

JAXA ASTEROID DATA EXPLORER (JADE) FOR ACCESSING AND RETRIEVING HAYABUSA2 ONC IMAGE DATA: 2023 UPDATE. H. Kikuchi¹, M. Yamamoto¹, Y. Yokota¹, H. Otake¹, R. Honda², S. Sugita³, T. Morota³, R. Wayama⁴, Y. Sasaki⁴, C. Kobayashi⁴, R. Hemmi³, H. Miyamoto³, Y. Yamamoto¹, N. Hirata⁵, N. Hirata⁶, S. Sasaki⁷, G. Komatsu⁸, H. Demura⁵, C. Honda⁵, M. Yamada⁹, S. Kameda¹⁰, E. Tatsumi¹¹, S. Murakami¹, Y. Cho³, K. Yoshikawa³, H. Sawada¹, N. Sakatani¹, M. Hayakawa¹, M. Matsuoka¹², T. Kouyama¹², H. Suzuki¹³, K. Ogawa¹, K. Honda¹, W. Uno¹, D. Syoji¹, H. Sato¹, ¹JAXA, Sagami-hara, Japan. ²Ehime Univ, Ehime, Japan. ³Univ of Tokyo, Tokyo, Japan. ⁴NSS, Iwate, Japan ⁵Univ of Aizu, Aizu, Japan. ⁶Kobe Univ, Kobe, Japan. ⁷Osaka Univ, Osaka, Japan. ⁸IRSPS, Università d'Annunzio, Pescara, Italy. ⁹Chiba Tech, Narashino, Japan. ¹⁰Rikkyo Univ, Tokyo, Japan. ¹¹Instituto de Astrofísica de Canarias, Santa Cruz de Tenerife, Spain, ¹²AIST, Tsukuba, Japan. ¹³Meiji Univ, Tokyo, Japan. (kikuchi.hiroshi@jaxa.jp)

Introduction: Asteroid sample return mission Hayabusa2 by Japan Aerospace Exploration Agency (JAXA) has succeeded in obtaining a vast quantity of data about the asteroid (162173) Ryugu. After delivering the capsule containing a sample from Ryugu to Earth, the Hayabusa2 spacecraft began a new journey to the asteroid 2001 CC21 and 1998 KY26.

JAXA's Lunar and Planetary Exploration Data Analysis group (JLPEDA) is taking the lead in developing JAXA Asteroid Data Explorer (JADE) web system that can switch between 2D map of the equidistant cylindrical projection and 3D map displays of Asteroid Ryugu in the same system [1]. The system allows users to access, search, and download data according to their requirements.

JADE is open available in a web browser as a free access at <https://jade.darts.isas.jaxa.jp/>. For optimal using, we recommend using the following web browsers: Google Chrome, Microsoft Edge, Firefox, and Safari. CesiumJS for 3D visualization is used as the front end, and PostGIS is used as the back end of the system. JADE provides a search interface to Hayabusa2 ONC images hosted in Data Archives and Transmission System (DARTS).

Available data: The ONC data set includes L2a: raw/partially onboard processed image data, L2b: partially processed image data, L2c: Distortion corrected and physically converted image data, L2d: derived I/F image data, L2e: derived photometrically corrected reflectance image data, L2drc: derived co-registered I/F cube data, L2erc: derived co-registered photometrically corrected reflectance cube data, L2dbpc: derived backplane cube data [2]. The backplane data created for each pixel of derived I/F image data that include such as longitude, latitude, incident angle, emission angle, solar phase angle, polygon id, and distance from the facet in a fits cube format s such as ones created for first Hayabusa's camera (AMICA) [3].

Usages: In the initial screen of JADE, filtering of images is possible by Observation Time, instrument(ONC-T, ONC-W1, ONC-W2), Product Level,

Resolution, Latitude, Longitude, and Phase Angle. For researchers, it is also possible to filter by Mission Phase, Filename, Slant Distance, Target Center Distance, Emission Angle, Incidence Angle, etc.

As an example of how to use JADE, you can select an area of interest on a 2D or 3D map of Ryugu by selecting it as a polygon and extracting images that include that area.

Updates: One of the main goals of JADE is to help us understand where an image was taken on the surface of an irregularly shaped object. JADE has the search function to display images on 2D and 3D maps using the latitude and longitude information from ONC's backplane data (L2dbpc).

The footprint, which is the information of the outer edge of the image, has been modified because the previous footprints had problems with not becoming closed polygons when viewed on a 2D or 3D map. For example, in a 2D map, a polygon extending from 0°E in the negative direction to within 360°E will be split into two large polygons. Some of those polygons were not closed on the map. In addition, some insignificant polygons may be created in areas of high latitude or at the edges of the image.

