

*ESEP  
2017*



# Planetary Science Archive

What does the PSA do with  
interoperability

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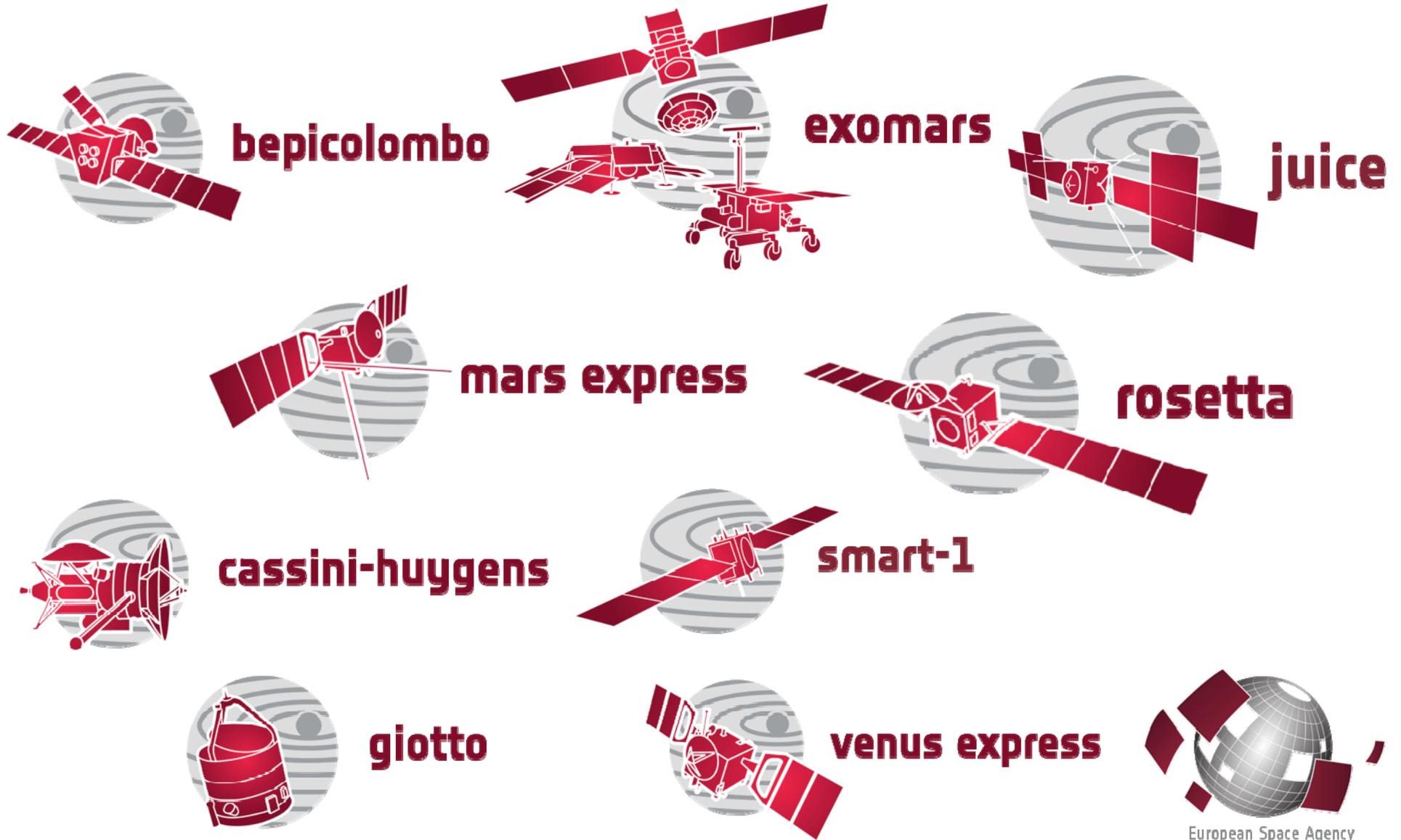
European Space Agency

# What is the Planetary Science Archive (PSA)?

- Repository of ESA' missions for exploration of the Solar System
- It contains science datasets, as well as engineering datasets of spacecrafts and instruments (i.e., HK)
- It uses a common format with other international planetary missions, the Planetary Data System (PDS)
- PSA is committed to provide access to ESA's missions scientific and engineering datasets for decades to the public.



