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Approvals	[Approved] Project Manager, MMX Project Team,		Yasuhiro Kawakatsu
	[Approved] Principal Investigator, MMX Project Team,		Kiyoshi Kuramoto
	[Inspected] Deputy of Project Manager, MMX Project Team,		Hisashi Otake
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EMX-223001

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# **MARTIAN MOONS EXPLORATION (MMX) MISSION**

## **SCIENCE MANAGEMENT PLAN**

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### REVISION AND HISTORY PAGE

Status	Revision Number	Change Number	Description	Release Date
Original	0	0	JAXA-RPR-MX16308_MMX_Science Management Plan for ALL_NC.pdf	Mar.1, 2017
Fully Updated	0	1	Sec. 2 & 3 are converged to New Sec. 2 in which MMX organization is described and various teams and their memberships are defined.  New Sec. 3 was added to describe MMX science policy, including the contents of the old Sec. 4.	4/15/2019
	0	2	The following sections were updated:  3.1.3 Data sharing policy and proprietary period  3.1.4 Research paper authority during the proprietary Period	5/14/2019
	0	3	The following sections were updated, accordingly changing section numbers:  3.1.1 Data category and level definition 3.1.3 Data sharing policy and proprietary period 3.1.5.1 Publication Plan Table and research proposal 3.1.5.2 Authorship 3.4 Copyright and acknowledgement  Following section was added: 3.1.4 Shape model and precise spacecraft ancillary information	6/4/2019
	0	4	The following sections were updated:  1 Summary and Scope 2.1.7 Other teams 3.1 Science Policy for observation in space 3.4 Credit and acknowledgement	6/7/2019

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			3.2.5 Scientific data archiving	
	0	5	<p>The following sections were updated:</p> <p>3.1.3 Data sharing policy and proprietary period</p> <p>3.1.6 Scientific data archiving</p> <p>3.4 Credit and acknowledgement</p> <p>The following sections were added (section titles only so far)</p> <p>4 Extended proprietary period</p> <p>5 Concrete expression of credits and acknowledgements</p>	6/13/2019
	1	0	<p>The following sections were updated:</p> <p>2.1.2 Science Working Team (SWT)</p> <p>2.1.5 Working Team (WT)</p> <p>3.1.3 Data sharing policy and proprietary period</p> <p>3.1.6 Scientific data archiving</p> <p>3.4 Credit and acknowledgement</p>	7/19/2019
	1	1	<p>The following sections were updated:</p> <p>1 Summary and Scope</p> <p>2.1.6 Sub Science Team (SST)</p> <p>Fig. 2.2 (SST names were updated)</p> <p>3.1.3 Data sharing policy and proprietary period</p> <p>3.1.5 Research paper authority during the proprietary period</p> <p>3.1.5.1 Publication Plan Table and research proposal</p> <p>3.1.5.2 Authorship</p> <p>3.3 Data utilization by MMX project</p> <p>Following section was newly added, by editing old Sec. 3.3 and 3.4, and accordingly changing subsequent section numbers:</p>	11/22/2019

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			4 Data utilization for public relation	
	1	2	The following sections and a figure were updated, reflecting the instrument change MacrOmega to MIRS. Fig.2.1 2.1.4 Instrument Team (IT)	8/14/2019
	1	3	The following sections were updated: 2.1.2 Science Working Team (SWT) 2.1.6 Sub Science Team (SST) 3.1.3 Data sharing policy and proprietary period 3.1.5.1 Publication Plan Table and research proposal	9/25/2019
	1	4	The following sections were updated: 2.1.2 Science Working Team (SWT) 2.1.6 Sub Science Team (SST) 3.1.3 Data sharing policy and proprietary period 3.1.4 Shape model and precise spacecraft ancillary information 3.1.5.1 Publication Plan Table and research proposal	5/25/2021
		5	“Sub Science Team” is changed to “Science Strategy Team”. Table of Contents is changed, corresponding to omitting Chaps. 5 and 7. The following sections were updated: 3.1.3 Data sharing policy and proprietary period 3.1.5.2 Authorship 3.1.5.3 Presentations in conferences 3.3 Data utilization by MMX project 6. Acronyms	1/27/2023

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## 1. SUMMARY AND SCOPE

This document, MMX Science Management Plan (MMX-SciMP-ALL), deals with the scheme that will be implemented up to and including the post operational phase, to ensure the fulfilment of the scientific objectives of the MMX mission and to optimize its scientific return, with special emphasis on science operation and data management.

