

Question: Please recommend open source tools for asteroid mapping.

OSSIG GPT said:

For open-source tools suitable for **asteroid mapping**, based on your documents and the broader standards in planetary cartography and planetary spatial data infrastructures (PSDI), I recommend the following:

Primary Open Source Tools for Asteroid Mapping:

Tool	Purpose	Notes
ISIS (Integrated Software for Imagers and Spectrometers)	Core processing of planetary remote sensing data	Developed by USGS Astrogeology Science Center; supports small irregular bodies 【30:2.2】 .
QGIS with planetary plugins	Visualization, mapping, GIS analysis	QGIS is a robust platform, and planetary plugins can load SPICE kernels, raster basemaps, DEMs.
SBMT (Small Body Mapping Tool)	Mapping of small, irregularly shaped bodies like asteroids	Tailored for complex topologies of asteroids and comets.
PDARTS (Planetary Data ARchiving and Tools System)	Open framework for data preservation and analysis	Evolving to support FAIR principles.
GDAL/OGR with planetary support	Geospatial raster/vector translation	Can process PDS3/PDS4 formats used by asteroid missions.
SPICE Toolkit (NASA NAIF)	Spacecraft, planetary ephemerides, instrument orientation and event timing	Critical for referencing asteroid data spatially 【30:2.4】 .

Other Essential Resources and Infrastructure:

- **PDS4 Tools:** Tools that work with NASA's Planetary Data System Version 4 archive standards.

- **MAPSIT Roadmap Recommendations:** Encourage open, interoperable tools that directly support mapping small bodies.
 - **OSSIG/OSSF Platforms:** Your own Open Solar System Foundation supports simulation and mapping frameworks that align with open-source ethics.
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References (if you want to dig deeper):

- **"Planetary Cartography and GIS"** edited by Henrik Hargitai: has a whole chapter on *Mapping Irregular Bodies* (like asteroids).
 - **NASA USGS MAPSIT Reports:** strong emphasis on open-source tool adoption for irregular body mapping.
 - **Earth and Space Science - PSDI Framework for Europa:** many techniques for Europa mapping are extensible to asteroid mapping.
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Would you like me to also suggest a **starter workflow** using these tools for a sample asteroid mapping project? 🚀

(If yes, I can even tailor it for a target like Bennu, Ryugu, or Didymos!)

You said:

yes for Bennu

ChatGPT said:

Perfect! 🧰 Let's build a **starter workflow for asteroid Bennu mapping** using open-source tools.

Starter Workflow for Mapping Bennu (Asteroid)

Goal: Generate spatial products (maps, DTMs, feature layers) of Bennu from mission data (e.g., OSIRIS-REx).

1. Get the Data

- Download raw and calibrated datasets from:

- NASA PDS Small Bodies Node - OSIRIS-REx Archive
 - Key datasets:
 - OCAMS (imaging camera) images
 - OLA (Laser Altimeter) point clouds and gridded DTMs
 - SPICE kernels (for spacecraft navigation and timing)
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2. Prepare SPICE Kernels

Tools: SPICE Toolkit (NASA NAIF)

- Load spacecraft position, pointing, and timing information.
- Required for correctly projecting Bennu images onto its irregular 3D surface.

bash

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example

cspice furnsh kernels/mk/orex_ops.tm

3. Core Data Processing

Tool: ISIS3 (Integrated Software for Imagers and Spectrometers)

- Import raw OCAMS images.
- Apply SPICE kernels to correct geometry (spiceinit command).
- Convert images into map-projected form suitable for mosaicking.

Example steps:

bash

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Convert .IMG to .cub

isis3> pds2isis from=ocams_image.img to=ocams_image.cub

Attach SPICE info

```
isis3> spiceinit from=ocams_image.cub
```

Project into Bennu body-fixed coordinates

```
isis3> cam2map from=ocams_image.cub to=ocams_image_projected.cub
```

4. Build 3D Surface Products

Tool: SBMT (Small Body Mapping Tool)

- Load 3D shape models (.OBJ or .PLY) of Bennu (provided by OSIRIS-REx).
- Overlay images on 3D surface for context mapping.
- Annotate features (boulders, craters, ridges).

Alternative: use QGIS 3D + plugins for 3D visualization, but SBMT is optimized for asteroid shapes.

5. Generate GIS-Ready Maps

Tool: QGIS (with Planetary Extensions)

- Load projected images and DEMs.
- Build high-resolution basemaps.
- Digitize features like:
 - Sample collection sites
 - Boulder fields
 - Hazard maps

Recommended Plugins:

- **OpenPlanetary QGIS Plugins** (for handling planetary bodies)
 - **Raster Terrain Analysis** (for slope, roughness, hillshade generation)
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6. Publish and Archive

Follow **FAIR** practices:

- Metadata according to NASA PDS4 standards.
- Archive maps back into open repositories (like the Open Solar System Foundation archive, or NASA PDS).



Summary of Tools

Step	Tool(s)
Data download	PDS OSIRIS-REx Archive
SPICE processing	SPICE Toolkit
Image and data processing	ISIS3
3D visualization	SBMT or QGIS 3D
GIS mapping	QGIS + OpenPlanetary Plugins