# Planetary Science Archive (PSA)



**bepicolombo**

**exomars**

**juice**

**mars express**

**rosetta**

**cassini-huygens**

**smart-1**

**giotto**

**venus express**

# Numbers of the PSA



## 10 missions

- In Legacy Phase (Giotto, Vex, Smart-1, Huygens)
- In Post-Operation Phase (Rosetta)
- In Operation Phase (ExoMars 2016, MarsExpress)
- In Development (BepiColombo, Juice, ExoMars RSP)

## 76 instruments

- Including in-situ Vs. remote sensing
- 44 more upcoming by 2024 (JUICE, BepiColombo, Exomars RSP)

## 55 TB of data and 12 millions products

- coming from 76 instruments, 7 missions, spread over 20 years
- 8 millions products for Rosetta, 30TB for Mars Express!



# User interface to search datasets



## planetary science archive

PSA 5.0.3



HOME VIEW



PSA

START SEARCHING YOUR DATASET!

The European Space Agency's Planetary Science Archive (PSA) contains data from the Rosetta, SMART-1 and ExoMars 16, as well as several ground-based missions.

- NAVCAM [instrument]
- SPICAM [instrument]

Current missions: currently including Giotto, Huygens, Mars Express, Venus Express, and the ESA Mars Express. The PSA uses Planetary Data System standards as a baseline for the data.

### DATA ACCESS

- TABLE VIEW
- FTP ACCESS

### PRODUCT INFO & TOOLS

- ANCILLARY DATA
- TOOLS
- DOCUMENTATION
- ESA MISSIONS

### USEFUL INFORMATION

- WORKSHOP
- USER GROUP
- HELP & FAQ
- CONTACT



# Interoperability

**What does it mean for the  
PSA**

## Obtain & provide science products

### 1. Obtain science products from other projects

- a. Useful for supporting science investigations on an already observed planet (e.g., international partners)
- b. Obtained science products useful for visualization that are not necessarily archived (e.g. high level science products)

### 2. Provide science products

- a. Other services are interested in the content of the PSA database
- b. Agreement with other archives (NASA/IKI/JAXA) to provide products (mirroring, co-archiving, etc...)

### 3. Point to additional useful science products

- a. Other archives are ESAC (e.g., EsaSky, Helio, etc...)
- b. Other archives and services



# Tools for interoperability



The only important part is to understand each others

- a. Agree on the language(s)
- b. All speak the same language(s)

PSA is following recommendations from the International Planetary Data Alliance (IPDA)

- a. PDAP – Planetary Data Access Protocol
  - Recommended by the IPDA
- b. EPN-TAP – Europlanet Table Access Protocol
  - Under evaluation by the IPDA



# PDAP

## Planetary Data Access Protocol (IPDA project)

# PDAP – Concept and Status



- Protocol designed and evolved by IPDA (International Planetary Data Alliance) technical experts from different IPDA organization members (ESA/PSA, NASA/PDS, JAXA, etc)
- PDAP was born at the ESA/PSA and NASA/PDS Technical Interoperability Meeting, held January 10-12, 2006 in Madrid Spain. Since then, other IPDA members have collaborated in the definition and refinement of the protocol (e.g., JAXA)
- The two steps performed when executing the protocol are the following:
  - a. Step 1: Metadata Access
  - b. Step 2: Data Access
- The PSA implements PDAP Core v1.0 and currently supports both PDS3 and PDS4 Data Formats.



# Get Products by INSTRUMENT\_HOST NAME (e.g. Rosetta Lander)



[https://archives.esac.esa.int/psa/pdap/metadata?RETURN\\_TYPE=HTML&RESOURCE\\_CLASS=PRODUCT&INSTRUMENT\\_HOST\\_NAME=RL](https://archives.esac.esa.int/psa/pdap/metadata?RETURN_TYPE=HTML&RESOURCE_CLASS=PRODUCT&INSTRUMENT_HOST_NAME=RL)

Query

Search Result (3089 products found)

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HTML  
FORMAT



# Getbundles byINSTRUMENT\_HOST\_NAME (e.g Trace Gas Orbiter, ExoMars 16)



[https://psa.esa.int/psa/pdap/metadata?RETURN\\_TYPE=VOTABLE&RESOURCE\\_CLASS=DATA\\_SET&INSTRUMENT\\_HOST\\_NAME='TRACE%20GAS%20ORBITER'](https://psa.esa.int/psa/pdap/metadata?RETURN_TYPE=VOTABLE&RESOURCE_CLASS=DATA_SET&INSTRUMENT_HOST_NAME='TRACE%20GAS%20ORBITER')

