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DOCUMENT

Rosetta Archive Enhancement Data Closeout Review procedure

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1 INTRODUCTION

1.1 Purpose and Scope

This document provides information on all review steps of the Rosetta Science Archive Closeout Review for all review participants.

1.2 Archiving Authorities

The Planetary Data System Standard is used as archiving standard by

- NASA for U.S. planetary missions, implemented by PDS
- ESA for European planetary missions, implemented by the SCI-O Department

1.3 The Rosetta Mission and Instruments

Rosetta Mission overview

The main objective of the Rosetta mission, which was approved in November 1993 as the Planetary Cornerstone mission of ESA's Horizon 2000 long-term program, was to rendezvous with a comet. In-situ investigation of a cometary nucleus was regarded as of the utmost scientific interest.

The original target comet of Rosetta was 46P/Wirtanen, but after the failure of the Ariane 5 ECA in December 2002, the Ariane 5 P1+ was not ready to launch Rosetta in January 2003. In February 2003 the Science Working Team (SWT) approved the preparation for a mission to be launched in February-March 2004. This alternative mission would rendezvous with comet 67P/Churyumov-Gerasimenko in 2014.

The Rosetta satellite was launched in March 2004 and after a 10-year journey, which included two flybys of asteroids as well as a deep space hibernation phase, it was woken up on the 20th of January 2014. The Rosetta orbiter deployed the Philae lander to the surface of the comet in November 2014 and escorted the comet through perihelion in August 2015 and beyond. The mission ended in September 2016 with the orbiter impacting the surface of the comet.

Rosetta Mission Phases

Between 20th January 2014 and its arrival at the comet on the 6th of August 2014, the instruments were successfully commissioned and began to generate science data already at a significant distance from the comet. This mission phase was called "Prelanding" (PRL) in

that all data taken up to the Philae Lander delivery had an objective to support the landing site selection. The Prelanding phase ended approximately 5 days after the landing itself, at which point the Comet Escort phase (ESC) began, with the spacecraft accompanying the comet through its perihelion passage and beyond. The nominal mission was due to end on the 31st of December 2015 but was approved for a mission extension (EXT) until the end of September 2016.

The data (to be) delivered by all instruments for this review have been mapped to the 3 different comet mission phases described above: PRL, ESC and EXT.

The Rosetta orbiter carried a significant set of scientific instruments – the following represents a list of those instruments and the science investigations being performed by each:

Remote sensing:
- OSIRIS (VIS and NIR imaging)
- VIRTIS (VIS and NIR mapping spectroscopy)
- ALICE (UV mapping spectroscopy)
- MIRO (microwave spectroscopy)

Composition analysis:
- ROSINA (neutral gas and ion mass spectrometry)
- COSIMA (dust mass spectrometry)

Dust physical properties:
- MIDAS (dust grain morphology)
- GIADA (dust velocity, impact momentum, mass flow)

Nucleus large-scale structure:
- CONSERT (radiowave sounding, nucleus tomography) – also on Philae Lander
- RSI (radio science)

Comet plasma environment and solar wind interaction:
- RPC (Rosetta plasma consortium)
  > ICA (ion composition analyser)
  > IES (ion and electron sensor)
  > LAP (Langmuir probe)
  > MAG (fluxgate magnetometer)
  > MIP (mutual impedance probe)
- SREM Radiation Monitor Data

1.4 Rosetta Archive Data Processing

Data from all of the Orbiter and Lander instruments and from the Rosetta spacecraft have been archived thanks to a common effort from the Orbiter and Lander instrument teams, the Lander Science Operations and Navigation Center (SONC), the Rosetta Mission Operations Center (RMOC), and the PSA-PDS team.

The PSA-PDS team includes members from the ESA Rosetta Science Ground Segment (RSGS) and the PDS Small Bodies Node (SBN). The official Rosetta Science Data Archive will be part of the Planetary Science Archive (PSA) hosted at the European Space Astronomy Centre (ESAC), with a data copy at the SBN.

The archiving process includes the design, generation, validation and ingestion of the data archive. The archive includes raw and reduced data, calibration data, higher-level derived data products, documentation and software, where relevant.

