Industry

Mining for volatiles

Solar energy sent to earth

Tourism

Goals

- We need to find a resource that can be mined for profit
- Using solar panels and He-3 isotopes mined from the dust. Provide all of the earth's energy by 2070.
- Finish the development of a fusion reactor and make solar cells on the moon and transmit via radiowaves the energy back to earth.

What to mine?

- Hydrogen- water, rocket fuel, hydrocarbons, oxygen
- Helium-3-fusion energy-ex. Propulsion or electric power
- Helium-4-atmosphere control, cryogenics
- Water-life support, oxygen
- Nitrogen- food, atmosphere control, reagents
- CO,CO2,CH4-food, hydrocarbons, fuel
- F2-oxygen and metal production, Teflon
- Cl2-oxygen and metal production, reagents
- SO2-metal extraction, H2SO4, explosives, binder for bricks or large rocks.

Continued…

- We will land in the largest basin, on the south side of the moon. Three south pole craters have high amounts of H and He-3 and Al are abundant on the far side which we can get to.
- Not likely to find precious metals such as gold, silver, platinum. Although even mining these wouldn't justify the journey.
- Al, Ti, Mg, Cr, He, H and even Pt.
- Near craters we could look for diamond and coesite
- Highlands cover 85% of the surface and almost all the far side, this area is rich in aluminum which can be mined

Oxygen

- Extract oxygen which makes up 45% of the regolith
- Critical for sustaining life and future rocket fuel
- Process- fluff up moon dust with our mining rover and add heat and hydrogen to make water.
- Waste products Si, Fe, and TiO2 will be reused for solar cells. Fuel cells-(H2, O2), life-support(N2O2, H2O, CO2), propulsion-(H2, O2, He-4)

Reactions

- Hydrogen-
- $H_2 + FeTiO_3 \leftrightarrow Fe + TiO_2 + H_2O \rightarrow H_2 + 1/2O_2$ (Temp=900C)
- Carbon monoxide cycle-
- $FeTiO_3 + CO \leftrightarrow Fe + TiO_2 + CO_2$
- Methane cycle
- $FeTiO_3 + CH_4 \leftrightarrow Fe + TiO_2 + CO + 2H_2$
- $2CO + 6H_2 \leftrightarrow 2CH_4 + 2H_2O$
- $2H_2O \leftrightarrow 2H_2 + O_2$
- Williams reduction reaction 79’
- $FeTiO_3 + H_2 \leftrightarrow Fe + TiO_2 + H_2O$

