

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 -> 2019-05-09.

Sample site selection – Mike Nolan

The site selection decision must be ready for defense by 17 July, about 8 weeks from now. Team members should prioritize their site selection activities over long-term science for this period—not only planned products but also new ideas for products that could inform the decision. Although better data will be coming later, we need to move forward using the data that we have (with caveats) given the timeline. A wiki page will be stood up for depositing products.

The list of regions of interest (ROIs) for sampling is available on the RDWG wiki page. It is prioritized into four categories, where category 1 (highest priority) has the best apparent safety and deliverability, and category 4 (lowest priority) is likely to be ruled out by safety and deliverability concerns. If your preferred ROI does not fall on the high-priority list, let Mike know.

Manar Al Asad noted that AltWG is planning to deliver quality documents for the ROIs (at least those in category 1), which will include metadata for the DTMs and the images that fed into them. Olivier Barnouin added that a new version of SBMT, to be released shortly, will include the latest shape model and all of the ROI DTMs (which previously had to be pulled in from the AltWG website).

Reminder: Look at the full dataset of images for a candidate sample site, not just the global mosaic, which can exhibit foreshortening.

Detailed Survey science updates

IPWG color mapping and combined panchromatic mosaic – Dani DellaGiustina, Carina Bennett

IPWG is preparing to release the color map product required by MRD-141 and a combined PolyCam panchromatic mosaic from the Baseball Diamond (BBD) data. The former product, to be released to the team next week, shows a variety of color, indicating that multiple types of asteroids are represented on Bennu. The brightest areas show a signal indicative of pyroxene (see SAWG findings discussed below). Small craters appear redder than average. One boulder is very bright blue. The Rock of McCoy shows color as well as albedo variation.

The combined panchromatic mosaic is expected to be released to the team within the next day or two. Polar mosaics will also be delivered. IPWG is open to requests for alternative map projections.

We discussed a proposal to explore phase reddening and slope as proxies for grain size (below the OCAMS resolution limit) at potential sample sites. Pursuing this idea would lead to a delay in the delivery of the OCAMS global photometric model, on which other products such as the basemap depend. No objections were raised.

OVIRS status – Amy Simon

Amy discussed caveats for OVIRS data analysis. The least processed data possible should be used. Dividing by a local or global average can remove artifacts, but it can also remove signal; care is needed in selecting a suitable average. Features are evident in BBD Flyby 3 (BBD3) data but are near the noise limit, making them difficult to interpret. Confirmation of features should wait for observations with cooler surface and detector temperatures.

~Twelve spectra with an 0.92-micron feature (band depth, 2 to 3%) indicative of pyroxene have been identified in OVIRS BBD3 data (see also below). The spectra match well with laboratory measurements of pyroxene. Spectra of the two reddest and bluest regions in OCAMS data exhibit a different slope than the global average. In both red and blue spectra, a feature at 1.3 microns is evident, but is noisy and ambiguous. A few spectra were found in Equatorial Station 1 data that support these BBD3 results.

Spectral analysis: pyroxene signatures at bright spots – Antonella Barucci, Hannah Kaplan

Antonella showed spectral signatures of pyroxene, revealed by dividing OVIRS BBD3 spectra of bright spots identified in OCAMS data by the global average. The bright spots (boulders) cover as little as 1.4% of the OVIRS footprint. The signatures at 0.9 and 2 microns appear only in spectra covering the boulders. All observed boulders with >15% albedo show spectral evidence of pyroxene. If the material is exogenous, impact probability computations can give insight into its origins.

Hannah showed that the band centers are consistent with orthopyroxene-rich compositions, in an analysis using ~10 BBD3 spectra divided by the global average with a modified Gaussian model. The strength of the features can be used to estimate the ratio of low-calcium to high-calcium pyroxene. More work is needed to evaluate the compositional resemblance to potential analog meteorites.

2.7-micron band depth analysis – Alice Praet

Spatial variation in the band depth of the absorption feature at 2.7 microns was analyzed using the BBD3 data. Shallower band depths are typically associated with boulders, including the relatively low-albedo BenBen, Bouldertown, and the Roc. Absorption area shows a similar pattern but with more variation. The study indicates that we should avoid computing a 2-point ratio. Future work will look at band minimum positions in the same dataset and ROIs in forthcoming OVIRS data. Mike Nolan requested that ROIs be analyzed with the current dataset in the interest of the site selection timeline.

Particle photometry update – Carl Hergenrother

Daily particle monitoring images continue to be inspected visually and run through the GIANT software. Our observations were more sensitive to particles during Orbital A because of the closer heliocentric distance. The most recent particle sighting was 7 May. The most recent ejection event was 19 April and is classified as a major event (defined by 20 or more particles captured in a single image). The particles were imaged tens of minutes after the ejection event. Several particles that stayed in orbit were captured at many different phase angles, enabling the generation of phase functions. The phase functions have shallow-sloped linear fits that do not match the global average.

These shallower phase functions provide information about the particle sizes. Previous estimations assuming the global phase function yielded particle sizes up to the order of decimeters, but Steve Chesley's area-to-mass ratio (AMR) calculations from trajectories

indicated that particles should be smaller. The particle photometry and AMRs agree if the particle albedos are similar to that of the bright material on Bennu (although these calculations use the density assumed for carbonaceous chondrites).

Two of the observed particles show evidence of having lightcurves. If these are rotational lightcurves, they would indicate an improbable rotation period of tens of hours. The observed behavior may be due to shape or aliasing effects. The particles are unlikely to have a stable orientation and are probably tumbling.

Preliminary estimates of mass and energies (milliJoule scale) are sensitive to our uncertain knowledge of particle albedo and phase function. Smaller particles appear to have higher velocities, as expected. Size-frequency distributions for the 6 January event show a knee-like break in slope.

3:20 AM Equatorial Station dust plume search – Bashar Rizk

Results are very preliminary at this point, but the initial quick look indicates no dust, only stray light. Efforts to correct the images for stray light are underway and look promising. The goal is to compute column abundance, number density, and rate of mass loss, which requires a number of (reasonable) assumptions; see the OCAMS slides and the WebEx recording for details.

3:20 AM Equatorial Station thermal results – Josh Emery

Thermal inertia (TI) maps from this nighttime station show a decreased amplitude of variation relative to previous (daytime) observations. Areas that seemed to have very high TI in the daytime station data are better explained by roughness. The surface roughness map agrees well with surface geomorphology. More to be reported next week.

Data products – Mike Nolan and Jon Cutts

The Baseball Diamond Flyby 1 thermal inertia map has been delivered but is rendered out of date by more recent observations; the ticket (DP-646) will be rejected. The individual temperature maps from Baseball Diamond will be accepted.

See the SDPS slides for a diagram of the critical paths to sample site down-selection, as well as the current Gantt chart, MRD and major milestone status, blessing durations by instrument, 1-month look-ahead, and summaries of completions to date.

Upcoming meetings

Next week's meeting (16 May) will be a Science Monthly.