1.5 Rosetta Archive Review Cycle

The following cycle is foreseen for the Peer Reviews:

(a) Cruise Phase Science Review: A science review took place for the Asteroid 21 Lutetia (April 2012) & 2867 Steins (October 2009) data sets

(b) Initial Comet Data Peer Review: The first data sets containing data acquired at the comet C-G will be peer reviewed – Performed in February 2016.

(c) End of Mission Comet Data Peer Review: Consisting of all data generated since the initial data review up to the end of the mission – Performed in October 2017

(d) Archive Enhancement Data Review: Covering archive enhancement products delivered by the Orbiter teams as well as ensuring completion of all archiving products from the full mission (possibly incl. Cruise & flybys if feasible).
- US Specific Review: Performed in July 2018
- European/US Review: Autumn 2018

(e) Rosetta Final Archive Enhancement Data Review: Spring 2019 – This review included the closeout of any instrument datasets deemed to need a delta-review or which had not been reviewed up to that point.

(f) Rosetta Archive Enhancement Data Closeout Review: Autumn 2019 - This review included the closeout of any instrument datasets deemed to need a full re-review or which had not been reviewed up to that point. Note: the RPC-LAP L5 DERIV2 and VIRTIS L2 & L3 datasets shall also be checked in order to take advantage of the

reviewers participating already for these instruments. In their case, the focus will be on closing out the RIDs from previous reviews with, in principle, no ECLIPSE involvement for raising new RIDs.

1.6 Acronyms

ALICE Orbiter experiment: Ultraviolet Imaging Spectrometer
APXS Lander experiment: Alpha Proton X-Ray Spectrometer
AST Group of mission phases: Asteroid
AUX Auxiliary Data

CASSE SESAME instrument: Cometary Acoustic Sounding Surface Experiment
CAT Mission phase: Close approach trajectory
C-G 67P/Churyumov-Gerasimenko
CNES Centre National d'Etudes Spatiales
CODMAC Committee on Data Management and Computation
CONSERT Orbiter experiment: Comet Nucleus Sounding Experiment by Radiowave Transmission
COP Mission phase: Close observation phase
COSIMA Orbiter experiment: Cometary Secondary Ion Mass Analyser
CR1…6 Mission phase: Cruise 1…6
CVP1/2 Mission phase: Commissioning and verification phase part 1/2

DAWG Data Archive Working Group
DCR Document Change Request
DDID Data Delivery Interface Document
DDS Data Distribution System
DLR Deutsches Zentrum für Luft- und Raumfahrt
DMS Document Management System
DSN Deep Space Network

EAICD Experiment to Planetary Science Archive Interface Control Document
EAR1/2/3 Mission phase: Earth swing-by 1/2/3
EOM End of Mission
ESC Mission Phase : Escort phase
ESA European Space Agency
ESAC European Space Astronomy Centre in Madrid, Spain
ESOC European Space Operations Centre in Darmstadt, Germany
ESTEC European Space and Technology Centre in Noordwijk, The Netherlands
EXT Mission phase: Extended mission

FAT Mission phase: Far approach trajectory

FITS	Flexible Image Transport System
GIADA	Orbiter experiment: Grain Impact Analyser and Dust Accumulator
GMP	Mission phase: Global mapping phase
GSE	Ground Support Equipment
HK	Housekeeping Data
ICA	RPC instrument: Ion Composition Analyser
IDS	Interdisciplinary Scientist
IES	RPC instrument: Ion and Electron Sensor
LAP	RPC instrument: Langmuir Probe
LCC	Lander Control Center at DLR, Cologne, Germany
LEOP	Mission phase: Launch and early operations
MAG	RPC instrument: Magnetometer
MAG	ROMAP instrument: Magnetometer
MARS	Mission phase: Mars swing-by
MIDAS	Orbiter experiment: Micro-Imaging Dust Analysis System
MIP	RPC instrument: Mutual Impedance Probe
MIRO	Orbiter experiment: Microwave Instrument for the Rosetta Orbiter
MTP	Medium Term Plan (4 week planning period)
NASA	National Aeronautics and Space Administration
NCD	Mission phase: Near comet drift
OSIRIS	Orbiter experiment: Optical, Spectroscopic and Infrared Remote Imaging System
PDS	Planetary Data System
PI	Principal Investigator
PP	SESAME instrument: Permittivity Probe
PRL	Prelanding Phase (S/c wakeup in Jan 2014 until week after lander delivery – Mid-Nov 2014)
PSA	Planetary Science Archive
PVV	PSA Validation and Verification Tool
RDV	Mission phase: Rendezvous
RID	Review Item Discrepancy
RLGS	Rosetta Lander Ground Segment
RMOC	Rosetta Mission Operations Center
ROMAP	Lander experiment: Rosetta Lander Magnetometer and Plasma Monitor