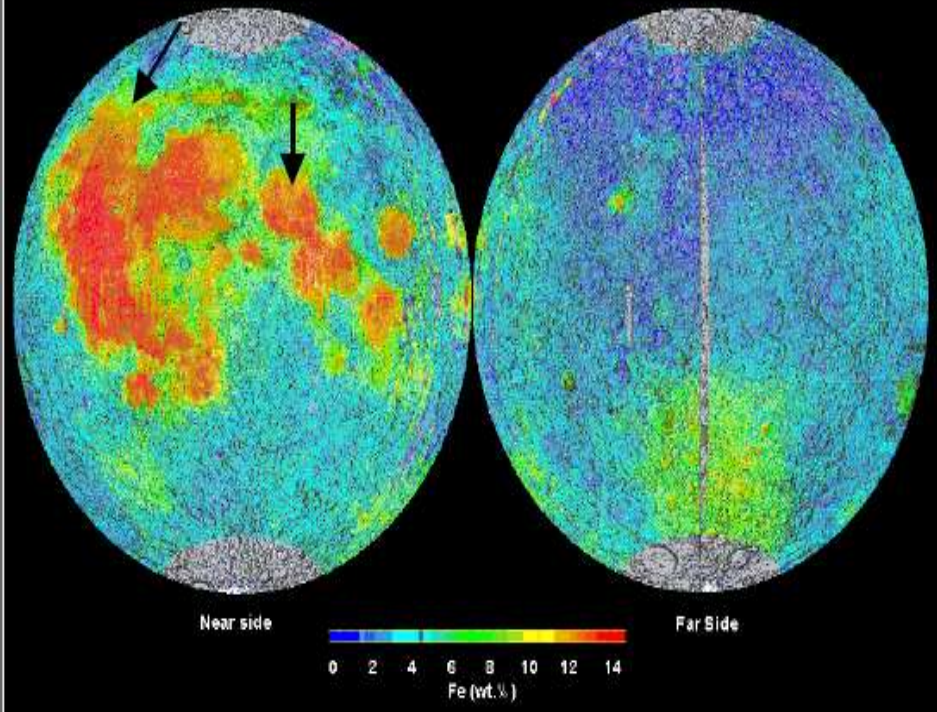
Iron

- To build the camp we will need an efficient way to extract iron from the dirt.
- The mare has up to 20% wt iron and to find this high amount we will employ large magnets.
- Produce heat-treated stainless steel (type 420)- This can be used for future machines and rockets and building materials. Composition: Fe-86.65%, Cr-13%, C-.35%.

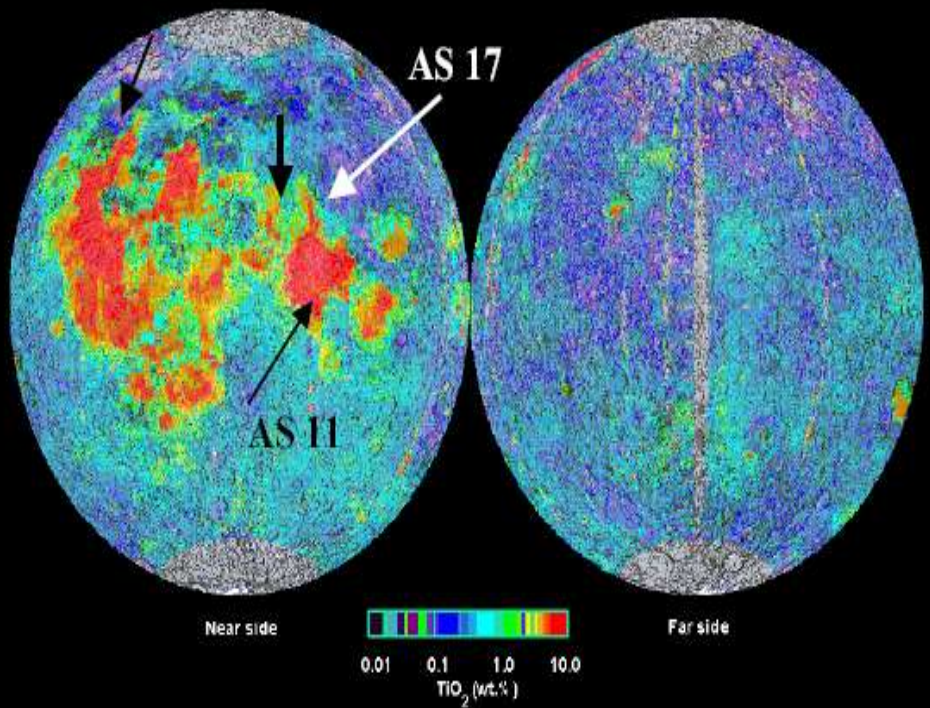
DISTRIBUTION OF BASALTIC MARIA

SHOWN BY IRON DISTRIBUTION (LEFT)
CONTRAST WITH VARIABILITY OF TITANIUM DISTRIBUTION (RIGHT)
(ARROWS INDICATE DIFFERENCES IN CENTRAL SERENITATIS MARIA AND NORTERN OCEANUS PROCELLARUM)

Clementine Iron Map of the Moon
Equal Area Projection



Clementine Titanium Map of the Moon
Equal Area Projection



Glass

- glass fiber production for fiber optics.
- Our mining rover is multi functioning. It will collect He-3 as well as other critical volatiles.
- And it will make solar cells on the surface to send energy back to earth.
- This environment is ultra-high vacuum so creating a thin film solar cell is easy and the required Si,Fe, TiO_2, Ca, and Al are already present


UNOX
Pat Rawlings

He-3 Fusion

- The small amount of 20ppb He-3 in the regolith means we need to mine a .75 sq mi area 9 foot deep.
- Downside to fusion or He-3 is it takes 18 years for first operating 100kg He-3 plant or 1,000 MW fusion plant, which is a long payback period. Upside is clean and non-radioactive energy.