Described in this document are what make a secure development of the mission and what make the mission scientifically most successful. There should not be firewalls among the members. This document defines and describes MMX-SB, MMX-PI, instrument PIs and SST leaders. The members of these teams make strategic plans to maximize the success that the mission deserves. Given the nature of science expected of MMX, multi-instrument studies matter most. It is this idea that made JAXA decide to set up a framework where all information is focused at MMX-SB which consists of members who are equipped with suitable capabilities so that the best strategy and planning will be formulated. Description of this document will be finally approved by the MMX-PM as MMX project.

## 2. SCIENCE AND PROJECT MANAGEMENT

### The JAXA/MMX Project Team, Definition of Science Groups, and Their Constituent Members

See MMX organization chart (Fig. 2.1) for an overview.

#### The JAXA/MMX Project Team

Definition and roles of MMX-PM and MMX-PI:

[MMX-PM] JAXA, via the MMX Project Manager (MMX-PM), will retain overall responsibility for the MMX mission through all phases. The MMX Project Team is led by the Project Manager (MMX-PM) and will fulfil its function until the completion of the MMX mission operations.

The MMX-PM will periodically (nominally a few times per year) call Project Reviews, which will include all aspects of the MMX mission, and discussion relevant to the development of the mission will be carried out at MMX Design Meetings hosted by JAXA.

[MMX-PI] JAXA nominates the MMX Principal Investigator (MMX-PI) who is the interface of the MMX project with the Science Working Team (SWT) for scientific matters. The MMX-PI will chair the MMX Science Board (MMX SB) and MMX SWT meeting and coordinate its activities.

During all phases of the MMX mission, the MMX-PI will be responsible for all scientific issues within the MMX Project, including the strategy for maximizing the scientific output. The MMX-PI will advise the MMX-PM on technical matters affecting scientific performance, and will monitor the state of implementation and readiness of the MMX instrument operations and data processing infrastructure. The MMX-PI will also have overall responsibility for coordination of the MMX science operations as approved within assigned constraints. The MMX-PI will

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coordinate the production of the MMX scientific products, their archiving and distribution to the scientific community.

