Quantifying the Emissions Per Kg Mass Returned From an Asteroid Mining Mission

Ritchie, Benjamin (School: Barrenjoey High School)

Space is becoming more accessible for industrialization, and it is becoming increasingly clear that the modern world must be environmentally vigilant. The global approach towards the inevitable mining of asteroids must be sustainable and beneficial, to society and the environment. As such, this study investigates the emissions of an asteroid mining mission by quantifying the number of asteroids in the Near-Earth Asteroid (NEA) and Main-Belt Asteroid (MBA) group that could be environmentally beneficial, when compared to the average terrestrial Platinum Group Metal (PGM) mine. This is done by calculating the fuel emitted in the atmosphere for Falcon Heavy to launch to a 200km parking orbit with the payloads required for a transportation spacecraft to propel itself to the target asteroid, then finding the total return mass possible for each asteroid. Calculations are based upon ?V calculated using the Shoemaker-Helin Transformation. Fuel emissions to reach a 200km parking orbit are converted into the IPCC's standardized CO2e indexes for the gasses emitted. Total CO2e emissions for the launch and the return mass are used to find the emission ratio, which is compared to the emissions for terrestrial mines. It is found that 84% of NEAs could be environmentally beneficial compared to 36% for MBAs. The lower than expected difference in emission rates between asteroid mining and terrestrial mines is likely due to the extreme global warming potential (GWP) of tropospheric Black Carbon. Further research is suggested to confirm these predictions, and regulation is recommended to monitor the environmental effects of rocket launches.

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