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Asteroid Sampling: What Kind of Celestial Objects Should We Target?

ABSTRACT:

Using the JPL Small-Body Database Browser, asteroids whose orbits determined a safe and convenient landing for rockets and probes were identified. This experiment was conducted by carefully analysing the orbits of various types of asteroids in the inner asteroid belt since they are closer to Earth than others. Asteroids such as 2 Pallas, 1 Ceres, 4 Vesta and 10 Hygiea were excessively studied and compared to other asteroids by physical parameters and orbit paths. After completing the comparison stage, it had been concluded that the asteroids 2 Pallas, 4 Vesta and 1 Ceres are our best choices due to their orbits, closeness to Earth and composition. Furthermore, M-type asteroids located in the inner asteroid belt are generally good choices when it comes to asteroid mining.

INTRODUCTION:

The reason why this experiment was conducted was to identify the asteroids which would give us the best kinds of samples if we were to go there. For example, elements such as Rhodium are not easily accessible on Earth, but on M-type asteroids, these are extremely abundant. If we do enter a time of space exploration, it would be good to consider going to these asteroids to harvest samples for further research. These could help us better understand asteroids in our solar system and how they came to be. M-type asteroids are celestial bodies that are metallic and are composed of metals including Nickel, Iron and Rhodium.[3] B-Type asteroids, on the other hand, are different kinds of asteroids. They are known for displaying water in the form of ice as well as

many other different kinds of metals. These are commonly found in the Asteroid Belt and have a reflective surface.[4] Data accumulated by the Nasa Jet Propulsion Laboratory on different kinds of M-type asteroids were observed for over a period of one week. These results were then compared to other types of asteroids to give us a better grasp different types of asteroids samples. The purpose of this experiment was to target asteroids and pinpoint the ones that will give us the best chance of landing on their surface, which is done by looking at the orbit paths of asteroids.

AIM:

The aim of this experiment is to acknowledge the different kinds of asteroids that are the most likely candidates to land on. My hypothesis is that C-Type asteroids will be the most likely contender. C-Type asteroids are the most common types of asteroids in the entire asteroid belt. These means that they would be scattered around the asteroid belt, with some of them ending up in the inner-asteroid belt. C-type asteroids also consist of hydrated (water-containing) minerals.[5]

MATERIALS:

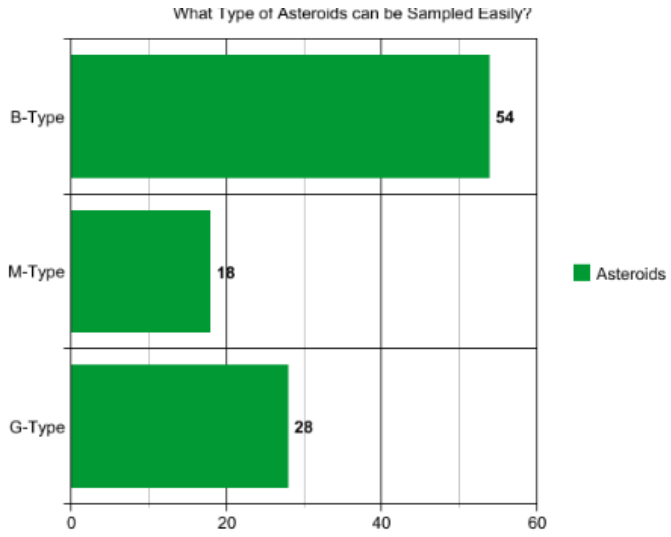
- Laptop with an internet connection; used to conduct the experiment, look at databases and write this scientific report.
- Lab notebook; used to record results and track progress.
- Pen; used to write with.

METHOD:

1. Searched for asteroid samples on the NASA JPL Database Browser based on specific criteria.
2. Results were recorded in a Lab notebook.
3. Data was put into an excel spreadsheet keeping track of what types of asteroids each sample was.
4. Data collected from the spreadsheet was then put into a collum graph.
5. Samples were compared based on orbit and distance relative to the Earth.

