Extraterrestrial Supply Chains On Mars

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Abstract

Precious metals are one of the most important resources on earth. They are used in nearly every industry, ranging from healthcare to furniture, and they play a vital role in the technology industry. However, centralized mining deposits in foreign countries mean that sometimes nearly all of the world's supply of a precious metal may run through a single country or supply chain (Clark). This issue can be combated by reducing American reliance on metals imported from countries like China, and looking to the red planet, mars, for precious metals and resources ("Sands of Mars: Digging up the Red Planet").

Extraterrestrial Supply Chains on Mars

With precious metals nearly completely controlled by China, the US tech industries reliance on the metals can be worrisome. A single supply chain means one point of failure, and gives the center of the supply chain the ability to control prices and wage economic warfare. A mission to extract metals from mars and create a mining settlement there would greatly help out the American tech industry, and it would build economic independence from China in the case of a trade war.

Needs and Goals

The primary need of this mission would be to become less reliant on China for precious and heavy metals. The three main questions the mission would aim to answer would be:

1. How can we support life on Martian Soil?
2. How can autonomous vehicles help us determine places to build settlements
3. How can we extract resources from Mars?

These main mission questions coincide with the three of the four NASA Mars Exploration Program Science Goals - Determining the Climate of Mars, the geological composition of Mars, and preparing the planet for Human Exploration and Settlement (mars.nasa.gov).

Mission Subject

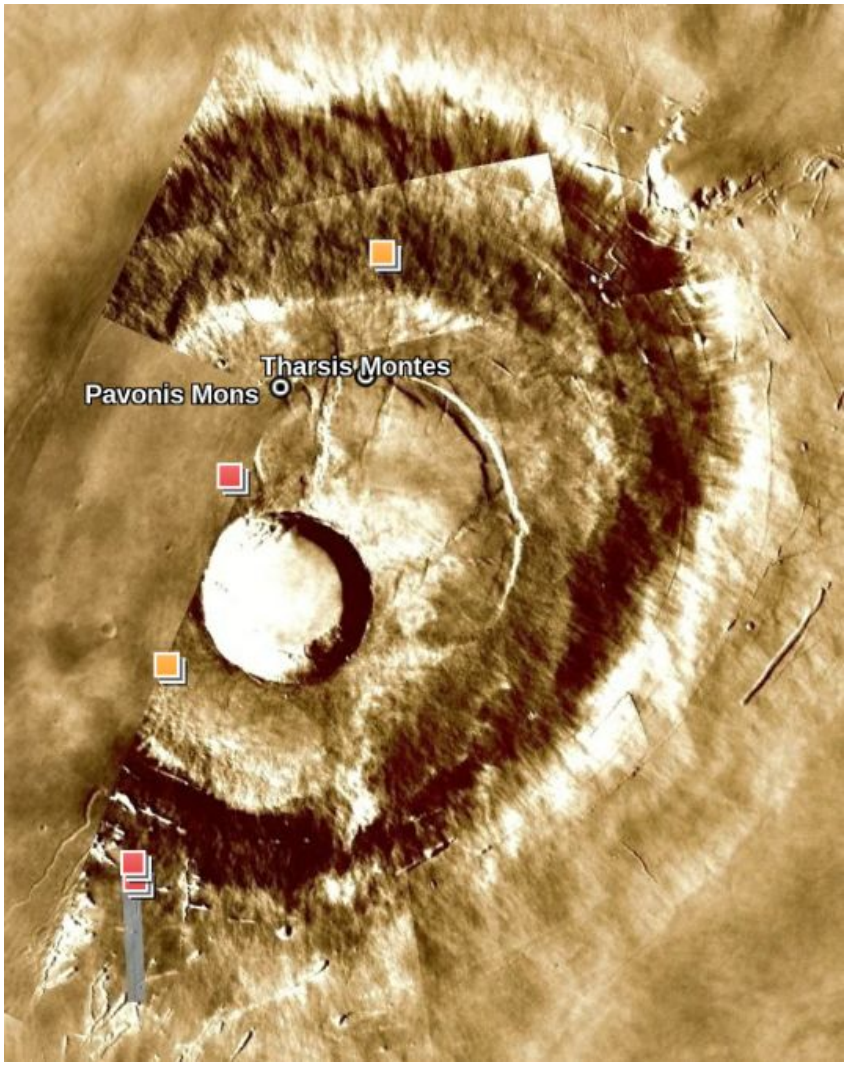
The main focus of the mission is to determine the geological composition of Mars and extract whatever metals and rock data needed for research and the tech Industry. Observations will initially be made by a fleet of rovers near the crater basin location to determine the optimal metal source and the best place to build a settlement. Observations will be made by a joint team of Humans and Rovers after the settlement is established

