

## The World Is Not Enough (WINE) - space mining robot with steam propulsion

The World Is Not Enough (WINE) is a concept for a new generation of spacecraft that takes advantage of In-Situ Resource Utilization (ISRU) to explore space. WINE mines to extract water from planetary regolith, capturing the water as ice in a cold trap and heating it to create steam for propulsion. By propulsively "hopping" from location to location, WINE can explore Solar System bodies as well as individual bodies (e.g. WINE could cover much greater distances on Europa or the Moon than a rover, and can reach otherwise inaccessible regions). And by refueling itself as it goes, WINE's range is not limited by consumables. This makes WINE particularly well suited to prospecting and reconnaissance missions.

A prototype of WINE was designed, fabricated and tested in a large vacuum chamber. The vehicle was used to demonstrate several of the primary operations that would be required of the WINE spacecraft including: mining and heating regolith to extract water; capturing water as ice in a cold trap; reorienting the vehicle to allow for further mining; pushing captured water into a propulsion tank; and heating propellant to create steam for thrust. All systems demonstrated are fully functional. All tests are conducted with regolith simulant in a vacuum chamber.