The ExoMars Rover Science Archive: Status and Plans

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[1]ExoMars Rover Surface Platform SGS, [2]ExoMars 2016 SGS

Introduction

The **ExoMars** program is a co-operation between **ESA and Roscosmos** comprising two missions: **the first, launched on 14 March 2016**, included the **Trace Gas Orbiter and Schiaparelli lander; the second, due for launch in 2020**, will be a **Rover and Surface Platform (RSP)**.

Archiving of the ExoMars Rover and Surface Platform science data presents ESA's Planetary Science Archive with several new challenges. These data will be among the first in the PSA to follow the new PDS4 archiving standards, and they will be the first rover data of any kind to be managed within the PSA. There will be a need for some significant development effort within the PSA in response to the needs of this mission.

ExoMars Rover and Surface Platform (RSP)

The **ExoMars Rover** and **Surface Platform** (RSP) mission is scheduled for a launch in 2020, and will deliver the European ExoMars Rover and a Russian Surface Platform to the surface of Mars. The primary objective is to land the rover at a site with **high potential for finding well-preserved organic material**, particularly from the very early history of the planet.

Once on ground, the **ExoMars Rover** will establish the **physical and chemical properties** of Martian samples, mainly from the **subsurface where biomarkers are more likely to be present**. The Rover carries a drill that is able to extract samples from various depths, down to **a maximum of two metres**. The Rover is expected to travel several kilometres during its mission. In addition to the detailed sampling, the Rover will carry a suite of instruments designed to establish the **geological and depositional context** of each site visited.
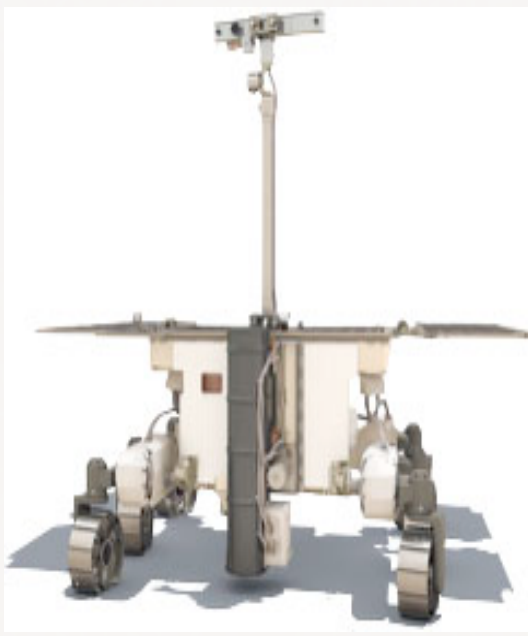
The **Surface Platform** will carry a suite of instruments to **monitor and characterise the environment** at the selected landing site, and will provide further context for the scientific investigations of the Rover. In combination, the Surface Platform and ExoMars Rover will provide a **comprehensive environmental, geological and chemical investigation** of the selected landing site from macro to molecular scale.

Archiving Challenges for ExoMars

The ExoMars program presents the PSA with many exciting new challenges. Firstly, the data are among the first to use the new **PDS4** standards. To minimise the impact of this change, the PSA has been working closely with NASA's PDS team throughout the development of PDS4. In doing so, we have made sure that we are already able to manage the PDS4 data within the new PSA, and that the standards meet the needs of our missions and the international community. Much of this work is being done through the **International Planetary Data Alliance** (IPDA) [2], within which ESA is a key member.

The **ExoMars RSP** mission will also be the **first rover data** archived within the PSA, and scientists will want to be able to query and retrieve these data in a different way to that from an orbiter. This is well demonstrated by the '**Analysts Notebook**' developed by the PDS [3] (below), which involves a strong user community interaction for the exploitation of the rover science data. It is likely that a similar approach will be needed for the future PSA, and we are working closely with our PDS colleagues to learn from their experiences.