Operational Concepts

The Mission would be divided into 5 main phases, each of which would be in chronological order. The first phase would be focused on settlement development, and the mining equipment development. The settlement would be made using 3D Printed parts (Dunn et. al), and would take advantage of technologies like vertical farming ("Vertical Farming for the Future") to maximize space and save resources. The development of a settlement on Mars would take a substantial amount of time, so the rough time frame for the settlement design and development would be about 5 years. Concurrently with the Settlement Development, private tech companies, NASA, and mining companies would collaborate to create mining tools focused for space. After completion of phase 1 (settlement and mining tech), the NASA researchers would begin to work on Rover and Robotics Development to build the settlement. Fleet robotics for construction would require a lot of time to fine tune and create, so an estimated time frame of about 3 years would be needed. After all of the components are ready, they would be sent to Mars on Deep Space Rockets, and would land at the Tharsis Montes crater. The estimated time for the travel and construction time after landing would be about 2 years. After the base is finished, a small team of about 30 scientists, engineers, miners, doctors, and astronauts would be sent to live in the settlement, and help collect scientific data or mine for metals. Every 1 year or so, people, supplies, and metal would travel back and forth from the base for the next 5 years until the majority of the scientists are done with research. Then the scientists and miners would return back to Earth, and the next group/mission would be sent to the base. The overall timeframe for the mission would be about 20 years, and require a lot of money, time, and commitment from NASA, Tech Companies, and Mining Companies.

Constraints and Landing Site

The landing site would be at the Tharsis Montes crater on Mars. This crater was likely caused by a meteorite or asteroid strike, and as a result valuable metals, and geological data would be in the crater. The crater looks something like this:



The mission has several constraints, the most important one being the technology on the autonomous construction fleet. Fleet Robotics is still a developing field, and the usage of it in a mission critical construction scheme has never been tried before. Another major constraint would

be the money and resources of the tech companies and NASA, and how much the US Government would be willing to invest behind eventual metal independence from China.

Scope Summary:

Need: Divert US-Chinese Heavy Metal supply chains.

Goal: Build short and long term settlements.

Objective: Develop advanced semi autonomous mining equipment and rovers for data collection.

Mission Case: Get metals from mars, build a temporary settlement, and return metals and people safely.

Operational Concept: Launch settlement supplies, rovers, and mining equipment to Mars, wait for autonomous robots to build shelter, send Astronauts, Doctors, Miners, and Technicians to mine metals. Send supply shipments to and from settlement to ferry people and materials as needed. After 5 years, the crew will return with data collected and a new group will be sent out.

Assumption: All technology is current available, or can be achieved within the next 15 years

Constraints: Complete full mission in under 20 years, secure funding and partnership of Tech Companies, and advance autonomous fleet robotics to a construction scale.

Authority: NASA and Private Tech Companies share authority and responsibility of the mission.

Conclusion

Precious metals could not be more important in today's world. They are the fundamental building block for advanced technology, and support critical industries like healthcare and food. However, a centralized supply chain of precious metals out of China, leaves not only a single point of failure, but it also allows for price wars and supply/demand fluctuations. With the development of a Mars base to mine for precious metals, the US government could not onl advance technology, but they could also secure financial independence in the tech industry.

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