**MMX organization chart**

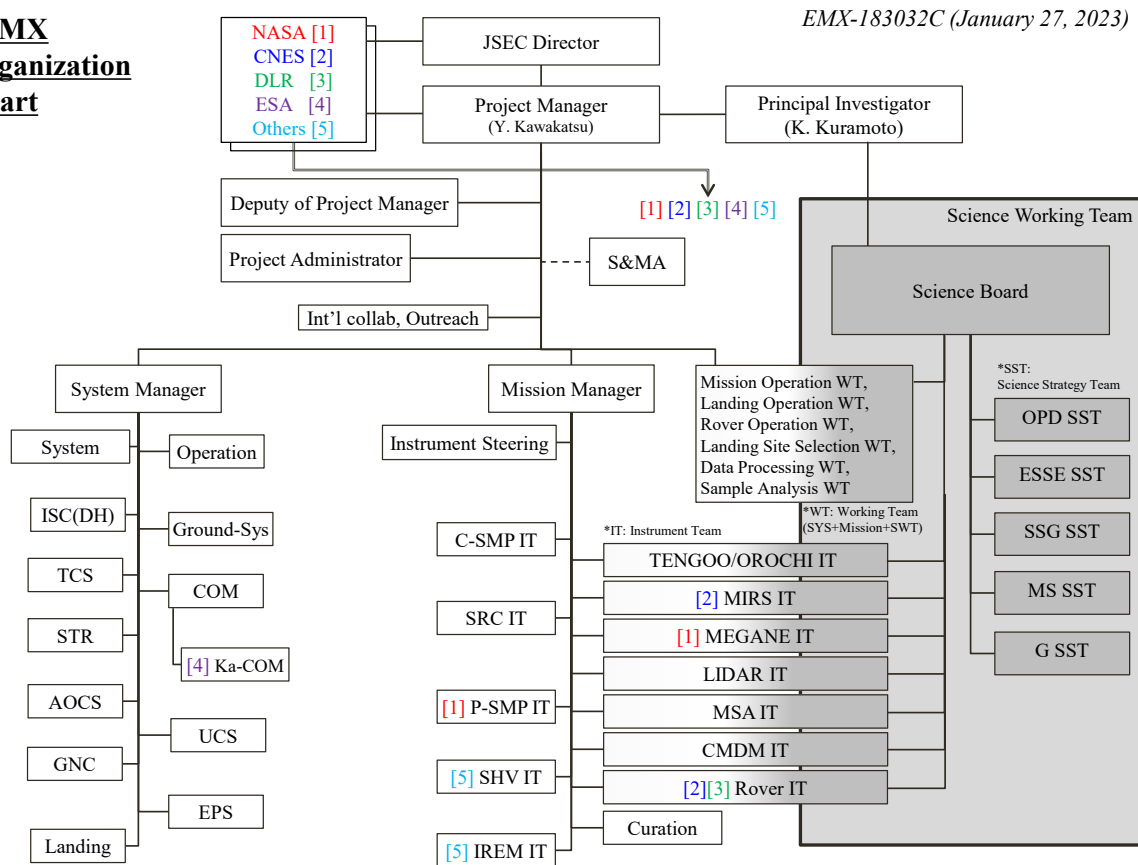


Fig. 2.1: MMX organization chart as of January 27, 2023.

### 2.1.2. Science Working Team (SWT)

The MMX Science Working Team (SWT) is defined as the largest frame in which all teams relevant to MMX scientific activity are included. All scientists acting for MMX science in the MMX project should be members of SWT. MMX-PI is assigned to be Chair of SWT. SWT members are listed by the representatives of all teams, for participation and withdrawal, must be reported to SB and get approved from the Science Board (SB) Chair. The SB Chair keeps and updates the accumulated list.

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### 2.1.3. Science Board (SB)

Science Board is the central group of SWT. The SB makes decisions as recommendation to MMX-PM about scientific issues in MMX, and manages and controls all science-side teams in MMX including Science Strategy Teams (SSTs) and parts of Instrument Teams (ITs) and Working Teams (WTs).

SB consists of MMX-PI as the SB Chair, SB members, SB Organizers who are designated by the SB Chair, and the SB observers. The SB members consist of one representative from each SST, one representative from each IT (one domestic representative POC) can be added for each international instrument team), and others as approved by the SB Chair with recommendations of international participant agencies. As a special case, for the MMX Rover, 2 representatives, one from each agency (CNES and DLR), should be SB members. The SB Observers consist of one representative from each Working Team (WT), one representative from the project side, representatives from each team who act on behalf of the team in the absence of the regular SB member, persons invited by the SB Chair to present information or answer questions for specific purposes, support personnel, for example those who take minutes at regular SB meetings, others involved in MMX at a high level, who facilitate cooperation and partnerships with other organizations such as academic societies in addition to their scientific contributions, and others as approved by the SB Chair.

If there is a resolution to be voted upon, in principle the SB Chair, the SB Organizers, and the SB members will have one vote per person (except for the domestic POCs of international instruments). However, the SB Chair may judge and change which persons or groups vote on a case-by-case basis. This voting process should be principally in a unanimous. Observers have the authority to participate in regular SB meetings and view meeting materials but do not have the right to vote.

### 2.1.4. Instrument Team (IT)

Since the structure and detailed job titles in the instrument teams are expected to be defined by the MMX project or within the teams, the following is an example for reference. They can be redefined on demand from the project, especially for MIRS, MEGANE, MMX Rover, and other potential international instruments, for constructing the optimal framework.