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VO Table  
FORMAT



# Useful Links and Future Plans



- PSA PDAP is accessible at this address <http://psa.esa.int/pdap/metadata>
- PSA will continue to provide access via PDAP to its archive
  - Used by scientists to explore PSA database
  - Used by PDS to obtain specific data (e.g., VEX)
- Maintenance of PDAP Core v1.0 is done at the PSA
- Further development are not foreseen in near future on PSA side
  - Development will be significant, resources are limited
  - Other players in the field





# EPN-TAP

## **Europlanet Table Access Protocol**



# PSA EPN-TAP: Current status



- Version 2.0:
  - Improves larger services accommodation
  - Simplify setup and use of data services
  
- Granularity of PSA EPN-TAP is per PDS observational product
  
- Searchable parameters:
  - Mission / Instrument Host
  - Instrument
  - Target
  - Start / Stop Time
  
- Provide access URL's to allow data retrieval
  
- Geometry parameters values to be included are being analysed by the team
  
- Mapping PDS Labels to the EPN-TAP standard
  - How to determine data product type automatically



# PSA EPN-TAP: Parameters



granule_uid	✓
granule_gid	✓
obs_id	✓
dataproduct_type	✓
target_name	✓
target_class	✓

instrument_host_name	✓
instrument_name	✓
measurement_type	
processing_level	✓
creation_date	✓
modification_date	✓
release_date	✓
service_title	✓

spatial_frame_type	✓
--------------------	---

s_region	
----------	--

time_min	✓
time_max	✓
time_sampling_step_min	
time_sampling_step_max	
time_exp_min	
time_exp_max	

spectral_range_min	
spectral_range_max	
spectral_sampling_step_min	
spectral_sampling_step_max	
spectral_resolution_min	
spectral_resolution_max	

incidence_min	
incidence_max	
emergence_min	
emergence_max	
phase_min	
phase_max	

c1min	
c1max	
c2min	
c2max	
c3min	
c3max	

c1_resol_min	
c1_resol_max	
c2_resol_min	
c2_resol_max	
c3_resol_min	
c3_resol_max	

MANDATORY

OPTIONAL

access_url	✓
access_format	✓
access_estsize	✓
thumbnail_url	✓



# PSA EPN-TAP: tests



## VESPA

Virtual European Solar and Planetary Access

All VO Custom resource Direct Query Advanced Query Help

Submit Reset

### Main Parameters

<b>Resource Url</b> <input type="text" value="saint01.n1data.lan:8080/psa-epn-tap/tap"/>	<b>Schema Name</b> <input type="text" value="psa"/>
<b>Target Name</b> <input type="text" value="Mars"/>	<b>Target Class</b> <ul style="list-style-type: none"><li>Interplanetary Medium</li><li><b>Planet</b></li><li>Ring</li><li>Sample</li><li>Satellite</li></ul>
<b>Granule UID</b> <input type="text"/>	<b>Dataproduct Type</b> <ul style="list-style-type: none"><li>Catalog</li><li>Catalogue Item</li><li>Cube</li></ul>
<b>Granule GID</b> <input type="text"/>	<b>Measurement Type</b> <input type="text"/>
<b>Obs ID</b> <input type="text"/>	<b>Time selection</b> <input type="text" value="The range between"/>
<b>Time selection</b> <input type="text" value="Data range is included in"/>	<b>Time Min</b>
<b>Time Min</b>	<b>Time Max</b>

### Plotting tools

- TOPCAT
- Aladin
- SPLAT
- CASSIS
- 3DView

### Example queries

Saturn in March 2012



# PSA EPN-TAP: tests



## Results in service psa

Show  entries

Column visibility Show all Hide all  
 Select All in current page Reset Selection

