The past orbital and thermal evolution of asteroid (162173) Ryugu*

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Abstract. Knowledge of physical and chemical properties of small bodies, such as asteroids, it's essential for understanding the history of the Solar System. These objects may have experienced high temperatures during their formation and life, thus modifying their superficial composition. These alterations may have been caused by thermal factors, due to radiative heating during close approaches to the Sun[3][1]. The present work aims to study the past orbital and thermal evolution of the asteroid Ryugu, which was the target of JAXA's Hayabusa2 sample-return mission. This approach allows us to estimate the radiative heating that this body received in a determined epoch, as well, the several temperatures that its surface has received since the moment that turned an NEA until the present. For the orbital evolution analyses of Ryugu was realized numerical integration of the N-bodies gravitational problem. As its most probable origin is the main belt asteroids with secular resonance $\nu 6$, were generated 29000 clones of Ryugu starting from the vicinity of this region. We checked then to see which ones arrived in the surroundings of Ryugu's current orbit. Were analyzed the close encounters with the Sun that the asteroid may have experienced and also the study of the temperatures that the object has reached during its lifetime as an NEA. Our results indicate that the observed alterations of Ryugu surfaces may have been caused by a unique close encounter event with the Sun, although, the probability of this event occurring is low. These results allow us to infer if the reached temperatures on Ryugu surfaces, due to the past orbital evolution, corroborate with the analyses of the received sample [2].

Keywords: (162173) Ryugu · Asteroid surface · Asteroid dynamics.

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References

1. Michel, P.;Delbo, M.: Orbital and Thermal evolutions of four potential targets for a sample return space mission to a primitive near-Earth asteroid. Icarus **209**, 520–534 (2010)
2. Yokoyama, T., et al.: Sample returned from the asteroid Ryugu are similar to Ivuna-type carbonaceous meteorites. Science (2022)
3. Kitazato, K., et al.: Thermally altered subsurface material of asteroid (162173) Ryugu. Nature Astronomy. **5** (2021)