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DOCUMENT

Rosetta Science Archive Comet data 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 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 SRE-O of ESA

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, is a rendezvous with a comet. In-situ investigation of a cometary nucleus is regarded as of the utmost scientific interest. An Orbiter will carry a Lander to the nucleus and deploy it on the surface. The mission is a collaborative one, with NASA providing Orbiter payload elements and ground-support by the Deep Space Network (DSN).

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 to prepare 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 January 2014.

Rosetta Mission Phases

Between this date and its arrival at the comet on the 6th August 2014, the instruments were successfully commissioned and began to generate science data already at a significant distance from the comet. The 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 process. The prelanding phase ended approximately 5 days after the landing itself. At this point, the comet escort phase (ESC) kicked off whereby the spacecraft

accompanied the comet through its perihelion passage and beyond. The nominal mission was due to end on the 31st December 2015 but was approved for a mission extension (EXT) until the end September 2016.

The data (to be) delivered by all instruments have been mapped to the 3 different comet mission phases above.

Rosetta Instruments

The Rosetta orbiter 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)
- 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)

The Philae lander has an instrument package of its own. The following represents a list of its instruments and the science investigations being performed by each :

Imaging:
- ROLIS (descent camera, close-up imager)
- CIVA (panoramic micro-cameras, microscope)

Composition analysis:
- SD2 (sampling, drilling, distribution)
- COSAC (gas chromatograph and spectrometer for molecular composition)
- PTOLEMY (gas chromatograph and spectrometer for isotopic composition)
- APXS (X-ray fluorescence, alpha-particle back-scattering)

Surface and subsurface physical properties:
- MUPUS (density, mechanical and thermal properties)
- SESAME (acoustic and electrical properties, dust impacts)
  > CASSE (acoustic sounding)
  > PP (permittivity probe)
  > DIM (dust impact monitor)

Nucleus large-scale structure:
- CONSERT (radiowave sounding, nucleus tomography)

Comet plasma environment and solar wind interaction:
- ROMAP (local magnetic field, plasma monitor)
  > MAG (fluxgate magnetometer)
  > SPM (energy analyser for ions and electrons)

1.4 Rosetta Archive Data Processing

Data from all the Orbiter and Lander instruments and from the Rosetta spacecraft is archived by a common effort from all 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 reviews: A science review took place for the Asteroid 21 Lutetia & 2867 Steins data set

(b) Initial Comet data Peer Review: The first data sets containing data acquired at the comet C-G will be peer reviewed - THIS CURRENT REVIEW

(c) Final Comet data Peer Review: Consisting of all data generated since the initial data review up to the end of the mission.

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
CIVA	Lander experiment: Comet Nucleus Infrared and Visible Analyser
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
COSAC	Lander experiment: Cometary Sampling and Composition Experiment
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
DIM	SESAME instrument: Dust Impact Monitor
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
ESC	Mission Phase : Escort phase
ESA	European Space Agency
ESAC	European Space Astronomy Centre in Madrid, Spain
ESOC	European Space Operations Center in Darmstadt, Germany
ESTEC	European Space and Technology Center 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)
MUPUS	Lander experiment: Multi-Purpose Sensors for Surface and Subsurface Science
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
PTOLEMY	Lander experiment: Gas chromatograph and mass spectrometer
PVV	PSA Validation and Verification Tool
RDV	Mission phase: Rendezvous
RID	Review Item Discrepancy
RLGS	Rosetta Lander Ground Segment
RMOC	Rosetta Mission Operations Center
ROLIS	Lander experiment: Rosetta Lander Imaging System
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
SD2	Lander experiment: Sampling, Drilling and Distribution Subsystem
SESAME	Lander experiment: Surface Electrical, Seismic and Acoustic Monitoring Experiment
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
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 ROSETTA ARCHIVE 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 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 necessary 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, making the calibration 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)

Shortcomings - including detailed recommendations and their implementation period - shall be given for each major finding.