Such an interface is a long way detached from the experience currently offered to PSA users, and will require not only major updates to the front-end of the archive, but also new ways to manage and access meta-data that is specific to a **rover operations**. This information will be needed to understand what the rover was doing at the time of an observation, and how it was working in connection with other instrumentation, and will need to be carefully formatted and stored in an **easily accessible** form.
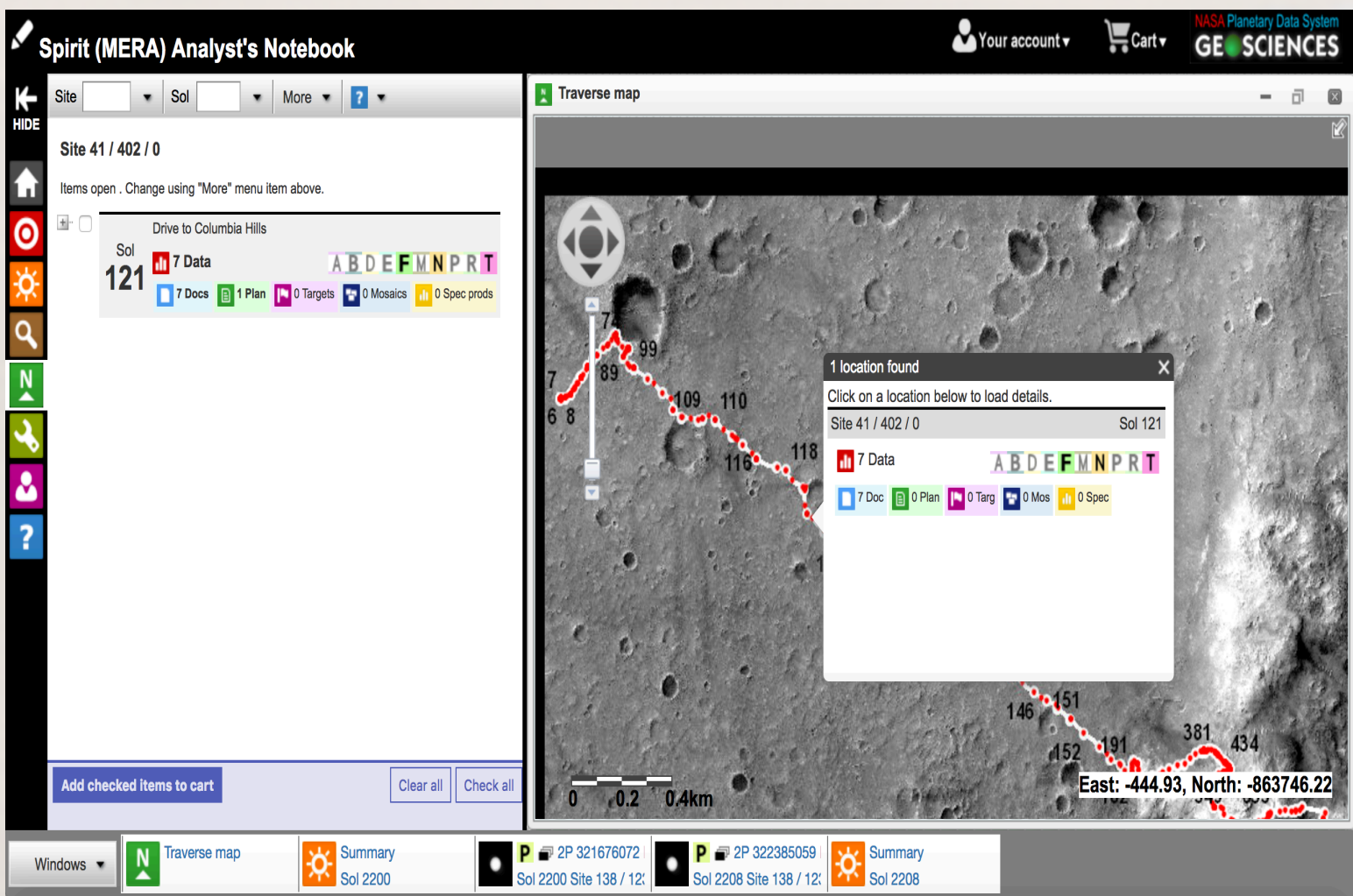
ExoMars Rover Archiving Process