The ITs are responsible for the development of their instruments including ground verification tests. An IT consists of one representative who is responsible for the development (PI), one or two representatives who act on behalf of PI in the PI's absence (sub-PIs), one, if necessary, representative who is responsible for science inherent to the instrument (Sci-PI), and all other members (Co-Is) who are selected by the PI. Non-scientists as well as scientists who act for MMX science in ITs can be assigned as SWT members. A list of members belonging to each IT is updated and reported to SB by each IT PI.

### 2.1.5. Working Team (WT)

The WTs are temporary teams whose purpose is to solve particular tasks in MMX for a

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limited time. A WT consists of one or two representative(s) who are responsible for team operations (Chair(s)), one or two representative(s) who act on behalf of Chair(s) in the absence of Chair(s) (Vice-chair(s)), and all other members who are selected by the Chair. Non-scientists as well as scientists who act for MMX science in WTs can be assigned as SWT members. A list of members belonging to each WT is updated and reported to SB by each WT Chair(s).

New WTs begin their organization and activity when SB distinguishes and defines new tasks for MMX to be solved in a limited time and assigns the WT Chair(s), after consulting other teams/persons relevant to the tasks in the MMX project out of SWT. The assigned Chair(s) select the Vice-chair(s) and the team members.

### 2.1.6. Science Strategy Team (SST)

The goal of the MMX mission is to fulfil the mission objective by making use of all available data taken from remote sensing observation, rover observation, and return sample analysis. The mission objective consists of 7 medium-level objectives. Therefore, scientific activities concentrated on the scopes of the medium-level objectives are the most important tasks in the MMX mission. Science Strategy teams (SSTs) are organized for this purpose. Each SST corresponds to each MMX mission medium-level objective, and is responsible for making and conducting a plan to achieve the mission objectives and their publication including relevant studies on the ground (excluding the development of the instruments) (see Fig. 2.2 for actual SSTs). The Geodesy SST is only exceptional team because it is not directly connected to any medium-level mission objectives, but a number of scientific activities of the MMX mission are based on geodetic products, such as shape models of the Martian moons, so that the Geodesy SST is also set up as one of SSTs. One of important activities of SSTs is to clearly indicate the degree of attainment of the mission objectives not only for science communities but also for the general public, under control of SB. All information and obtained data that are necessary for each SST activity are available to each SST with effective interaction with ITs, WTs, and other SSTs. Each SST also covers a wide area of science themes and will continue over the life of the mission.

Each SST consists of one representative who is responsible for team operations (Leader), one or two representatives who act on behalf of the Leader in the absence of the Leader (Sub-Leader(s)), and all other members (Co-Is) who are selected by the Leader. Co-Is can be overlapped between several SSTs and other teams, but SST Leaders cannot be IT PIs in principle. All SST members join the SWT from the perspective of information management. A list of members belonging to each SST is updated and reported to SB by each SST Chair and is required to be approved by the SB Chair.

### 2.1.7. Other teams

The sample analysis team is defined to set policy on the sampling condition and curation (see also Section 3.3).

Other types of teams will be defined when they are necessary.

