# Terrestrial Planet Formation: Delivery of Water to Mercury and Venus

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The formation of the four terrestrial planets of the solar system is one of the most fundamental problems in the planetary sciences. However, the delivery of water and other volatiles to Mercury and Venus during their formation remains poorly understood. Indeed, although previous works have focused on the delivery of such substances to Earth based on N-body simulations, to our knowledge no similar studies have discussed the same delivery to the other terrestrial planets in the context of formation of the other terrestrial planets.

We investigated terrestrial planet formation by performing N-body simulation runs using hundreds of embryos and thousands of disk planetesimals representing a primordial protoplanetary disk. To investigate the formation and the delivery of water to Mercury and Venus, these simulations considered an inner region of the disk (the Mercury region) and disks with and without mass enhancements beyond the ice line location in the disk.

Although Venus and Earth analogs (considering both orbits and masses) successfully formed in the majority of the runs, Mercury analogs were obtained in lesser runs. We found that our Mercury analogs acquired most of their final masses from embryos/planetesimals initially located between the disk inner edge and ~1–1.5 au within 10 Myr, while the remaining mass came from a wider region up to ~3 au at later times. Although the ice line was negligible in the formation of planets located in the Mercury region, it enriched all terrestrial planets with water. Indeed, Mercury and Venus analogs showed a wide range of water mass fractions at the end of terrestrial planet formation. In particular, the region beyond ~1–1.5 au would have the potential to source Mercury with water and possibly other volatiles during a late veneer period of accretion.

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