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THE WAY OF INDIGENOUS PEOPLES - 3D PRINTING SUSTAINABLE LUNAR BASES FROM IN-SITU RESOURCES

Abstract

We explore the limits of in-situ resource utilisation (ISRU) on the Moon to maximise living off the land by building lunar bases from in-situ material. Currently, most ISRU schemes are focussed on: (i) extraction of water from the polar regions despite the accessibility implications, (ii) extraction of oxygen from minerals through a range of candidate processes; (iii) 3D printing regolith as protective shield structure such as D-shaping. We suggest that water and oxygen supply are not critical resources and they can be recycled through advanced controlled environmental life support systems (CELSS). Indeed, we argue that to be sustainable, extraction of highly valuable volatiles other than water (particularly carbon and nitrogen) must be husbanded responsibly. To that end, we must not waste critical resources for future generations (like burning natural gas by oil wells). We are interested in leveraging lunar resources to 3D print an entire lunar base that projects beyond the D-shape process in such a fashion that is fully sustainable and minimises supplies required from Earth. For instance, lunar basalt may be cast to form piping for the distribution of water and air through the habitat. It is but a short step from the recovery of oxygen from minerals to the recovery of a range of metals and ceramics, and a short step from the extraction of water to the extraction of volatiles for the manufacture of silicone plastic. From this, electrical cabling for the distribution of electric power and routing data may be manufactured. Fused silica glass fibre may be manufactured from lunar silicates for thermal insulation. As a step towards 3D printing lunar bases, we emphasise 3D printing the load-bearing structure, the power supply, electrical system, heating system, water system, air system and orbital transport system from in-situ resources. The vast majority of systems constituting a lunar base can be manufactured from in-situ resources. The lunar base must be designed to ensure that materials are readily separable for recyclability so the base can be re-customised ad infinitum. This is the lesson we can learn from indigenous peoples who excelled in sustainability – use everything, recycle everything, waste nothing. This is the only way to colonise the Moon and other bodies of our solar system in a manner that is fully sustainable.