3 REVIEW SCHEDULE

Date	Type	Purpose
15th January 2016	Document and data set distribution to reviewers.	Data & documentation release to reviewers
12th February 2016	Deadline for reviewers to assess data & submit RIDs.	Feed in any comments for discussion the following week
15th to 19th February 2016	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)
26th February 2016	Release of the Review report	Deadline for Final Rosetta Archive Review Report to be disseminated

4 REVIEW BOARD PARTICIPANTS AND INVOLVED PARTIES

4.1 Review Co-chairs

M.A'Hearn	NASA PDS, University of Maryland	ma@astro.umd.edu	+TBD
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4.2 PSA Review Members & Secretaries

S. Besse	RSGS/PSA	sbesse@sciops.esa.int	COSIMA, ROSINA
D.Heather	RSGS/PSA	dheather@cosmos.esa.int	OSIRIS, RSI
M.Barthelemy	RSGS/PSA	mbarthelemy@sciops.esa.int	MIRO, RPC-ICA, RPC-MIP, RPC-LAP, VIRTIS, LANDER
D.Fraga	RSGS/PSA	dfraga@sciops.esa.int	ALICE, GIADA, MIDAS, RPC-IES, RPC-MAG

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

P. Martin	ESA/ESAC	Rosetta Mission Manager
M. Taylor	ESA/ESTEC	Rosetta Project Scientist
C. Arviset	ESA/ESAC	Head of the Science Archives and Computer Support Engineering Unit - TBC
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 have a representative in the discussions about their specific instrument.

5 REVIEW ORGANIZATION 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.

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

The inputs to the Archive Review are the archived data sets from each instrument team which will contain data from the Prelanding phase and the first 3 months of the Comet Escort phase. Exceptions to this are the OSIRIS & VIRTIS instruments where data will be only partially from the PRL phase. In addition the NAVCAM provides data up to mid-2015 although at level 2 only.

Further to this, the lander teams deliver data from the prelanding phase as well as data generated during descent, rebound and landing on the comet.

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

Confidentiality Agreement : The downloading of data by an independent reviewer automatically places a confidentiality condition on that reviewer to not 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 without using any team-provided software, since team-provided software won't be available to archival users.
  - be able to read the data (multiple ways)
  - 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 (SHAP2 and RMOC)
  - SPICE kernels

The board members shall transmit their comments and concerns via the Review Item Discrepancy (RID) system or via email in a text format (see Appendix A).

5.3 The Review Item Discrepancy (RID) system

The RID forms are derived from the ECSS-M-30-01A [4] and there will be two ways to deliver a RID for the review. The first via an online system (for European based reviewers in particular) to enter and track these RIDs. A link & login details shall be sent to each reviewer soon after review kick-off. The second is using the form in Appendix A, which can also be used as a backup for the on-line system in any case. Note that this form may also be delivered in excel form via for easier incorporation/ingestion in the system.

This form can be copied to an ASCII file, filled in and send to the review chair and secretary.

Only input received via the RID online system or the Appendix A form will be taken into account during the board meetings.

The RIDs shall be numbered as RO-AR-RID-INST-1XX-ShortTitle (e.g. R-AR-RID-VIRT-101- IndexFileProblem). All RIDs are to be entered in the system by 12th February 2016.

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 (likely three) days, starting early morning EST and ending early evening CET. The instruments will be grouped by day, e.g., orbiter remote sensing, orbiter in situ, and lander. Every attempt will be made to schedule things to minimize the burden on participation by the instrument teams (e.g.,, MIRO will be scheduled mid-day EST).

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.

The discussion for each instrument will begin with presentations by the prime 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. This is best done as a PowerPoint (or equivalent, such as Keynote or PDF) presentation that can be provided to the data provider (aka instrument team).

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 (non-prime) reviewers and review board members will have the opportunity to comment, either on the problems found by the prime reviewers or on other problems.