access_url	dataprodect_type	granule_uid	target_name	time_max (d)	time_min (d)
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M00ODFSL1B_DPS_063301929_00.TAB	Mars	2006-11-26T21:22:57.000	2006-11-26T18:29:48.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M15ODFSL02_DPS_063301929_00.TAB	Mars	2006-11-26T21:22:57.000	2006-11-26T18:29:48.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M00ODFXL1B_DPX_063301930_00.TAB	Mars	2006-11-26T21:45:08.999	2006-11-26T18:30:01.000
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M00ODF0L1A_ODF_063301929_00.DAT	Mars	2006-11-26T21:22:57.000	2006-11-26T18:29:48.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M15ODFXL02_DPX_063301930_00.TAB	Mars	2006-11-26T21:45:08.999	2006-11-26T18:30:01.000
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M00ODF0L1A_ODF_063301930_00.DAT	Mars	2006-11-26T21:45:08.999	2006-11-26T18:30:01.000
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1092-V1.0:DATA:M00ODF0L1B_RMP_063301757_00.TAB	Mars	2006-11-26T21:45:08.999	2006-11-26T16:57:56.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1091-V1.0:DATA:M32ICL1L1B_AG1_063300544_00.TAB	Mars	2006-11-26T05:44:49.999	2006-11-26T04:44:50.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1091-V1.0:DATA:M32ICL3L1B_D2S_063300545_01.TAB	Mars	2006-11-26T06:45:17.999	2006-11-26T05:45:18.999
<a href="http://psaint01.n1da...">http://psaint01.n1da...</a>	catalogue	MEX-M-MRS-1/2/3-EXT1-1091-V1.0:DATA:M32ICL2L1B_D2X_063300545_01.TAB	Mars	2006-11-26T06:45:01.999	2006-11-26T05:45:02.999

Showing 1 to 10 of 122,393 entries

Page  of 12240

### Plotting tools

- TOPCAT
- Aladin
- SPLAT
- CASSIS
- 3DView

### Example queries

Saturn in March 2012



# Potential future development

# Future development



- ✓ EPN-TAP improvements
- ✓ VO tools
- ✓ Visibility of operations
  - ❖ 3D view
  - ❖ Cosmographia
- ✓ GIS interoperability
  - ❖ Mars
  - ❖ Mercure

→ PSA would like to benefit from the great products and tools provided by the community.

PSA will also improve its database to be used by the community



# EPN-TAP: Future Parameters



granule_uid	✓
granule_gid	✓
obs_id	✓
dataproduct_type	✓
target_name	✓
target_class	✓

time_min	✓
time_max	✓
time_sampling_step_min	
time_sampling_step_max	
time_exp_min	
time_exp_max	

c1min	
c1max	
c2min	
c2max	
c3min	
c3max	

instrument_host_name	✓
instrument_name	✓
measurement_type	
processing_level	✓
creation_date	✓
modification_date	✓
release_date	✓
service_title	✓

spectral_range_min	
spectral_range_max	
spectral_sampling_step_min	
spectral_sampling_step_max	
spectral_resolution_min	
spectral_resolution_max	

c1_resol_min	
c1_resol_max	
c2_resol_min	
c2_resol_max	
c3_resol_min	
c3_resol_max	

spatial_frame_type	✓
s_region	

incidence_min	
incidence_max	
emergence_min	
emergence_max	
phase_min	
phase_max	

MANDATORY

OPTIONAL

access_url	✓
access_format	✓
access_estsize	✓
thumbnail_url	✓



European Space Agency

# VO Tools



- Long list of tools that can be implemented in the PSA
  - ❖ Cassis, VO Spec, Aladin, Topcat, etc....

The screenshot shows the ESA Planetary Science Archive (PSA) interface. The main table lists products with columns for Postcard, Product Identifier, Observation Start Time, Observation Stop Time, Target, Mission, Instrument, and Processing Level. A detailed view for product ORBG398\_0\_DATA is shown on the right, indicating that no browse product is available.

