SOUTH POLE AITKEN BASIN SAMPLE RETURN MISSION

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The South Pole Aitken Basin is the oldest and largest of the lunar impact basins that formed prior to 3.9 by ago. The impact may have penetrated several hundred kilometers through the crust and perhaps into an ancient mantle. The original crust was stripped off and emplaced as impact ejecta beyond the rim of the basin, while the interior of the basin was filled by with subcrustal rocks, probably in the form of breccias and/or impact melts. Mare volcanism occurred locally within the Basin. The South Pole Aitken event is significantly older than the oldest mare basalts that have been dated but it is not known whether the basin is significantly older than the front side mare basins. Several multi-ring impact basins formed within it, which redistributed rocks within the South Pole Aitken.

South Pole Aitken Basin sample return has two major objectives: (1) determine the range of rock types that were excavated by the event and what classes of subcrustal rocks were involved. (2) determine the age of the basin. A mission was proposed to NASA’s Discovery Program in 2000 with the objective of landing at a well-chosen site and collecting about 1 kg of material, mostly fragments between 1 mm and 1 cm, by sieving a few hundred kilograms of regolith over a six day period. The mission fit into the scale, timing and cost constraints of the Discovery program, but was not selected for further study.

Is a “grab sample” adequate to address the important scientific issues represented by the South Pole Aitken Basin, considering the complexity of its formation and history? It is argued here that samples obtained from a limited area can be very effective because of the remote sensing data from Clementine and Lunar Prospector, which allow the selection of a site where the geological history is relatively simple (e.g. the center of a relatively recent large impact into the floor of the South Pole Aitken Basin) and the association of rock fragments in melt rocks and breccias to mapped nearby terrains. Still, a single mission is not likely to answer all questions and will raise new ones. A simple sample return mission can be the first step in the intensive study of this region of the Moon.