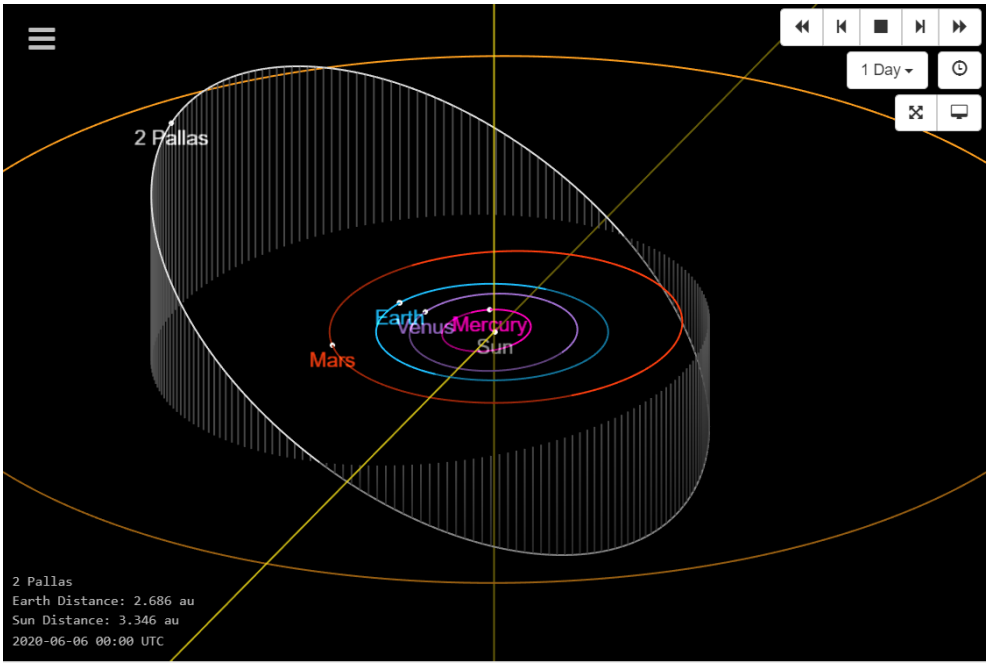
OBSERVATIONS AND RESULTS:

I classified over a hundred asteroids and determined whether they were good choices or not. Based on the conducted comparison experiment, most asteroids that have higher chances of being successfully travelled to were B-type asteroids in terms of asteroid sampling. A graph was put together tracking these types of asteroids. It represented the number of asteroids that were located in the inner asteroid belt.



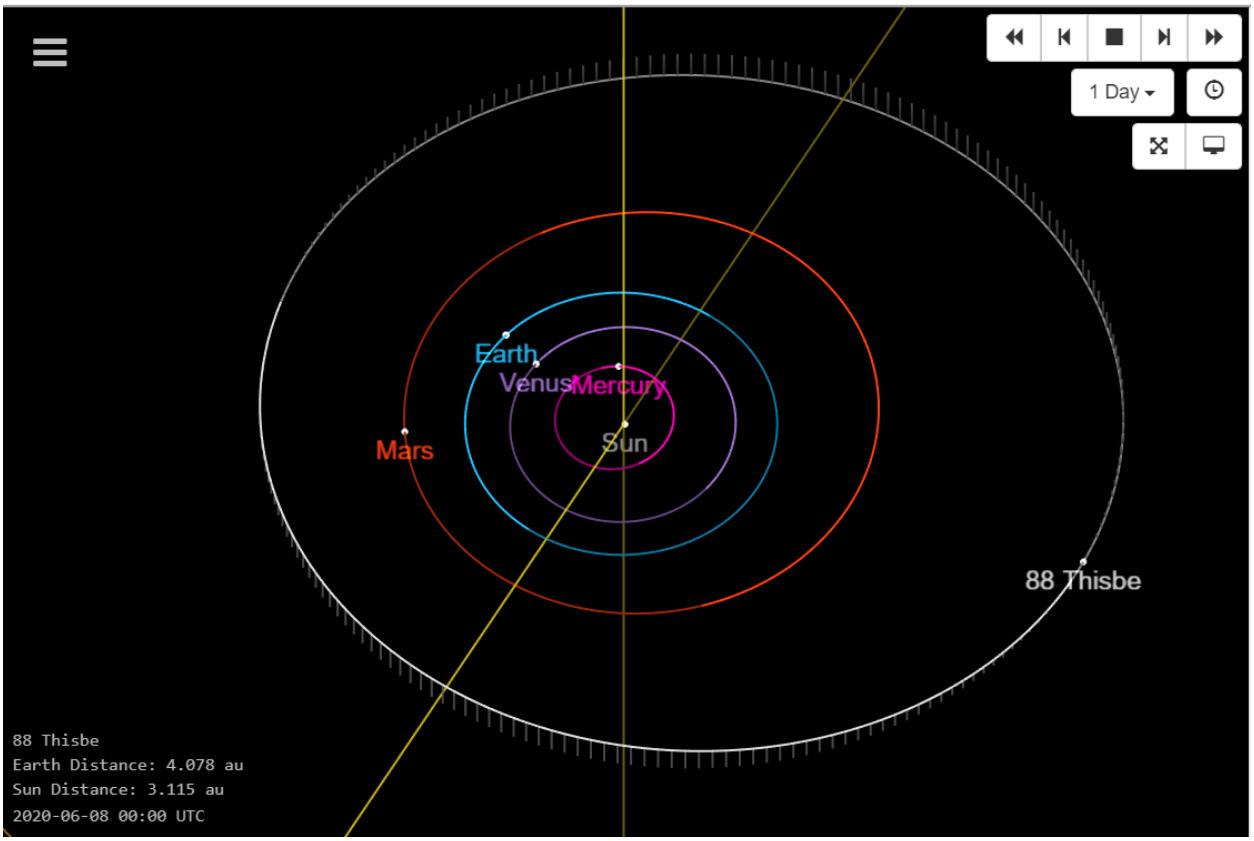
As shown in the graph, B-type asteroids are the best types of asteroids we can get to, since 54% of our results belonged to this group. This may be due to their location and distance relative to other kinds of asteroids. To further narrow down my selection, I looked at specific asteroids that were classified as B-type.

