Euro-Cares Work Package 5: Analogue Samples

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February 8, 2016

Paris, France

Analogue samples

Analogue samples are terrestrial samples presenting characteristics more or less representative of extra-terrestrial samples.

Analogue samples are used to:

- Test and calibrate instrumentation

- Help *in situ* interpretation

- **Make science**
- **Also analogue sites**

The International Space Analogue Rockstore

Bost et al., 2013, PSS 82-83, 113-127

A well characterized collection of analogue rocks and minerals dedicated to testing the payload for *in situ* missions.

An online database with information on:
-the available samples,
-the sample lending system,
-data on the samples obtained using laboratory and space instruments.

www.isar.cnrs-orleans.fr

Soon, the collection will be transferred to the Natural History Museum of London under the responsibility of ESA.

Login frances Password ●●●●●●● OK

Not yet registered ?

ISAR
International Space Analogue Rockstore

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Workshop Analogue

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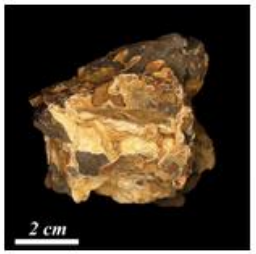
The International Space Analogue Rockstore (ISAR) is a collection of well-characterised rocks used for testing and calibrating instruments to be flown on space missions. The samples and their general characteristics are included in a database available for consultation via the link samples.



People directly involved in space science research can register to have access to a free sample lending system and the full data associated with each sample (.pdf and .xls files) after registration.

The *ISAR* in located in the Centre de Biophysique Moléculaire (CBM) of the *CNRS* in Orléans, in the framework of the Observatoire des Sciences de l'Univers en Région Centre (OSUC). It is supported by *ESA* and *CNES*.

ESA-TN2:CAFÉ: The Catalogue of Planetary Analogues 2013

Louisa Preston, Monica Grady, Simeon Barber, OU, UK

i.e. Analogue sites

Planetary Body	Feature Class	Feature
Moon	Impact	Crater
		Ejecta
		Impact Melt
		Regolith
	Volcanic	Structure
		Lava Flows
		Pyroclastic Deposits
		Collapse Pits
		Wrinkle Ridges
		Rilles/Channel Systems
	Environmental	Granular Flows
	Composition	Anorthosite
		Basalt
		Impact Breccia
		Water/Ice

Mars	Impact Features	Crater
		Ejecta
		Melt Sheets
		Hydrothermal Deposits
		Gullies
		Crater Lakes
	Volcanic	Structure
		Lava Flows
		Lava Tubes
		Pyroclastic Deposits
		Collapse Pits
		Wrinkle Ridges
		Hydrothermal Deposits
		Mud Volcanoes
	Fluvial	Lakes
		Channels
		Deltas/Fans
		Gullies
	Wind	Soils/regolith
		Dunes
		Yardangs
		Transverse Aeolian Ridges
		Dust Devils
	Ice	Polygon Terrain
		Icy Flows/glacial features
	Composition	Basalt

Planning for Mars Returned Sample Science: Final report of the MSR End-to-End International Science Analysis Group (E2E-iSAG)

A report requested by the Mars Exploration Program Analysis Group (MEPAG)

Nov. 22, 2011

Recommended bibliographic citation:

MEPAG E2E-iSAG (2011) Planning for Mars Returned Sample Science: Final report of the MSR End-to-End International Science Analysis Group (E2E-iSAG), 101 pp., posted December, 2011, by the Mars Exploration Program Analysis Group (MEPAG) at http://mepag.jpl.nasa.gov/reports/.

E2E priority listinghighlighting different rock types//geological environments in order of importance to satisfy the scientific objectives of MSR missions

1A - Subaqueous sediments or hydrothermal sediments

1B - Hydrothermally and low-temperature fluid-altered rocks

2 - Unaltered igneous rocks

3 – Regolith

4 - Atmosphere

EuroCares report:
Table 1. Analogues and calibration samples sorted by nature, type and relevance.

