
P46	6.9	937	858	1055	867
P47	7.4	1015	935	1132	944

Distance measurements in Table 1 are taken from the center of the secondary crater to...

- Distance 1 ... the Schrödinger Basin center.
- Distance 2 ... the transient crater rim on this trajectory.
- Distance 3 ... the intersection of the two main crater rays.
- Distance 4 ... the transient crater rim on this trajectory.

Supplementary Table 2. Values used in a comparison of energy needed to produce grand canyons on the Moon

Energy to produce Grand Canyons on the Moon

	Energy (J)	Reference
Vallis Schrödinger	3.39×10^{20}	This study
Vallis Planck	1.21×10^{21}	This study
Both canyons	1.55×10^{21}	This study

Energy to excavate second Panama Canal with nuclear explosives

Minimum	7.12×10^{17}	New York Times, 1964
Maximum	1.26×10^{18}	New York Times, 1964

Total yield of nuclear weapons tests of the US, USSR, and China

US	8.24×10^{17}	Department of Energy, 2015
USSR	1.20×10^{18}	Andryshin et al., 1996
China	1.02×10^{17}	wikipedia, 2024

Global inventory of nuclear weapons

Total	1.20×10^{19}	Mizokami, 2022
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References

Andryshin, I. A. et al., 1996, USSR Nuclear Weapons Tests and Peaceful Nuclear Explosions, 1949 through 1990, RFNC-VNIIEF, Sarov, 63 p.

Department of Energy, 2015, United States Nuclear Tests, July 1945 through September 1992, DOE/NV-209-REV16, 186 p.

Mizokami, Kyle, April 22, 2022, What If We Blew Up All the World's Nukes at Once? Popular Mechanics.

New York Times, September 20, 1964, A new canal - dug by atom bombs; nuclear energy is the key to replacing our obsolescent big ditch with a bigger one.

Wikipedia, List of Nuclear Weapons Tests of China, downloaded May 21, 2024.