ROSINA	Orbiter experiment: Rosetta Orbiter Spectrometer for Ion and Neutral Analysis
RPC	Orbiter experiment: Rosetta Plasma Consortium
RSGS	Rosetta Science Ground Segment
RSI	Orbiter experiment: Radio Science Investigation
SATT	Satellite Attitude Data
SBN	Small Bodies Node
SFDU	System Formatted Data Unit
SONC	Science Operations and Navigation Center for the Lander at CNES,Toulouse, France
SPC	Science Programme Committee
SPM	ROMAP instrument: Simple Plasma Monitor
SREM	Solar Radiation Environment Monitor
SSP	Mission phase: Lander delivery and relay
SWT	Science Working Team
TGM	Mission phase: Transition to global mapping
VIRTIS	Orbiter experiment: Visible and Infrared Thermal Imaging System

1.7 Applicable Documents

[1] Rosetta Archive Generation, Validation and Transfer Plan, RO-EST-PL-5011, Issue 2.3, 10 Jan 2006.

[2] Rosetta Archive conventions document, RO-EST-TN-3372, Issue 8.0, 20 Apr 2015

[3] Planetary Data System Standards Reference, JPL D-7669, Part 2, Version 3.6, 1 Aug 2003.

[4] European Cooperation for Space Standardization, ECSS Internal Procedures, ECSS/SEC(2004)35

1.8 Reference Documents

[5] PDS Standards Reference, JPL-D-7669, Part 2, version 3.7, 2006 March 20

[6] PSA Geometry and Position Information, SOP-RSSD-TN-010, version 4.1, 2007 April 2

2 ARCHIVE ENHANCEMENT DATA CLOSEOUT REVIEW OBJECTIVES

This specific review can be compared to the review procedure of a paper in a scientific journal, and will be completed in a single stage. The primary goals of the archive review are to ensure the scientific usefulness of the archive data, and to ensure that the data is complete for the duration of the period delivered.

List of Objectives for Archive Enhancement Data Closeout Review

1. Confirm the completeness and scientific integrity of the Rosetta data sets in the PSA, including:
   1.1. Data quality (e.g. signal-to-noise ratio, radiance level, instrument artifacts).
   1.2. Data processing levels.
   1.3. Usage of proper units.
   1.4. Whether the needs of the scientific community are met.
2. Confirm that the datasets contain the instrument science, instrument housekeeping, spacecraft housekeeping and science operations information necessary to execute instrument, cross-instrument and cross-mission data analysis.
   2.1. Verify that the set of documentation is complete and sufficient for data processing and analysis.
   2.2. Confirm that calibration information provided is complete, that the reviewer can obtain the same results as in the data set if he/she follows the described procedure, and for the case of level 3 that the calibration is reversible (if applicable).
3. Confirm the long-term scientific usability of the data, e.g. against already existing planetary archives.
4. Confirm the usefulness of the provided data sets for analysis by the science community e.g. by attempting to read/manipulate the data (without team-provided software) to produce or reproduce scientifically published results (if feasible)
5. Shortcomings - including detailed recommendations and their implementation period - shall be given for each major finding.

NOTE: To take advantage of the reviewers participating already for those instruments, the RPC-LAP L5 DERIV2 and VIRTIS L2 & L3 datasets shall be included. In their case, the focus will be on closing out the RIDs from previous reviews with, in principle, no ECLIPSE involvement for raising new RIDs. As the above objectives were already verified in the last review, the reviewers will be asked to simply check that the RIDs have been closed to their satisfaction.

