

MAPPING CHINA'S LUNAR RESSOURCE STRATEGY THROUGH OPEN SOURCE INTELLIGENCE (OSINT): A HYBRID HUMAN-AI ANALYSIS

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Introduction: Interest in lunar resources has accelerated in recent years as governments, commercial organizations, and research institutions explore the potential for in-situ resource utilization (ISRU) to support sustained lunar operations and a broader cislunar economy. Water ice deposits, oxygen extraction from regolith, locally manufactured construction materials, and propellant production are widely viewed as enabling technologies for long-duration exploration and infrastructure development.

The People's Republic of China (PRC) has articulated an increasingly ambitious lunar program through the Chang'e robotic missions, the proposed International Lunar Research Station (ILRS), and long-term planning documents extending through mid-century [1, 2]. While official policy statements describe broad strategic goals, a significant portion of China's technical thinking about lunar resource utilization and infrastructure development appears in Chinese-language scientific literature, engineering journals, and institutional research publications.

Much of this literature remains underexamined in Western analyses of China's lunar program despite being relatively publicly accessible. Systematically analyzing these materials may provide valuable insight into emerging research priorities, technological pathways, and institutional networks supporting China's lunar resource development efforts.

This work proposes a structured analysis of Chinese-language technical literature related to lunar resources in order to map PRC research priorities, institutional actors, and technological themes associated with lunar resource utilization and infrastructure development.

Research Approach: The study employs a hybrid human-AI open source intelligence (OSINT) workflow designed to systematically analyze large volumes of multilingual open source material.

The project focuses on assembling and analyzing a corpus of Chinese language publications related to lunar science, ISRU technologies, and surface infrastructure. Primary sources include:

- Chinese scientific journals and conference proceedings addressing lunar geology and engineering
- technical publications from Chinese universities and research institutes
- patents related to lunar resource extraction and infrastructure technologies
- Chinese-language media and technical commentary discussing lunar initiatives

The analytical framework combines automated document processing with expert review. First, the corpus is collected via a variety of open source means, to include search engines, LLMs, and other methods. Next, automated tools are used to translate and extract key entities, technologies, and institutional affiliations from the literature corpus. These tools identify recurring research themes, technical processes, and relationships between organizations. Then, human SMEs review the extracted information to assess technological maturity, interpret research priorities, and identify patterns across institutions and programs.

For analytical purposes, the literature will be categorized into several thematic areas relevant to lunar resource development:

- ISRU processes: water extraction, oxygen production, and regolith processing
- Lunar construction and materials: sintered regolith structures and additive manufacturing approaches
- Surface infrastructure: power systems, robotics, mobility platforms, and autonomous construction
- Transportation and logistics: cislunar transport systems and lunar surface supply chains
- Defense technology: anything with clear military/security applications

Mapping research publications and patents within these categories enables identification of clusters of activity and institutional leadership within each technological domain.

Expected Outcomes: This research aims to produce a structured analytical view of PRC lunar resource research by mapping relationships among technologies, institutions, and research themes.

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The study will generate three primary outputs:

- A synthesized analysis of Chinese language research related to lunar resource utilization, identifying dominant technical themes and emerging research priorities.
- A mapping of institutions involved in lunar resource research, including universities, research institutes, and aerospace organizations contributing to these efforts.
- A technology landscape analysis showing clusters of research activity across ISRU processes, construction technologies, infrastructure systems, and transportation concepts.

Where possible, the study will also compare these research themes with publicly available information on international lunar initiatives such as Artemis to identify areas of overlap or divergence in technological focus.

Significance for the Space Resources Community: Understanding the technological priorities and institutional landscape of China's lunar research program is increasingly important for the international space resources community.

Chinese-language scientific literature provides a large but underutilized body of information about research related to ISRU processes, lunar materials engineering, and surface infrastructure technologies. Systematically analyzing this literature can provide early insight into emerging technological directions and strategic priorities.

In addition, many of the technologies discussed in this literature have dual-use characteristics, with applications relevant both to civil exploration and to defense implications.

By mapping these research activities using open-source methods, this work aims to provide a clearer picture of how different national programs may approach the development of lunar resource capabilities.

Future Work: As the dataset expands, the project will explore development of a dynamic research database and visualization platform that allows users to track lunar resource research across institutions, technologies, and programs. Such a tool could provide the space resources community with an evolving map of global research activity related to lunar resource development.

References:

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- [2] CAS/CNSA/CMSE (2024) National Medium- and Long-Term Development Plan for Space Science (2024–2050). Chinese Academy of Sciences, China National Space Administration, China Manned Space Agency, October 2024. http://english.nssc.cas.cn/pub/202410/t20241028_692867.html (<https://archive.ph/I4OV4>)

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