Surface

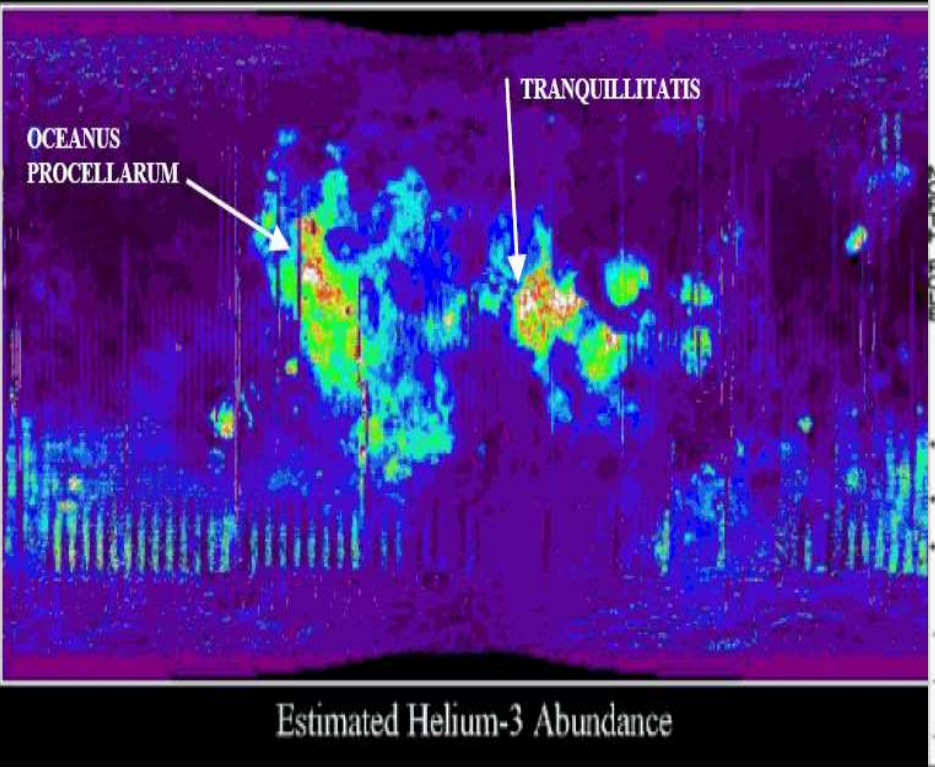
- The surface composition is Mg-6%, Al-7%, Ca-8%, Fe-13%, Si-21%, O-42%,
- Aside from the mare basalts, cooled molten rocks, most rocks are breccias which were formed from the shock wave of high speed impact craters fusing material together.
- A few inches are dust followed by 30 feet of pulverized rock. This can be mined but once a few feet deep the rock reaches cement like toughness.