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: REVIEW ITEM DISCREPANCY (RID) FORM

[This form may be delivered also to the reviewer in Excel form for easier ingestion into the system]

1. Initiator of the RID:
   Institute:
   Email Address:
2. Date:
3. Referred document number or data set identifier:
4. Review Item number: (entered by secretary) *
   4.a: Location of deficiency:
   4.b: Review Deficiency and justification:
   4.c: Proposed Change:
   4.d: Proposed RID Level**:
   4.e: Disposition of RID***:

*section 4 is repeated for each RID. Several RIDs can be combined into one ASCII file and sent via email to the review chair and secretary

**RID Levels are: major, minor, editorial

***Dispositions:

Accept (and implement the change as proposed)
Modify (the proposed change for implementation (incl. justification))
Refer (the proposed change via the Executive to the SB for disposition)
Reject (the proposed change (incl. justification for rejection))

APPENDIX B – DATA DELIVERED FOR THE REVIEW

B1 – Orbiter Instruments Data

Experiment	Data Level
Alice	PRL & ESC-1 - L2, L3, L4
Cosima	PRL & ESC-1 - L2, L3
Midas	PRL & ESC-1 - L2, L3
Giada	PRL & ESC-1 - L2, L3
Miro	PRL & ESC-1 - L2, L3
Osiris	Up to mid-Sept 2014 - L2 & L3
Rosina	PRL & ESC-1 - L2. L3 Sample dataset
Virtis	Two MTPs from PRL (6 & 9) - L2 & L3
RSI	Individual datasets - L2 & L3
RPC-ICA	PRL & ESC-1 - L2. L3 Sample data
RPC-IES	PRL & ESC-1 - L2. L3 Sample data
RPC-LAP	PRL & ESC-1 - L2, L3
RPC-MIP	PRL & ESC-1 - L2, L3
RPC-MAG	PRL (L2, L3, L4) & ESC-1 - L2, L4. No L3
NAVCAM	Up to MTP19 - L2 only

PRL – Pre-landing (Apr to Nov 2014)

ESC - Escort Phase (Nov 2014 to Mar 2015)

MTP – Medium Term Plan – a 4 week period of data.

B2 – Lander Instruments Data

	PHC	PDCS	SDL	RBD	FSS	Notes
CIVA-P	2,3	2,3			2,3A,3B	FSS L3B images will not be ready for the Peer Review[1]
CONSERT	2,3	2,3	2,3		2,3	L3 described in the EAICD but not produced[2]
COSAC	1,2,3	1,2,3		1,2,3	1,2,3	
MUPUS	1,2,3A		1,2,3B	1,2,3B	1,2,3B	L3A: produced by SONC L3B: produced by Lab
PTOLEMY	1,2,3	1,2,3		1,2,3	1,2,3,5	L5 (Lab): mid-January
ROMAP-MAG	2,3(A,B),5(E,F)	2,3(A,B),5(E,F)	2,3(A,B,C,D), 5(E,F,G,H)	2,3(A,B,C,D), 5(E,F,G,H)	2,3(A,B,C,D), 5(E,F,G,H)	FSS data = sample [3]
ROMAP-SPM	2,3			2,3	2,3	FSS scientific data not available[4]
ROLIS	1,2		1,2,3		1,2,3	SDL L3 ok : expected in January FSS L3 not ready[5]
SD2	2	2			2	
SESAME	1,2,3	1,2,3	1,2,3		1,2,3	
V1.0 (Orbit, Attitude, Sun direction, Comet models						

[1] JP.Bibring (16/12/2015): "Highest level of CIVA images requires the knowledge of the illumination conditions, which is still not acquired, since the exact attitude and location are still under study."
[2] W. Kofman (04/01/2016): "The complete data set and documentation will be released in 2016, however today it's not possible to give the date because we don't have yet funding for this work and it will
[3] U.Auster (20/11/2015): "5 mn after TD3, data currently best calibrated for offsets"
[4] U.Auster (20/11/2015): "'Scientific usable SPM data after TD2 are not available. The reason is, that the SPM sensor has been covered with cometary dust during TD2"
[5] S. Mottola (18/11/2015): "It is not clear when the FSS level-3 data will be ready, as our standard reduction procedure is not suitable for processing the FSS data. The problem is due to the considerable str