Nature	Type	Relevance	Example
Natural analogues	Site	Geology	Olivine rich sandy plains, Iceland (Mangold et al., 2011)
		Geomorphology	Mobility training in Utah desert, USA (Foing et al., 2011)
		Processes	Acidic alteration in Cyprus (Bost et al., 2013a)
		Mineralogy	Jarosite in Rio Tinto, Spain (Edwards et al., 2007)
		Astrobiology	Arsenic bacteria, Mono Lake, USA (Wolfe-Simon et al., 2010)
		Test and calibration	AMASE in Svalbard (Amundsen et al., 2010)
	Geological sample	Geology	Impactite rocks
		Mineralogy	Anorthosite (Moon analogue)
		Cosmochemistry	Meteorites
		Astrobiology	Rocks containing fossils of anaerobic microorganisms (Westall et al., 2011)
		Test and calibration	Diamond
	Biological sample	Astrobiology	Extremophiles (Rothschilde and Mancinelli, 2002)
		Test and calibration	Various bacteria (Parro et al., 2008)
		Planetary protection	Various bacteria (http://planetaryprotection.nasa.gov/methods)
	Chemical sample	Cosmochemistry	Organic compounds in meteorites

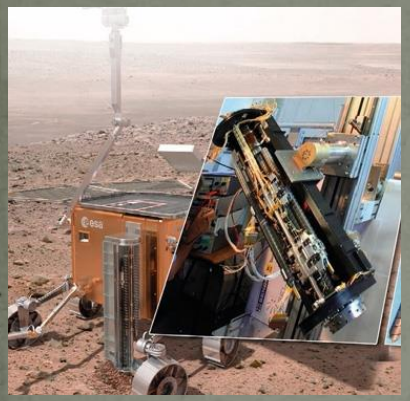
EuroCares report:
Table 1. Analogues and calibration samples sorted by nature, type and relevance.

Nature	Type	Relevance	Example
Simulated analogues	Site	Test and calibration	Lander touchdown and rover mobility (Richter et al., 2007)
	Simulation chamber	Cosmochemistry	Cometary analogue simulation chamber (Danger et al., 2013)
		Test and calibration	Mars 500 experiment in ESA
	Biological sample	Astrobiology	Artificially fossilized microorganisms (Orange et al., 2009)
	Chemical sample	Cosmochemistry	Analogue of tholins, Titan aerosols (Carrasco et al., 2013)
		Astrobiology	Pigments for Raman spectroscopy (Vitek et al., 2009)
		Test and calibration	Pure molecules
		Planetary protection	Biomolecules
	Material samples	Test and calibration	Colour target for cameras
		Handling and transportation	Gas to test airtightness of a sample return container
		Planetary protection	Resins used for space probes

Analogue samples

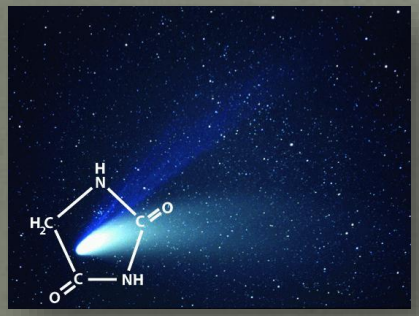
Analogue samples for Eurocares are terrestrial samples presenting compositional and physico-technical characteristics that are relevant for sample handling, processing and staff training in a curation facility

Different types of analogue samples



- Materials used in in instruments used for taking samples and for storing them during a mission;
- Materials potentially in contact with the samples in the curation facility
- Still to be determined in detail

For geology: rocks and minerals+ (including biosignature-containing rocks, ices and ice-organic mixtures.

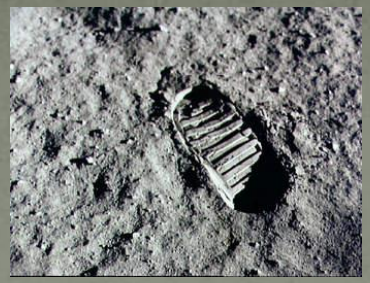


For chemistry: molecules (PP)

For (astro-)biology: biological contaminants (PP).