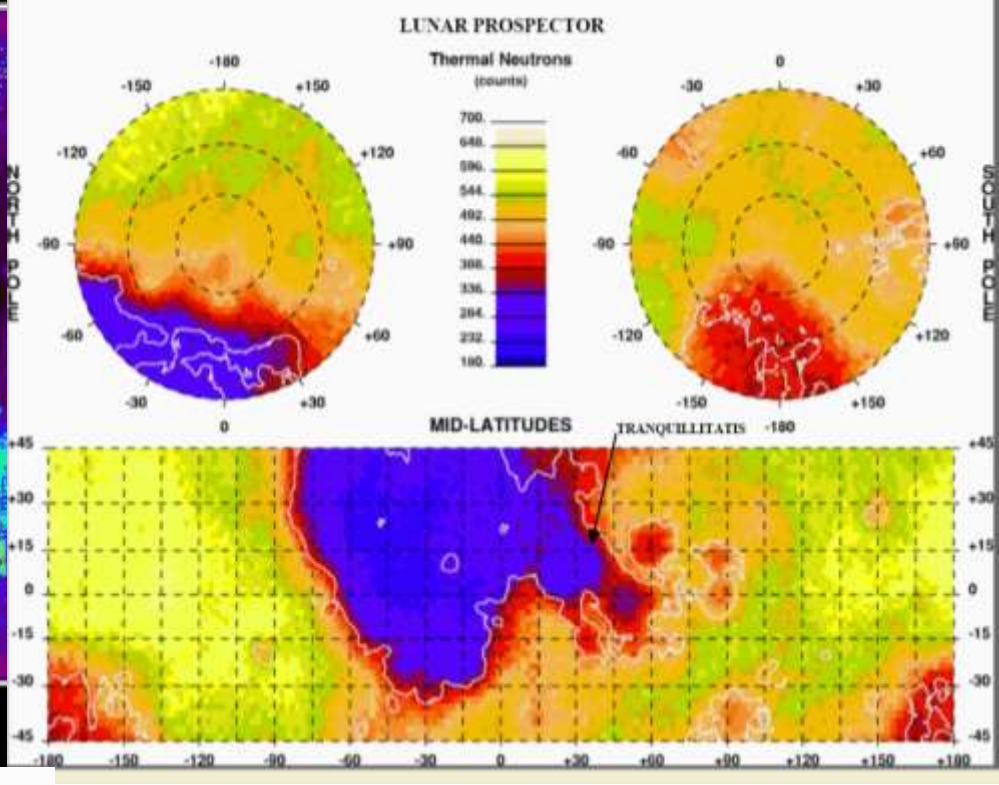
Mining

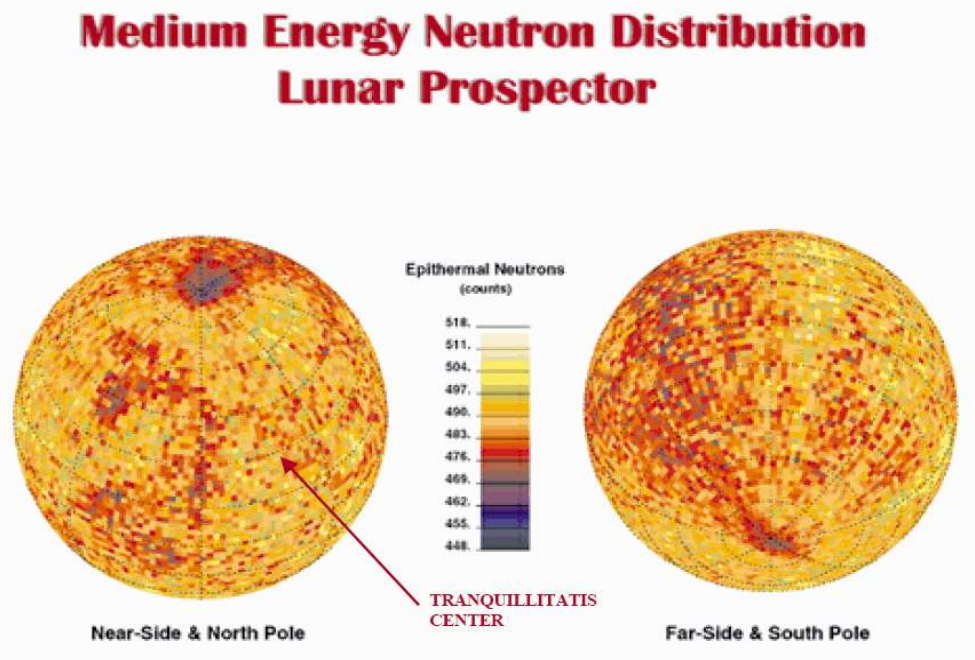
- Advanced or retreat mining is most preferred because of the quick return on investment.
- Most the energy will be used in busting the rock up and classifying it.
- A combination of surface and underground mining will be used.
- A crusher will be used with a jaw to break up the material. Other options are gyratory, cone, and ball/rod mill. For the sorter we can use grizzles, screens, cyclones, flotation, settling velocity, or shaker table. Our mining bulldozer will be capable of switching from scraper to rake to plow.

