

**ENDURANCE: LUNAR SOUTH POLE–AITKEN BASIN TRAVERSE AND SAMPLE RETURN ROVER.**

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**Summary:** Endurance is a mission concept for a long-range robotic rover designed to address high priority planetary science questions by exploring the South Pole–Aitken (SPA) basin on the farside of the Moon [1], and collecting, caching, and ultimately returning samples. Endurance was studied as part of the Planetary Science and Astrobiology Decadal Survey [2]. The Decadal recommended Endurance should be implemented as a strategic, medium-class mission as the highest priority of the NASA Lunar Discovery and Exploration Program.

**Science Motivation:** In the past decade, new ideas have emerged about the timing and nature of planet migration and impact bombardment across the Solar System [e.g., 3–5]. The Moon’s ancient surface provides a record of these events; however, there is debate about the completeness of the impact record, including whether there was a spike in impactor rate early in Solar System history (the so-called late heavy bombardment, or lunar cataclysm). At the same time, exploration of worlds across the Solar System has revealed the prevalence of giant, planetary-scale impacts, but only hint at the effects these impacts have on their target bodies.

The lunar farside, and the gigantic (~2,500 km diameter) SPA basin, provides an opportunity to address this combination of problems. SPA is the largest and oldest (undisputed) impact basin on the Moon. Determining the age of SPA, and the other large basins superposing it, would provide critical new constraints on the bombardment history of the Solar System at the time when life was first emerging on Earth. Additionally, SPA’s impact almost certainly excavated lunar mantle, and samples from SPA would provide a window into the early thermochemical evolution of a rocky world. For these reasons, SPA sample return has been consistently prioritized in the last three Decadal Surveys [6–7, 1] and other strategy documents [e.g., 8].

**Endurance Concept:** Endurance is an evolution of the Intrepid planetary mission concept study [9], which

was designed to traverse >1,800 km on the lunar near-side in order to address priority science questions focused on lunar magmatism. Intrepid demonstrated the efficacy of long-range rovers, and the Decadal sought to understand if an Intrepid-like architecture could be applied to the long-standing goal of SPA sample return. A long-range traverse of SPA enables collection of samples from varied terrains within the basin, which are necessary to understand the basin’s complex history.

The Decadal studied two variants of the Endurance rover: Endurance-R (Robotic), which would deliver a small sample cache to a robotic Earth return vehicle, and Endurance-A (Astronaut), which would deliver a large sample cache to Artemis astronauts. The Decadal recommended Endurance-A for implementation, as it offered flagship-caliber science at lower total cost to the Planetary Science Division and exemplified the ideal collaborations between NASA’s robotic and human exploration efforts [2]. Fig. 1 shows the Endurance-A rover and its traverse. More details can be found in the Endurance concept study report [1].

**References:** [1] Keane et al. (2022), Endurance concept study report (<https://tinyurl.com/2p88fx4f>). [2] NASEM (2022) *Origins, Worlds, and Life: A Decadal Strategy for Planetary Science and Astrobiology 2023–2032*. [3] Bottke et al. (2021) *BAAS*, 53(4), 218. [4] Cohen et al. (2021) *BAAS*, 53(4), 20. [5] Jolliff et al. (2021) *BAAS*, 53(4), 290. [6] NRC (2003) *New Frontiers in the Solar System: An Integrated Exploration Strategy*. [7] NRC (2011) *Vision and Voyages for Planetary Science in the Decade 2013–2022*. [8] NRC (2007) *Scientific Context for Exploration of the Moon*. [9] Robinson et al. (2020) Intrepid Planetary Mission Concept Study Report.

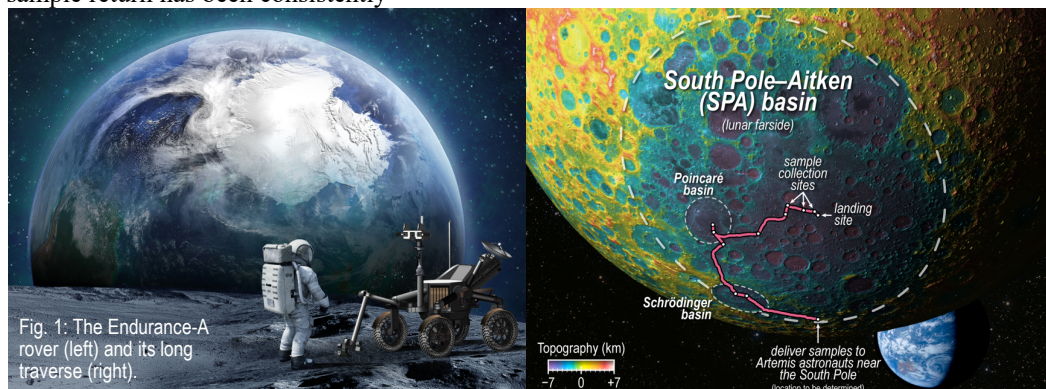


Fig. 1: The Endurance-A rover (left) and its long traverse (right).