3 REVIEW SCHEDULE

Date	Type	Purpose
19th July 2019	Document and data set distribution to reviewers.	Data & documentation release to reviewers
27th August 2019 @ 23:59 CEST	Deadline for reviewers to assess data & submit RIDs.	Date by which all RIDs must be in the system so that the instrument teams can analyse them and provide feedback
2nd September 2019 @23:59 CEST	Deadline for PI teams to assess the RIDs and provide feedback on them.	Date by which the PI teams will respond to the RIDs
4-5th September 2019 (N.B. Meeting will start on 3rd September for US Reviewers)	Meeting of Review members at ESAC and via Webex with the PDS & PI teams.	Discuss submitted RIDs, as well as responses from instrument teams (via their participation)
11th October 2019	Release of the Review report	Deadline for Final Review Report to be disseminated

4 REVIEW BOARD PARTICIPANTS AND INVOLVED PARTIES

4.1 Review Co-Chairs

L.O'Rourke	European Space Research and Technology Centre Keplerlaan 1 2201 AZ Noordwijk The Netherlands.	lorourke@esa.int
J.Bauer	NASA PDS, University of Maryland	gerbsb@astro.umd.edu

4.2 PSA Review Members & Secretaries

D.Heather	RSGS/PSA	dheather@cosmos.esa.int	Earth-Based, MUST, OSIRIS, RPC-LAP, RSI, SREM
D.Fraga	RSGS/PSA	dfraga@sciops.esa.int	VIRTIS

4.3 PDS Review Members & Secretary

L. Kolokolova	PDS/SBN	ludmilla@astro.umd.edu
T.Barnes	PDS/SBN	tbarnes4@astro.umd.edu
A.Raugh	PDS/SBN	raugh@astro.umd.edu

4.4 Review Members : ESA, PI teams and external reviewers

P. Martin	ESA/ESAC	Rosetta Mission Manager
M. Taylor	ESA/ESTEC	Rosetta Project Scientist
S.Besse	ESA/ESAC	PSA Lead Scientist
Independent Reviewers	European & US reviewers	All external scientists shall participate in the review board discussions
PI Team Representatives	From PI team sites	All PI teams shall be requested to have a representative in the discussions about their specific instrument

5 REVIEW ORGANISATION AND ACTIVITIES

5.1 Delivery of the Review Package & Confidentiality Agreement

The review package, in the form of documentation and data sets, will be made available to each member of the Independent Reviewers at the time of kick-off of the review.

Note that it is foreseen to deliver the documents to be reviewed, the reference documentation, as well as the data sets via FTP transfer to each Independent Reviewer in Europe. US reviewers will be contacted by PDS to arrange access to the data.

In some cases a memory stick may be provided where data is considered significant in size.

Individuals will receive only the material to be reviewed by them. However, if so desired, the individual can request to look at other datasets.

The inputs to the Archive Review are data sets provided from each instrument team, and can contain improved / new calibrations as well as in some cases enhanced data from the full Rosetta mission.

A summary of the full list of data to be submitted for the review is provided in Appendix A.

Confidentiality Agreement - The downloading of "non-public" archive data by an independent reviewer automatically places a confidentiality condition on that reviewer to not distribute the data any further or to make use of that data for scientific purposes.

5.2 Review Strategy

Following receipt of the review package (see section 3 for schedule), the Board members will start to review the documentation and datasets.

- Reviewers shall :
  - Be able to read and manipulate the data using PDS/PSA provided software (NASAVIEW, READPDS), or by writing your own script that follows the data format definition given in the PDS label. Data should be readable without using team-provided software, since team-provided software won't be available/maintained for archive users.
  - Use the data both to produce a scientific result and to check the calibration and/or reproduce published results.
  - Review documentation.