Radar

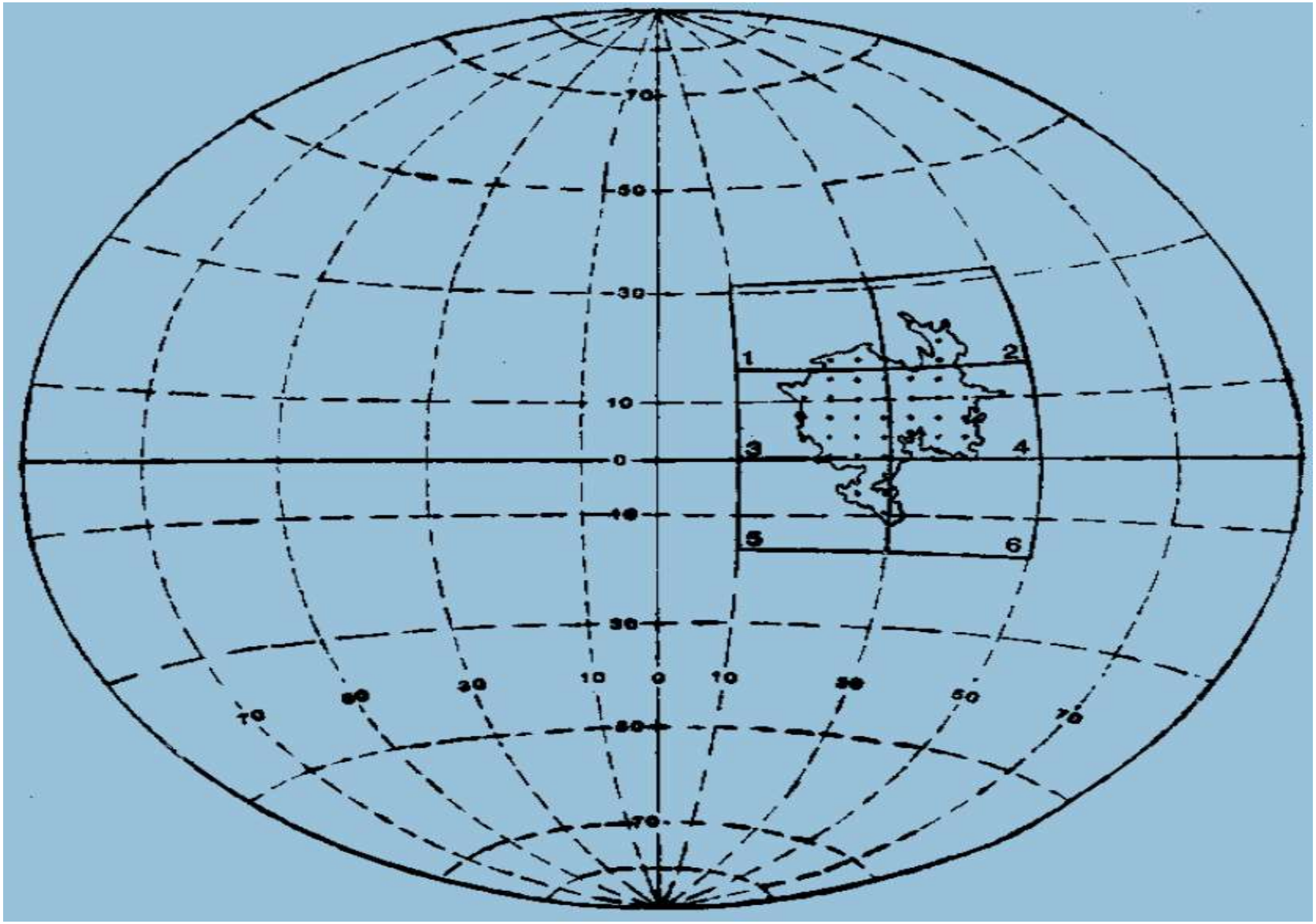
- Radar will be set up to determine where to mine for volatiles
- Solar cells to power our camp will be made on inclines on the moon and will reflect light to a transducer atop a large pole in our camp.
- Our rover will be powered by a solar dish that rotates to achieve optimum solar flux. The rover's importance means it must be able to operate while maintenance is done on it.







Where there is a lower neutron count there is more He-3 thus the north pole has the highest amounts of He-3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