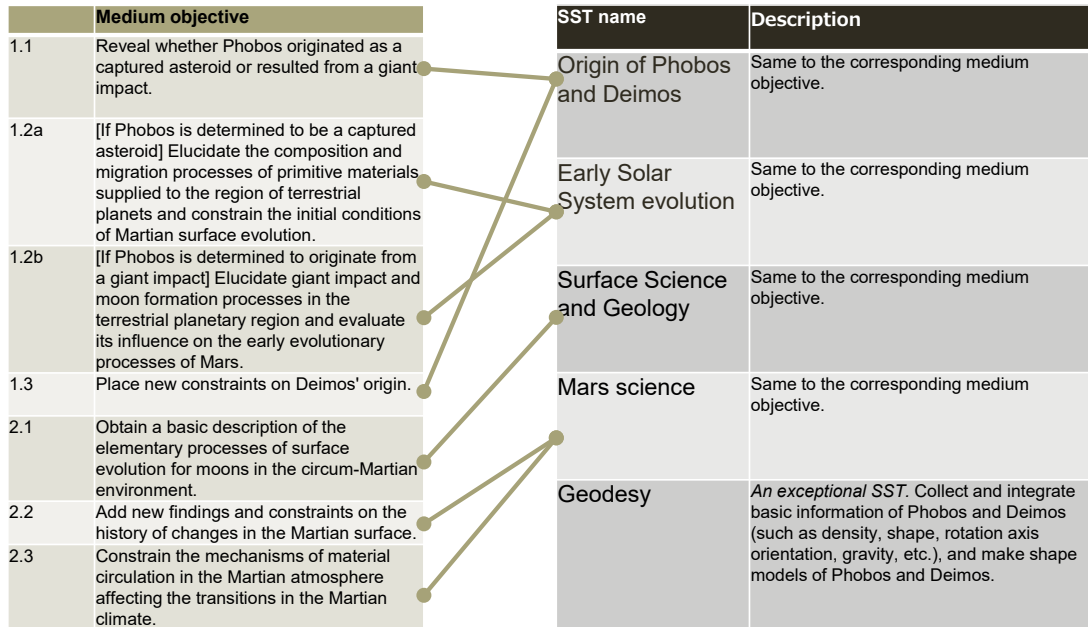


Fig. 2.2: MMX medium objectives and corresponding SSTs as of January 27, 2023.

## 2.2. Budget

Each participant agency fully supports its own contribution.

## 2.3. Membership

All SWT members must belong to any teams listed above. While selection of team members is basically done by the representative of each team, each participant agency can also select Participating Scientists and send them to appropriate teams in consultation with the representatives of the corresponding teams.

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### 3. SCIENCE POLICY

The science policy is discussed and approved by SB and it is defined in this document.

#### Science Policy for observation in space

##### 3.1.1 Data product category

Data obtained by mission instruments are categorized into the following three products: 1) Raw data products, 2) Calibrated data products, and 3) Derived data products.

##### 3.1.2 Right and responsibility of participant agencies

Participant agencies to which the scientific data from on-board instruments belong are determined based on MOU between participant agencies. The data-belonged agencies will maintain the right to use their own data for their own purposes including public outreach and commercial use, after agreement with JAXA and the relevant team representatives during the proprietary period (see below).

##### 3.1.3 Data sharing policy and proprietary period

Sharing calibrated and derived data products is effective for promoting MMX science, and these products are recommended to be immediately shared with other teams of MMX, with keeping right to priority use by the team producing each product. Other teams can use the data in agreement with the relevant team leader(s) and PI(s).

The proprietary period for the raw and calibrated data products within the MMX team should not exceed six (6) months after the end of each operational phase defined in the Operation Design Document. After the proprietary period, the raw and calibrated data products are open to the public in the manner explained below (Section 3.1.6). As an exception to this rule, however, this six (6)-month archival period does not include the landing operation periods because observational data on Phobos acquired in the pre-landing and landing operation phases are the most important and require the highest level of careful consideration in the MMX mission. If the proprietary period is longer than that as defined above, a proposal for proprietary data with significant reasons, such as a considerable extension of the landing site selection period or a failure in the landing operation, will be discussed and approved in SB. The proprietary period will be eventually adjusted to comply with the policies of the participating agencies. The proprietary period for the derived data products is not necessarily subject to the above six (6)-month rule. The derived data products are open to the public in the manner explained below (Section 3.1.6).

Anyone who uses MMX data and products of other teams for science purposes during the proprietary period (e.g., students working under someone from one of the teams) must register as a SWT member. Those who have the right to look at scientific data and products archived internally by the data-producing teams (WTs, ITs and SSTs) during the proprietary period are permitted by SB in consultation with the data-producing teams.

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### 3.1.4 Shape model and precise spacecraft ancillary information

Both “shape model” and “precise spacecraft ancillary information”, which are derived from analyses of multi-instrument data including the system data, are essentially important for making derived data products from any mission instruments. Therefore, the shape model and the precise spacecraft ancillary information should be provided to ITs and SSTs. The provider team members are appropriately acknowledged in visible manners from the outside the MMX project, such as including them as co-authors of the related papers and clearly stating them and/or their organizations in the credits of the related products.