  - Ensure there is nothing that would mislead users.
- In order to check geometry, reviewers shall also have access to
  - Shape models (SHAP7, SHAP8 and RMOC)
    - They can be found directly here : http://comsim.esac.esa.int/rossim/SHAPE_MODEL_DRAFTS/SHAP7_8/
    - Alternatively, go to the following link : https://www.cosmos.esa.int/web/psa/rosetta) and open the “Comet and asteroid shape models” link
  - SPICE kernels

The board members shall transmit their comments and concerns via the Review Item Discrepancy (RID) system.

5.3 The Review Item Discrepancy (RID) System

The RID forms are derived from the ECSS-M-30-01A [4] and they will be submitted using the ESA based ECLIPSE System which is an online system to enter and track the RIDs from this review.

A link & login details shall be sent to each reviewer soon after review kick-off.

All RIDs are to be entered in the system by 27th August 2019 at 23:59 CEST.

5.4 Review Meeting & Webex Telecons

In order to impose the least burden on time zones covering Europe to California, the telecons will be spread over several days, starting early morning EST and ending early evening CET. The instruments will be grouped by day with the groupings primarily done for similar science data outputs (plasma, cameras, spectrometers etc). Every attempt will be made to schedule things to minimise the burden on participation by the instrument teams.

To facilitate more efficient discussions, meetings will be held in the morning (on Europe side) and afternoon (on US side) to do a pre-review of RIDs such that the joint session (Europe Afternoon/US morning) can take place on a more limited set of RIDs and finish on schedule. For each meeting, the secretary(ies) will have the capability to show all the RIDs from the RID system at the start of each instrument section.

For the case of the meeting on the 4th September, the PDS team will meet with their reviewers on the previous day, 3rd September (US time).

The discussion for each instrument will begin with presentations by the two reviewers (one at PSA and one at SBN) for that instrument summarizing
a) what the instrument does,
b) what the dataset contains, and
c) a discussion of each of the problems (RIDs aka liens) discovered in the review.

The presentation is best done as a PowerPoint (or equivalent, such as Keynote or PDF) such that it can be provided to the data provider (aka instrument team). For (a) and (b), it's sufficient to have the first reviewer speaking to give that summary – nominally we will begin with the European Reviewer. For (c), any reference to a problem found should include the RID# and 'Originator Reference' on the slide.

The discussion of problems flagged should focus on the non-trivial issues. This means that simple typos, inappropriate keyword values, and such should simply be tabulated unless there is some special reason for them to be discussed. Details of the location of the problem (which dataset, which files, which keywords) are essential. Electronic copies of the presentations, including tabulations of the minor problems, will be made available to the data provider (PI representative) as quickly as possible, hopefully in real time.

Other reviewers, review board members, and the data provider (PI representative) may all ask questions or offer explanatory comments during the presentations.

After the two presentations, other reviewers e.g. interdisciplinary scientists, and review board members will have the opportunity to comment, either on the problems found by the

prime reviewers or on other problems. Note that Board members will also have the capacity to raise RIDs as well as the Independent Reviewers.

At the end of the discussion the data provider should raise any objections to the RIDs/liens and/or ask about different approaches to resolving the issues. The secretary(ies) will summarize the liens to be sure that everyone agrees. That summary will be provided to the data provider (aka instrument team) within a week of the review.

The summary will form the basis of the Review Board Report, which closes out the Review process.

This report will contain:

- An introduction and overall conclusion.
- Top-level findings of the Board together with a record of the recommendations made and their implementations.
- The Boards assessment against the objectives of the review.
- Further detailed comments on the documentation and datasets reviewed.

APPENDIX A: DATA TO BE REVIEWED

Instrument	Levels				Comments
	L2	L3	L4	L5	
EARTH-BASED	X	X			L2 and L3 data sets.
MUST				X	Selected HK Parameters. Internal ESA review, with Technical RIDs from PDS.
OSIRIS			X		Internal straylight corrected L4 data.
RPC-LAP				(X DERIV2) X NEL	L5 datasets. The DERIV2 data will be checked for RID closure only. The new NEL data will be a full review.
RSI	X	X			BSR datasets
SREM	X	X			L2 & L3 datasets
VIRTIS	(X)	(X)		X	Map data. The L2 and L3 data will be checked for RID closure only.

X: Data for full review.
(X): Data for checking RID closure only.