Regolith Extraction Through Molten Regolith Electrolysis Donald Sadoway, Alex Ignatiev, Peter Curreri, Lunar Resources, Inc., Houston, TX (alex@lunarresources.space, peter@lunarresources.space dsadow@lunarresources.space, elliot@lunarresources.space)

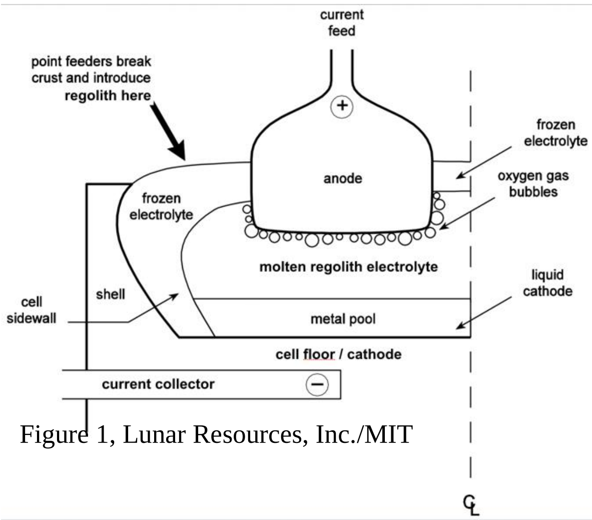

Figure 1, Lunar Resources, Inc./MIT

Introduction: Molten oxide electrolysis (a.k.a. magma electrolysis) is an extreme form of molten salt electrolysis, a technology that has been producing tonnage metal for over 100 years; aluminum, magnesium, lithium, sodium, and the rare-earth metals are all produced in this manner. What sets molten oxide electrolysis apart is its ability to directly electrolyze regolith as-received to produce pure oxygen at one electrode and a plurality of liquid metals at the other electrode, doing so without the need for any form of supporting electrolyte.

Figure 1 shows a schematic of such a reactor. The passage of electric current through the molten regolith drives electrochemical reactions at the electrodes producing oxygen at the anode and liquid metal at the cathode. In parallel, this electric current generates joule heat in the molten regolith so as to maintain the operating temperature. By tuning the insulation at the sidewall the temperature is made to fall below the freezing point of regolith enabling the melt to be contained within a frozen skull of same. Oxygen evolves continuously from the top of the cell. Liquid metal collects at the bottom of the cell from which it is periodically removed either by bottom tapping or siphoning. The composition of the metal product is a function of the composition of the regolith feedstock and the operating conditions, including cell current and temperature. Multicomponent liquid metal alloys can be subsequently refined in a secondary electrolysis cell. Among the metals present are Fe, Si, Al, Mg and Ca, which can be utilized to fabricate in-situ power grids, radio observatories, and other surface assets.

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