

Science Weekly Debrief

For slides and the WebEx recording on ODOCS, click [here](#) then follow the path: Folders -> Documents and Drawings -> OSIRIS-REx Bennu Proximity Operations -> Science Status -> Science Weekly -> 2019-05-23.

SfM-based DEMs from NavCam images: Experiments – James Garvin

Work on images of Mars has shown that structure-from-motion (SfM) techniques can be used to generate fine-scale digital elevation models (DEMs). Such products could allow us to assess the volume of sample collected during TAG and any associated changes to the local surface of Bennu. The SfM-based DEM capability was demonstrated before launch using pre-flight data and was successfully shown as a proof of concept with images taken during the approach to Bennu. Recently, emulation experiments were performed for TAGSAM-scale sampling regions, using sandboxes and simulated NavCam imaging. Volume change was measured with a measurement error of $\sim 100 \text{ cm}^3$. Next steps are to repeat the experiments at greater ranges (using drones for imaging) and to evaluate the effect of changing the number of frames. The PI suggests looking at Hayabusa2 touchdown data to further inform this activity.

Sample site selection: HQ status report – Dante Lauretta

The PI shared the briefing on site selection process and status that was given to Headquarters earlier this week. Mission design requirements for safety, deliverability, sampleability, and science value were determined pre-launch. We have made significant progress on the data products that feed into these requirements (e.g., top maps, shape model, rotation state, gravity field, landmark-tracking OpNav, local DTMs, others). However, Bennu has surprised us with its boulder-rich surface, large albedo variation, compositional diversity, and particle ejection events.

See the slides on ODOCS for charts illustrating the workflows for site selection. We currently have 50 regions of interest (ROIs) for sampling, identified through a variety of approaches ranging from visual inspection to machine learning algorithms. The ROIs predominantly occur in the northern hemisphere, which appears to be a real pattern rather than an observational bias.

Several inputs to the safety spreadsheet are known to be “green” for all cases, including communication with the spacecraft, surface temperature, and gravity uncertainty. NFT provides deliverability coverage for much of the surface. Surface tilt (and its uncertainty) is an important factor to be determined at the local level. In an example analysis of early-favorite ROI DL6, the safe (hazard-free) radius does not sufficiently overlap with favorable surface tilt scores for sampleability, and the spacecraft would have about a 45% chance of aborting TAG after a single attempt. The maximum acceptable probability of aborting TAG is yet to be set, but will probably be $\sim 20\%$.

Next week’s Site Selection Board meeting will downselect from the 50 ROIs based on safety considerations; after that, sampleability and science value will come into play for further downselection. Boulder counts and extent of resolved (unsampleable) material are likely to be

key factors for assessing sampleability ahead of Recon, given that thermal inertia and dust cover may not provide the needed information. AltWG is looking into how OLA data might change our understanding of candidate sites and will provide an assessment ahead of the site selection decision point. We could learn during Recon that a selected site is not sampleable, in which case we would have to design additional Recon observations for another site. To mitigate this eventuality, the PI recommends approving more than two candidate sites at the 17 July site selection meeting. Our top priority is TAG readiness by July 2020. The spacecraft could stay at Bennu until as late as May 2021 (while maintaining September 2023 Earth return) or even longer.

Working group and instrument team updates

- Science Value Map – Scott Messenger

The Science Value Map (SVM) can now be projected onto high-resolution images of ROIs. Current inputs to the SVM include albedo, temperature, geological feature, and color ratio maps; the SVM is ready to ingest blessed spectral maps when they are available.

- IPWG – Dathon Golish

Two new global mosaics are available on ODOCS and the IPWG share drive: a new version of the Flyby 1 mosaic (corrected for charge smear by the 12:30 PM Equatorial Station pan data, plus incorporating new SPC kernels), and a combined mosaic from Flybys 3 and 4.

- SAWG – Vicky Hamilton

SAWG members continue to examine the OVIRS and OTEs spectra of high-priority ROIs. Different methods are yielding similar results, lending confidence. The primary focus is whether candidate sites differ from or are similar to the global average spectrum for each instrument. A caveat is that because ROI sites are smaller than anticipated, the footprints of the spectrometers are sometimes large relative to the sites, and thus the data may be indicative of the local area rather than the site itself. Some weak features are evident in the OVIRS 10 AM data but have yet to be confirmed. OVIRS data do not yet show strong evidence of organics, carbonates, or magnetite, but further data analysis is to come. One candidate site (DL21) appears to be less hydrated than average in both OTEs and OVIRS data. It is as yet unclear whether the dust cover index is conveying the expected information. Spectral maps will be delivered early next week for the Site Selection Board and SVM.

Data product status

The Bennu Gravity Field Product was redelivered because of a sign error in the uncertainties. Data product status slides are available on ODOCS.

Upcoming meetings

Next week's Science Weekly meeting is canceled for the Site Selection Board meeting.

