

**An Area-Based Management Approach for Regulating Lunar Mining Activities.** K.M. Hubbard<sup>1\*</sup> and L.T. Elkins-Tanton<sup>1</sup>. <sup>1</sup>Arizona State University, 781 Terrace Mall. Tempe, AZ 85281. (k.m.h@asu.edu)\*

**Introduction:** The development of lunar mineral resources is hindered by two major factors: 1) the absence of an institution and instrument for issuing long term exclusive rights to explore and exploit the Moon for its resources and 2) a process by which a title could be acquired to explore and exploit an area and claim its resources. We recommend governance of Lunar mining activities using Area-Based Management Instruments. Such instruments are conventionally used in spatial planning and management of particular areas on Earth to regulate the distribution, timing, and intensity of activities. Moreover, they require a designated authority to implement and oversee rules, regulations, and procedures in specified areas requiring higher protection or restrictions [1]. A Lunar Spatial Planning Tool (Figure 1) is currently in development to facilitate the implementation of such instruments on the Moon.

A case study was conducted on the International Seabed Authority's (ISA) management of seabed minerals to identify best policies and practices for implementation in Area-Based Management of lunar mineral resources. The case study includes analysis of the ISA's 1) historical development and negotiating history, 2) guiding principles, 3) its 'Mining Code' [3], and 4) its Environmental Management Plan for the Clarion Clipperton Fracture Zone.

**The Lack of a Lunar Governance Regime:** We recommend the development of a Lunar Resource Management Authority (LRMA), an international regime responsible for: i) encouraging the development of lunar resources, ii) developing and administering area-based management strategies, iii) safeguarding the lunar environment as it may be affected by mining activities, and iv) ensuring the equitable use and economic benefits of lunar mineral resources.

**Regulations, Policies, and Procedures:** We recommended the following for overseeing Lunar mining activities: 1) a notification process for prospecting, where a lunar contractor must notify the LRMA of its intention to engage in prospecting, 2) an application process in the form of contracts where the LRMA would issue exclusive but temporary rights to a contractor to explore and exploit an area on the Moon's surface, providing security of tenure, 3) a Parallel System of Reserved Areas. This equitable management strategy reserves mining areas for non-space faring nations, which are

partitioned from each contract area granted to a Lunar contractor, 4) a "Relinquishment" procedure, both for resolving overlapping claims and for a contractor to delineate Reserved Areas, 5) the development and use of Areas of Particular Scientific Interest, which will implement Preservation Reference Areas and Impact Reference Zones to safeguard the lunar environment, 6) the development and use of Areas of Particular Operational Interest, which prohibit mining activities in areas due with high significance to another sector, and 7) the incorporation of priority rights and first possession principles (i.e., Homesteading) [4] for the "Pioneer Investors" that invest in the early development of lunar mineral resources.

**The Lunar Spatial Planning Tool:** The Lunar Spatial Planning Tool divides a lunar resource system into a grid of mining blocks. By simplifying the lunar surface into blocks, the tool facilitates the recognition of rights and compliance and enforcement of the recommended rules, regulations, and procedures listed above.

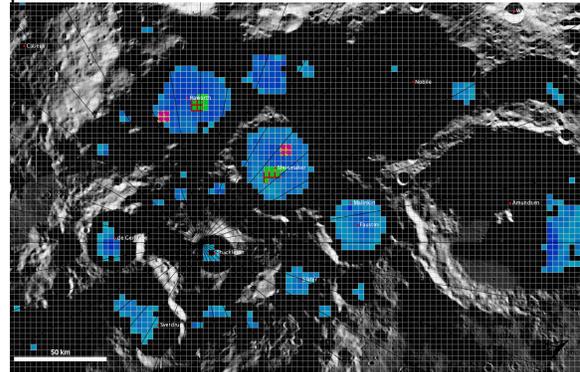


Figure 1 - Example of the Lunar Spatial Planning Tool dividing the south polar region to 80°S into ~9km<sup>2</sup> mining blocks. Colored blocks indicate locations with an average maximum summer temperature of <101K [5], which was used as a proxy to delineate locations potentially suitable for prospecting for lunar ice deposits. Pink blocks are hypothetical Areas of Particular Scientific Interest reserved for environmental impact studies and other scientific purposes. Green blocks are two hypothetical contract areas to explore for lunar ice deposits. Green blocks outlined in red depict "Reserved Areas" partitioned out of the contract areas by the lunar contractors that will be reserved for future mining entities from developing States.

**References:** [1] Gissi, E. et al. (2022). *Journal of Cleaner Production*, 330, 129910. [2] UN Doc. A/62/66/Add.2, 122–161. [3] ISA. Consolidated Regulations and Recommendations on Prospecting and Exploration. (2015). [4] Gruner, B.C. (2004). *Seton Hall Law Review*, 35, 1. [5] Williams, J.P. et al. (2019). *JGR Planets*. 124, 2505-2521.