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Geodesy Transforming Our Understanding of Planetary Interior

Geodesy — the study of a planet's shape, orientation, and gravity field — is one of the most powerful methods for investigating the formation, evolution, structure, and active processes of Solar System bodies. Geodetic measurements from space missions to distant worlds have revealed oceans of liquid water within icy moons, probed the atmospheric dynamics of gas giants, and characterized the deep structure of terrestrial worlds. The power of geodesy is best demonstrated at the Earth and Moon, where spacecraft missions have geodesy transformed from a purely geophysical tool into one that unlocks advances in geology, climate change, hydrology, geochemistry, and more.

While geodesy in the Earth-Moon system has flourished, geodesy of other worlds has lagged behind. Closing this gap would revolutionize planetary science. New geodetic data could be used to locate hidden water resources on Mars, elucidate the nature of



Martian crustal dichotomy as well as reveal the connections between Martian climate and orbital dynamics. At Venus, new geodetic data can be used to test how mantle dynamics operate in the absence of plate tectonics. Finally, I will outline the future strategy of ocean world exploration including the design and implementation of geophysical and remote sensing experiments that can support habitability investigations by providing essential geophysical context.