The first B-type asteroid observed was 2 Pallas. It is one of the largest asteroids in our solar system, so it seemed plausible to think that it was a good candidate. However, a diagram of its orbit indicated that it would be difficult to get to Pallas, due to its distance from Earth. An inner-asteroid belt object is preferable due to how close it is to Earth. However, the orbit of Pallas is evidently on an angle.



As shown in the diagram, Pallas is quite far from Earth and isn't located in the inner asteroid belt. This was the first clue which suggested that this asteroid is more likely to be a B-type asteroid instead of an M-type, considering how most B-type Asteroids are found in the inner asteroid belt. Although B-type asteroids do not contain as much metal as that of an M-type, they consist of small deposits of ice water.[3] The next asteroid analyzed was 88 Thisbe. Unlike Pallas, this is

much closer to Earth than other Asteroids. This implies that it is located in the inner asteroid belt.



Likewise, many other asteroids belonging to this classification had shown signs such as this such as 24 Themis, 47 Aglaja and 85 Io. From this information, I concluded that inner-asteroid belt B-type asteroids are the best kinds of celestial objects that we should target.

DISCUSSION:

These results indicate that B-type asteroids located in the inner asteroid belt are the most superior asteroids in terms of sampling. This means that B-type asteroids are the asteroids with the most diverse composition. The data is valid due to the fact that it had been collected from the JPL database, an archive consisting of all data accumulated over the years about different types of asteroids. The hypothesis was clearly rejected as the results had shown that B-type asteroids were the better choice instead of C-type ones. The primary reason as to why the graph consisted

of only G type, M-type and B-type asteroids was because they were the three most common in the asteroid belt. Many problems were encountered as this experiment was conducted, such as the fact that many relatively close asteroids were orbiting at an angle, meaning that calculating the trajectory of launching objects there would be extremely difficult. Coming up with the correct trajectory is also difficult and requires a good understanding of physics, making it difficult to narrow down my selection even further. The data collection could be improved by looking at a higher amount of asteroids, just to have a more accurate number. Asteroid sampling is also something that can be seen in the near future, so it isn't a current problem. Retrieving samples from asteroids could be something that gives us a better understanding of how these objects formed and find an estimate of how old they are.

CONCLUSION:

In conclusion, B-type asteroids are some of the best asteroids we can target for asteroid sampling. As for the hypothesis, it has been rejected. C-type asteroids are not superior in terms of asteroid sampling.

Works Cited

1. *Park, R, JPL Small-Body Database Browser, NASA, viewed 1 June 2020,* <*https://ssd.jpl.nasa.gov/sbdb.cgi*>.
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5. *Contributors, W, C-type Asteroid, Wikimedia Foundation, viewed 9 May 2020, <https://en.wikipedia.org/wiki/M-type_asteroid>.*