### 3.1.5 Research paper authority during the proprietary period

Concerning research papers, including papers to be published before launch, each SST Leader has the right to select topics for publication based on the data from instruments in cooperation with ITs. Each SST Leader selects research papers in consultation with the research proposer to whom the first authorship of the paper should be given. If the topics are related to the data from only one instrument, the first authorship can be discussed within the corresponding IT related to the data used. In case of disagreement, the IT PI has the final responsibility concerning data publication using this specific IT and each IT keeps the authority of research papers related to its instrument data during the proprietary period. In case that the research paper is mainly on the development of a scientific instrument (including performance test, pre/in-flight calibration, etc.), each IT PI has the right to select topics for publication.

#### 3.1.5.1 Publication Plan Table and research proposal

Research papers to be submitted during the proprietary period are required to be listed in the Publication Plan Table (PPT) prior to submission. Each SST Leader and IT PI prepare its publication plan with titles and main authors in advance. PPT is kept being frequently and flexibly updated and agreed by SB. When conflict of interest(s) is found among different publication plans, the SB and the relevant SST Leaders and IT PIs coordinate the research. The nominated authors are responsible for submitting the papers during the proprietary period. PPT is circulated as often as updated among the SWT members.

#### 3.1.5.2 Authorship

The first author and the corresponding authors of papers to be submitted during the proprietary period are coordinated by each SST Leader and IT PI. The decision shall be based on contribution to data preparation (acquisition, calibration, processing, and product delivery), provision of information with their laboratory experiments, numerical simulation, or ground observations, and concept of interpretation of the data and products.

The co-authors of papers are determined by the first author, taking into account their contributions to the papers. In particular, the data-producing team members shall be sufficiently acknowledged for generating relevant data products of each paper, such as including them as



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co-authors. Each relevant SST Leader and IT PI can express their opinions suggesting to add co-authors and/or acknowledgments, considering the contribution to the data acquisition.

MMX-PM and MMX-PI can express their opinions to the first authors, such as suggesting to add co-authors and/or acknowledgments, considering the contribution to the project development, operation, and management.

All the science research paper manuscripts using the data and products should be circulated among SB to ensure the quality of the papers, giving SB members sufficient numbers of days to review before submission, with the expectation that the SB responds in a timely manner so as to not inadvertently delay submission of papers.

### 3.1.5.3 Presentations in conferences

If the presentations in conferences are related to the research papers in PPT, the rules are, in principle, based on those mentioned above (3.1.5.1 and 3.1.5.2). If the presentations are something like status reports, the contents and presenters of the presentations should follow consultation with MMX-PI and MMX-PM.

### 3.1.6 Scientific data archiving

After the proprietary period, MMX science data and products are open to the public from each agency providing relevant instruments. JAXA is responsible for perpetually archiving the data and products. If each agency providing relevant instruments archives their own data and products, JAXA's archiving system collects and reflects them in the archive. These data archive and open data policies are based on the Institute of Space and Astronautical Science (ISAS) Data Policy. The science data archive should be in the PDS version 4 or its compatible format and reviewed in an appropriate manner. Each data-producing team (IT, SST, or others), therefore, prepares each data source in the above format.

### 3.1.7 Utilization of engineering data

If some engineering data are necessary to process the data obtained by science instruments, the corresponding SST Leaders and IT PIs can request the engineering data from MMX project. The MMX project discusses with the members in charge of the engineering data and the data should be given in a timely manner to the corresponding SSTs and ITs under mutual agreement.

## 3.2 Science Policy for the returned sample

### 3.2.1 Sample management organization and curation policy

The MMX sample allocation committee is established (within or partly within the MMX project) under the control of ISAS curation committee that oversees the long-term sample curation work. A certain amount of time after the Earth return, the samples are handled at the ISAS curation facility for initial description without exposure to the air. The initial proprietary analysis by SSTs follows the initial description, where a certain amount of samples is analyzed to fulfill the MMX science goals for a limited time duration before the sample allocation to the

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community. The amount of the samples allocated to SSTs and the duration of proprietary initial analysis are determined by the MMX sample allocation committee.

### 3.2.2 Sample allocation policy

After the proprietary analysis by SSTs, the samples should be available to the community with a sample catalogue.