Postcard	Product Identifier	Observation Start Time	Observation Stop Time	Target	Mission	Instrument	Processing Level
N/A	<a href="#">ORBG398_0_DATA</a>	2016-12-11 08:23:00	2016-12-11 08:38:50	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG398_0_GEOM</a>	2016-12-11 08:23:00	2016-12-11 08:38:50	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG394_0_GEOM</a>	2016-12-10 04:00:08	2016-12-10 04:18:00	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG394_0_DATA</a>	2016-12-10 04:00:08	2016-12-10 04:18:00	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG391_0_DATA</a>	2016-12-09 05:14:55	2016-12-09 05:54:44	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG391_0_GEOM</a>	2016-12-09 05:14:55	2016-12-09 05:54:44	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG386_0_GEOM</a>	2016-12-07 20:06:18	2016-12-07 20:22:08	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG386_0_DATA</a>	2016-12-07 20:06:18	2016-12-07 20:22:08	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG383_0_DATA</a>	2016-12-06 23:23:00	2016-12-06 23:38:50	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG383_0_GEOM</a>	2016-12-06 23:23:00	2016-12-06 23:38:50	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG382_0_GEOM</a>	2016-12-06 12:17:07	2016-12-06 12:47:02	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG382_0_DATA</a>	2016-12-06 12:17:07	2016-12-06 12:47:02	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG381_0_GEOM</a>	2016-12-06 12:12:34	2016-12-06 12:17:05	Mars	Mars Express	OMEGA	Not Available
N/A	<a href="#">ORBG381_0_DATA</a>	2016-12-06 12:12:34	2016-12-06 12:17:05	Mars	Mars Express	OMEGA	Not Available

Number of selected products: 0

Filter by string in the current page

TABLE VIEW

ORBG398\_0\_DATA

NO BROWSE PRODUCT AVAILABLE

Summary | Geometry | Products | Documents

Product Identifier	ORBG398_0_DATA
Start Time	2016-12-11 08:23:00
Stop Time	2016-12-11 08:38:50
Target	Mars
Mission	Mars Express
Instrument	OMEGA
Processing Level	Not Available
Instrument Host	Not Available
Instrument Type	IMAGING SPECTROMET
File Testment	Not Available

Page: 1 5 >>> Items/page: 5000 Displaying 1 - 5000 of 21237

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- TOPCAT
- Aladin
- SPLAT
- CASSIS



European Space Agency



# VO Tools



- Users of archive want to see operations (in 3D)
  - ❖ 3D view is a good example
  - ❖ Cosmographia is another possibility

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### planetary science archive

PSA 5.2.3

Number of selected products: 0

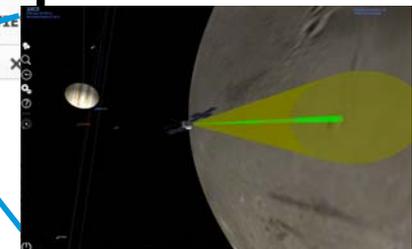
Filter by string in the current page

Postcard	Product Identifier	Observation Start Tin	Observation Stop Time	Target	Mission	Instrument	Processing Le
<input type="checkbox"/>	N/A ORBG398_0_DATA	2016-12-11 08:23:00	2016-12-11 08:38:50	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG398_0_GEOM	2016-12-11 08:23:00	2016-12-11 08:38:50	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG394_0_GEOM	2016-12-10 04:00:08	2016-12-10 04:18:00	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG394_0_DATA	2016-12-10 04:00:08	2016-12-10 04:18:00	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG391_0_DATA	2016-12-09 05:14:55	2016-12-09 05:54:44	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG391_0_GEOM	2016-12-09 05:14:55	2016-12-09 05:54:44	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG386_0_GEOM	2016-12-07 20:06:18	2016-12-07 20:22:08	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG386_0_DATA	2016-12-07 20:06:18	2016-12-07 20:22:08	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG383_0_DATA	2016-12-06 23:23:00	2016-12-06 23:38:50	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG383_0_GEOM	2016-12-06 23:23:00	2016-12-06 23:38:50	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG382_0_GEOM	2016-12-06 12:17:07	2016-12-06 12:47:02	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG382_0_DATA	2016-12-06 12:17:07	2016-12-06 12:47:02	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG381_0_GEOM	2016-12-06 12:12:34	2016-12-06 12:17:05	Mars	Mars Express	OMEGA	Not Available
<input type="checkbox"/>	N/A ORBG381_0_DATA	2016-12-06 12:12:34	2016-12-06 12:17:05	Mars	Mars Express	OMEGA	Not Available