In addition to the archiving interface, there are differences with the overall **archiving process** being followed for ExoMars compared to previous ESA planetary missions. For the **RSP mission**, the data pipelines are being **developed by European industry**, in close collaboration with ESA PSA experts and with the instrument teams.

ExoMars Rover Archiving Process (cont.)

The **first level of RSP data processing** will be carried out at **ALTEC in Turin** where the pipelines are developed (based on ESA software), and from where the rover operations will also be run. This setup introduces additional challenges in terms of ensuring that the output science products are compliant with the internal needs of the ESA archive, as well as those of the end users and instrument teams. Data and information will need to flow between the **Rover** and the **Surface Platform** as well, so **ESA** and **Roscosmos** are coordinating very closely to ensure that information is shared and interfaces are established at a very early stage to permit this.

A similar setup existed for the **Philae** lander on **Rosetta** where the data processing was contracted out to industry and, while the **process worked well overall**, not having direct access to the instrument teams was challenging when scientific updates were requested to the data. PSA will draw on the **lessons learned** from that experience to ensure a **closer contact** with the instrument teams is available at key moments in the RSP archiving process, thus **minimising any potential delays** in data delivery. ESA are also coordinating very closely with ALTEC to follow the pipeline development and assess the outputs regularly. Additionally, a '**Data Handling and Archiving Working Group**' (DHAWG) has been established. Lead by ESA, this working group includes ALTEC, instrument teams, as well as our colleagues from **Roscosmos** and the **Surface Platform**. This forum will be used to coordinate the data archiving activities through the complete mission lifetime, ensuring that the process from data reception through to ingestion and release in the archive is as smooth as possible.

PSA Overview

The Planetary Science Archive (PSA) [1] is the European Space Agency's (ESA) **repository of science data** from all planetary science and exploration missions. The PSA provides access to datasets that are scientifically **peer-reviewed** by independent scientists, and are compliant with the Planetary Data System (PDS) standard, which is the default standard used in planetary science.

The PSA has undergone a **complete re-engineering** in order to increase the accessibility of ESA's planetary data holdings utilising the latest technologies and to significantly **improve the user experience** for both the scientific community and the general public.

The new PSA user interface was **released in early 2017**. ExoMars 2016 data are already being delivered to the archive in the **new PDS4 format**, and the back-end of the new PSA is already in place, allowing for these data to be ingested and released after the 6-month proprietary period expires.

The **new user interface** (right) provides **direct** and **simple access** to the scientific data, as well as to the documentation and additional information needed to properly interpret them.