### 3.2.3 Data sharing policy and proprietary period

See 3.2.1 and 3.2.5. Proprietary period should be determined later.

### 3.2.4 Research paper authority during the proprietary period

The MMX project has a priority to write research papers during the proprietary period, collaborating with the ISAS curation team. A publication plan table and authorship will conform to the description in Section 3.1.

### 3.2.5 Scientific data archiving

All the data obtained during the initial analysis period and from samples allocated to the community will be archived in the ISAS sample database.

## 3.3 Data utilization by MMX project

If the data from science instruments are necessary for the execution of the project (such as proximity operation and landing site selections), the data must be provided to the teams involved in the execution in a timely manner. The data products for the execution of the project and the due dates are predetermined between data-producing teams (ITs and SSTs) and the execution-involved teams. The provided data are used only for the predetermined purpose.

## 4. DATA UTILIZATION FOR PUBLIC RELATIONS

### 4.1 Public relations

If data from science instruments are requested for public relation (PR) purposes by the project outreach team, or the PR sections of the participant agencies, the requested data should be provided as far as the disclosure of the data does not significantly reduce the value of scientific results. This decision should be made by MMX-PI, MMX-PM, and relevant SST Leaders and IT PIs. First announcement of data of a specific instrument shall be under the authority of the related IT PI. The data must be used with appropriate credit and acknowledgement as below.

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## 4.2 Credit and acknowledgement

Any user of MMX data must state the credits that the data belong to the agency(ies) providing relevant instruments and spacecraft operation, and the organizations which members making data acquisition (IT members) and processing (IT and/or SST members). Chap. 5 will detail how to state the credit and acknowledgement for each instrument after approval of SB.

## 5. CONCRETE EXPRESSIONS OF CREDITS AND ACKNOWLEDGEMENTS

## 6. ACRONYMS

Acronym	Name
<b>C-SMP</b>	Coring SaMPLer
<b>CMDM</b>	Circum-Martian Dust Monitor
<b>CNES</b>	Centre National d'Etudes Spatiales
<b>Co-I</b>	Cooperative Investigator
<b>DLR</b>	Deutsches Zentrum für Luft- und Raumfahrt (German Aerospace Center)
<b>ESSE SST</b>	Early Solar System Evolution SST
<b>G SST</b>	Geodesy SST
<b>IREM</b>	Interplanetary Radiation Environment Monitor
<b>ISAS</b>	Institute of Space and Astronautical Science
<b>IT</b>	Instrument Team
<b>JAXA</b>	Japan Aerospace Exploration Agency
<b>LIDAR</b>	Light Detection And Ranging
<b>MEGANE</b>	Mars-moon Exploration with GAMMA rays and Neutrons
<b>MIRS</b>	MMX near-InfraRed Spectrometer

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<b>MMX-PI</b>	MMX Principal Investigator
<b>MMX-PM</b>	MMX Project Manager
<b>MMX-SB</b>	MMX Science Board
<b>MMX</b>	Martian Moons eXploration
<b>MOU</b>	Memorandum of Understanding
<b>MS SST</b>	Mars Science SST
<b>MSA</b>	Mass Spectrum Analyzer
<b>OPD SST</b>	Origin of Phobos and Deimos SST
<b>OROCHI</b>	Optical Radiometer composed of CHromatic Imagers
<b>P-SMP</b>	Pneumatic SaMPLer
<b>PDS</b>	Planetary Data System
<b>PI</b>	Principal Investigator
<b>POC</b>	Point of Contact
<b>PPT</b>	Publication Plan Table
<b>PR</b>	Public Relation
<b>SB</b>	Science Board
<b>SHV</b>	Super Hi-Vision camera
<b>SRC</b>	Sample Return Capsule
<b>SSG SST</b>	Surface Science and Geology SST
<b>SST</b>	Science Strategy Team
<b>SWT</b>	Science Working Team
<b>Sci-PI</b>	Science Principal Investigator

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<b>SciMP</b>	Science Management Plan
<b>TENGOO</b>	TElescopic Nadir imager for GeOmOrphology
<b>WT</b>	Working Team