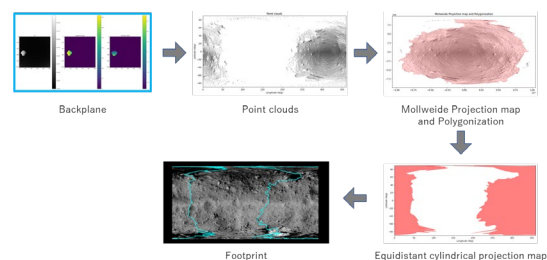


Figure 1. Scheme to create a footprint. A point cloud was created from the latitude and longitude information of the backplane, and a closed polygon group was formed by transforming it into the Mollweide projection centered on the coordinates of the polygons. The footprint was created by removing polygons of less than 10% of the largest polygon and extracting their outer edges.

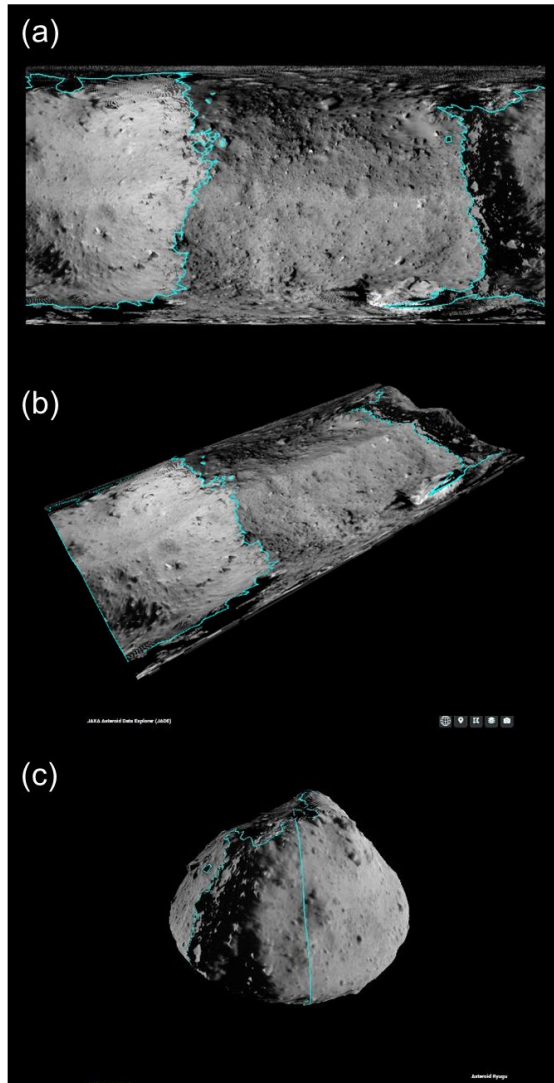


Figure 2. The retrieved images displayed on a map. The user can display the image selected by the user on the map in 2D (a), columbus view (b), or 3D (c) in the image capture area, allowing the user to grasp the image capture location with certainty.

Thus, we re-created polygons from the latitude and longitude information of the image extracted from back-plane data and expressed it in the Mollweide projection projection centered on the coordinates of the polygons, thereby creating large closed polygons. Polygons with an area of less than 10% of the largest polygon were deleted. These were converted to the equirectangular cylindrical drawing method to create closed, highly accurate polygons (Fig. 1).

In addition, JADE allows the retrieved images to be attached to the imaging area on 2D, columbus view, and 3D maps. This enables the user to reliably determine the location of the image (Fig. 2).

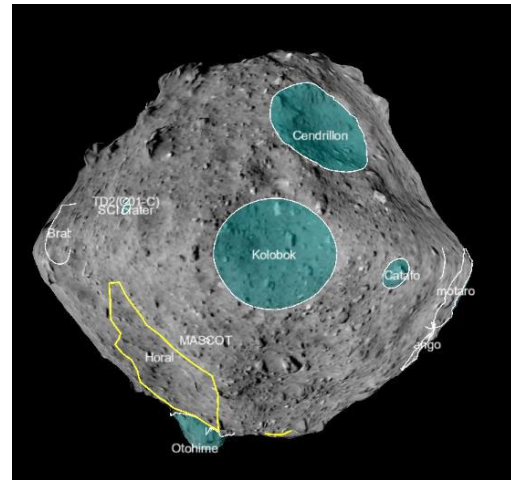


Figure 3. Display showing the topography of the craters, saxims, and fossae on Ryugu along Ryugu's geometry.

JADE can display POIs (Points of Interests) such as craters, saxums, fossae on Ryugu on the map. We modified JADE to display these topographic features along the shape of Ryugu to make it easier for users to see them (Fig. 3).

Conclusion: JAXA Asteroid Data Explorer (JADE) is a developing open web system for accessing and retrieving Hayabusa2 image data. The link to JADE is at <https://jade.darts.isas.jaxa.jp/>. JADE has been updated to display the retrieved images and their footprints accurately on the map, and to display Ryugu's topography along Ryugu's geometry, making this system even easier to use. The following link at <https://jlpeda.jaxa.jp/> will provide the latest developments on JADE.

References: [1] Kikuchi H. et al. (2022) *LPSC*, Abstract #1779. [2] Honda R. et al. (2020) *LPSC*, Abstract #2685. [3] Barucci M. A. et al. (2019). *Astronomy and Astrophysics*, 629, A13.