Exploring Lunar Impact Basin Porosity Through a Weighted Least-Squares Fit Model

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The Moon is cratered with thousands of well-preserved impact basins. Shared geologic history with Earth makes lunar basins a good proxy for the processes affecting early Earth. Porosity, the amount of empty space in rock, changes based on the forces during impact events. This study used data from NASA missions to analyze porosity in 50 basins with diameters of 170-360 km. The methods used here can map porosity in basins of any size, unlike previous methodologies which could only study basins of certain sizes. Python programs were designed to conduct a weighted least-squares fit to obtain porosity values for each basin interior and exterior region. Porosity decreased in the interior of the basin in 76% of the basins studied ($p < 0.05$), and porosity decreased more in older basins than younger ones. No trend was observed between porosity and basin diameter. These findings are inconsistent with previous studies of basins smaller and larger than the ones studied here, which may result from the assumptions of different methodologies. Overall, impact events appear to decrease porosity inside basins and increase porosity outside basins. This methodology represented a different approach to studying the properties of impact events and providing insight into ancient basins.