Items/page: 5000 Displaying 1 - 5000 of 21237

NO BROWSE PRODUCT AVAILABLE

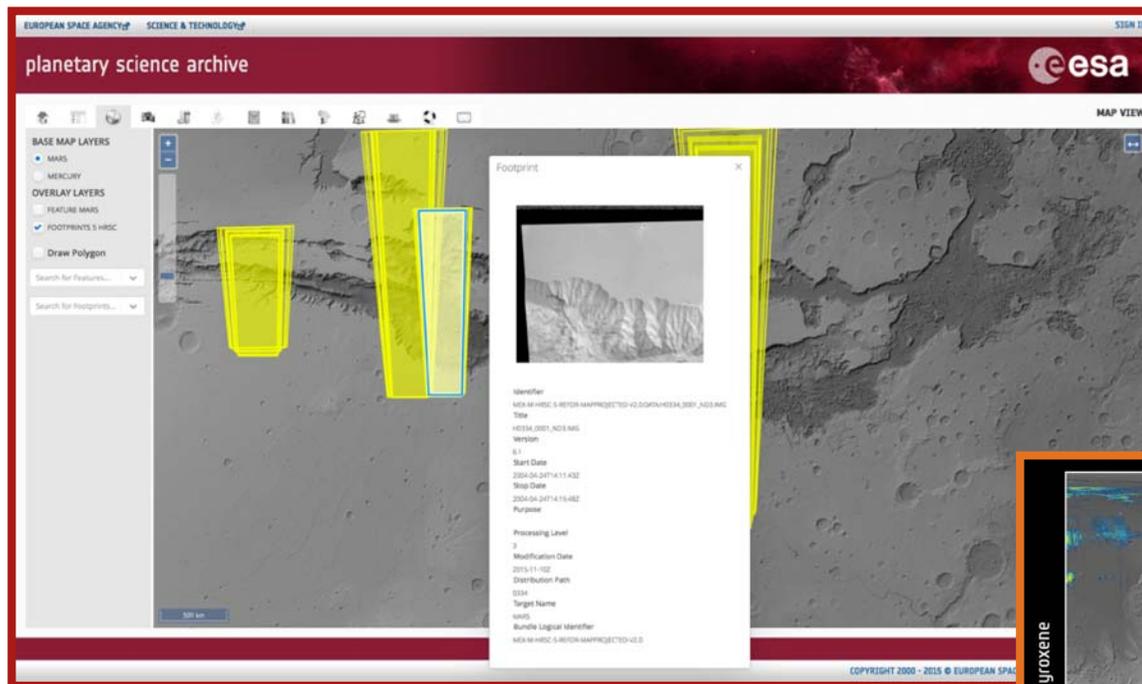
Summary	Geometry	Products	Documents
Product Identifier	ORBG398_0_DATA		
Start Time	2016-12-11 08:23:00		
Stop Time	2016-12-11 08:38:50		
Target	Mars		
Mission	Mars Express		
Instrument	OMEGA		
Processing Level	Not Available		
Instrument Host	Not Available		
Instrument Type	IMAGING SPECTROMET		
Sub Treatment	Not Available		



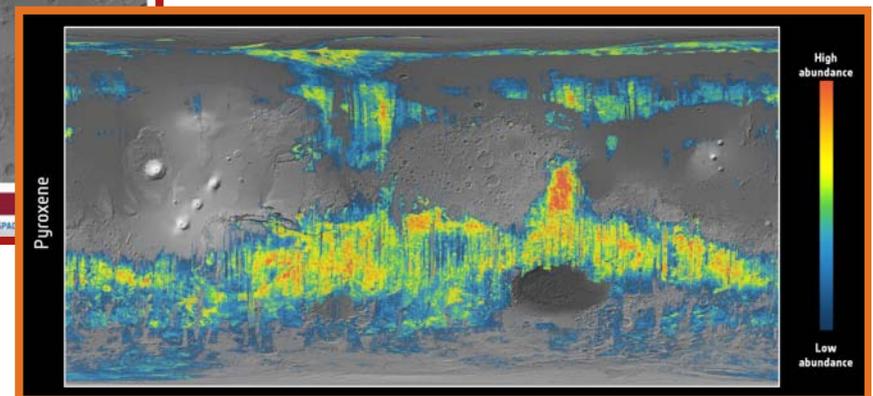
# GIS interoperability



- Provide products and shape files from other missions/instruments
  - In particular for Mars and Mercury
- Maximize the support for searching adequate products
  - Currently focused on surfaces (larger community)



Mars Pyroxene map



PSA GIS development

# Summary



## psa.esa.int

PSA is one generic tool that offer and will offer different ways to search and visualize datasets for the benefit of science

It ensures long time preservation of datasets which is a key aspect of science investigation that takes many years

PSA will ensure that the archive is accessible to the science community, the general public in any way that will enhance the visibility of the science produced by everyone.

