

ExMAG Document #: ExMAG 004

ExMAG Leads: Larry Nittler (Chair, Asteroid Subcommittee)

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Topic: Hayabusa2 Bulk Sample Question

Background

ExMAG has been asked to provide advice as to whether a portion of the Ryugu sample allocated to NASA should be reserved in order to reduce potential bias for future “bulk” measurements. Specifically, the Hayabusa2 curation team is currently planning to open and subdivide samples to expand the catalog, with a tentative plan to begin with opening two aggregate samples (A0217_0 and C0206_0). Individual particles between 0.1mm and 1mm would be isolated from each container, characterized, and included in the catalog as a split of the bulk sample. However, there is an expressed concern that this procedure could potentially bias future attempts to measure the bulk composition of the aggregates, for example if the individual particles that were removed for the catalog were not fully representative of the bulk. The team has proposed that aggregate masses be split and store at least half stored for bulk investigations. They have requested that ExMAG provide responses to four specific questions, discussed below. This document provides ExMAG’s response and recommendations to the Hayabusa2 Curation Team at JSC.

Analysis

The EXMAG Asteroids subcommittee met virtually to discuss this request on March 1, 2023. The subcommittee was unanimous in its responses to the four questions as answered below in the Recommendations section.

Recommendations

Deliverables requested from ExMAG for Curation:

1) [Does the ExMAG asteroid subcommittee have concerns about the potential to bias the bulk composition of aggregate samples A0217_0 and C0206_0 by removing and isolating individual particles?](#)

Response: Yes. We thank Curation for bringing this potential bias to our attention (and for noting that such bias may already have been introduced into the NASA sample by particle picking at JAXA during the Initial Analysis period). The preliminary examination of the Ryugu samples has shown them to be somewhat inhomogeneous, but they do consist of breccias of clasts with variable sizes and compositions. For example, based on an analysis of 20 mm-sized particles, subcommittee member Tomoki Nakamura reports that the samples consist of 5-6 major clast types, with varying mineral and elemental abundances ranging in size from 0.1 to 1 mm, and relative abundances ranging from roughly 0.1 vol% to 50 vol%. The grain-to-grain variability in elemental composition is much smaller than between meteorite clasts, but these observations do indicate that reserving a substantial fraction of the sample for future bulk measurements would minimize introducing additional bias.

2) Should NASA divide a percentage of aggregate samples A0217_0 and C0206_0 and store/curate the divided samples separately for bulk sample investigations?

Response: Yes.

3) What percentage of the sample should be conserved for bulk analyses?

Response: We recommend that on order of 50% of the aggregate samples be conserved for this purpose. Care should be taken to match the size distribution of each total sample as closely as possible in the reserved sample.

4) Would NASA's plan to conserve a percentage of samples A0217_0 and C0206_0 for bulk analyses sufficiently address the concerns expressed in question 1 (if answered "Yes")?

Response: Yes

Future Work

We recognize that reserving 50% of the A0217_0 and C0206_0 samples would not be an irreversible decision and as new information and analyses are reported from both the JAXA- and NASA-allocated samples, we recommend that the Curation Team and ExMAG re-consider this issue at a later date (say, in one year).