The archive can be explored through a set of parameters that allow the selection of products through space and time. **Quick views** are also provided where available to give information needed for the selection of appropriate scientific products. The example on the right shows a screenshot of the results from a simple query for **ExoMars 2016 data** in the new archive.
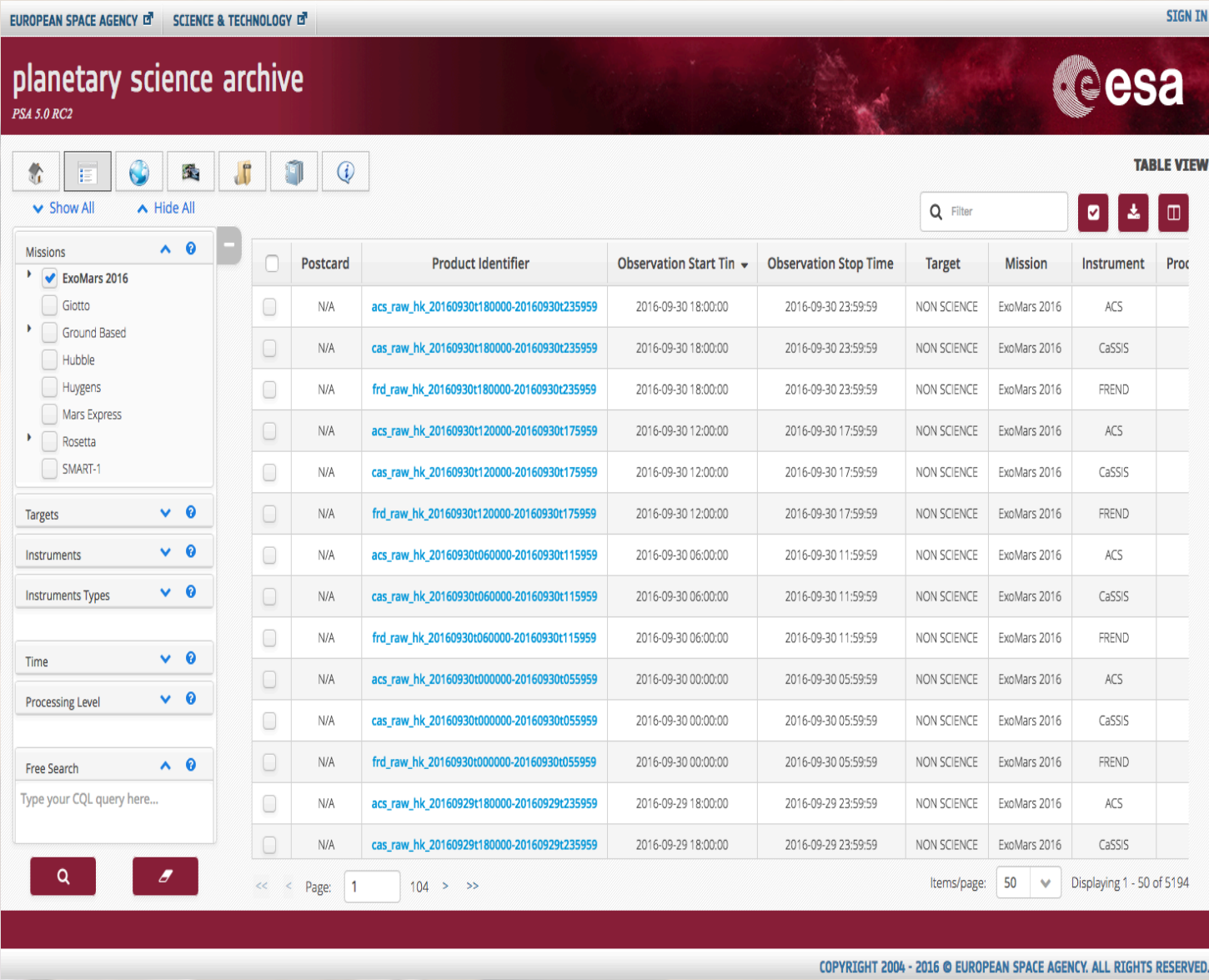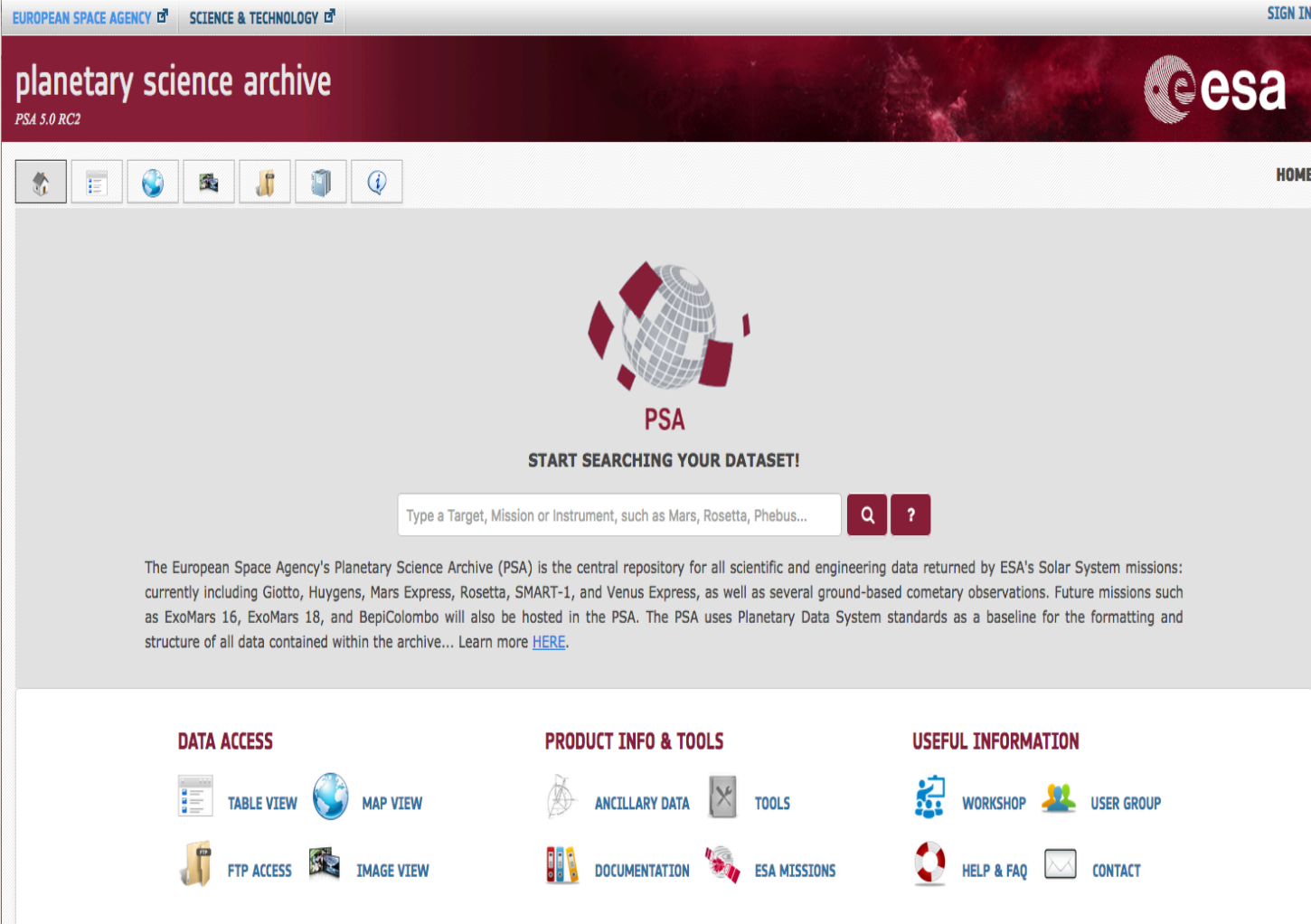
Conclusion

The ExoMars RSP mission will be the first rover data to be managed within the PSA and presents us with many exciting challenges. The **PSA is working hard** to overcome these and we are **confident** that we will be **ready to present the ExoMars data** to the community in a new set of user interfaces that are **efficient, user friendly** and will provide **easy access** to all the information needed to **maximise the use** of the **scientific data** to come from this ground-breaking mission.

References

1] Planetary Science Archive (PSA) : http://psa.esa.int
[2] International Planetary Data Alliance (IPDA):
http://www.planetarydata.org/
[3] Mars Rover Analyst's Notebook, PDS GeoSciences:
https://an.rsl.wustl.edu/

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