Variety of samples

Dust, regolith



Sedimentary rocks

Volcanic rocks

Slag 09IT01

Komatiite 10ZA09

Komatiite 11CA02

Chert 00AU04

Chert 00AU05

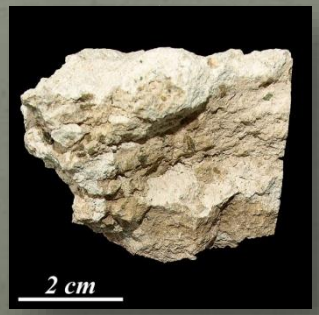
Minerals

Aragonite 12FR02

Apatite 12UN05

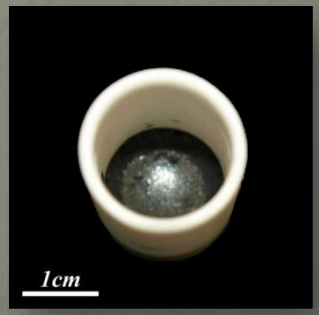
Epidote 12PK01

Products of altered rocks



Carbonate 11CY04

Artificial samples



Basalt 11AR02

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10 rocks, 14 minerals chosen because of their pertinance for :

- Composition/textural similarities with planetary materials;
- Relevance for sample handling, processing, training
- Contaminants
- N.B. Generic dust/regolith to be made up of mixtures of powdered basalt and minerals as needed (with addition of H_2O ice for SPA Basin on the Moon)
- Use of powdered meteorite to represent asteroidal material (N.B. rare therefore to be used only in specific cases)

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Rocks

- Primitive basalt
- Anorthosite
- Dolerite
- Tuff
- Suevite impact breccia
- Mudstone
- Sulphate veins (gypsum)
- Sandstone
- Silica, amorphous (opal)

Minerals

- Jarosite
- Goethite
- Hematite
- Ca-carbonate
- Fe carbonate
- Mg carbonate
- Gypsum
- Anhydrite
- Perchlorates
- Sulphides
- Mg smectites
- Illite
- Chlorite
- Ices

Contaminants

Rational for choices

Analogue type	Location	Mass available	How obtainable	Texture and Phys props	Indicative Density	Density Refs
Primitive basalt	Aeolian islands	lots	easy	Glassy, fine-grained, vesicular/non vesicular, fractured/unfractured	2600-2800 kg/km3	ESA MREP doc

Indicative Strength(?)	Strength Refs	Relevance	Descriptive Hardness (Ref)
		Planetary basalts (shergottites)	HARD

ANALOGUES WORKSHOP 4-5 FEBRUARY 2016

Rocks

Primitive basalt
Anorthosite
Dolerite
Tuff
Suevite impact breccia
Mudstone
Sulphate veins (gypsum)
Sandstone
Silica, amorphous (opal)

Minerals

Silicates (major rock-forming mins)
Jarosite
Hematite
Ca-carbonate
Fe carbonate
Mg carbonate
Gypsum
Anhydrite
Perchlorates
Sulphides
Mg smectites
Illite
Chlorite
Ices

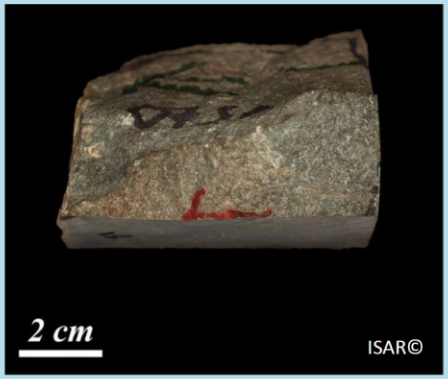
Contaminants

Basalt from South Africa

Reference: **EuroCares-B1**

Target Bodies:
- Mars,
- Moon,
- Asteroids

Target Geological Context:
- Igneous rock,
- Volcanic rocks,
- Surface



Curation Facility Usage	• Testing/verifying curation equipment • Testing/verifying protocols • Testing/verifying processes • Witness samples ○ Standards for TBD instruments ○ Component of artificial analogue recipe
Type of Analogue	• Rock ○ Mineral ○ Synthetic ○ Amorphous material
General geological Description	**Petrography:** Altered silicified basalt
	Mineralogy (for rock sample) : modal min i.e. 50% olivine, 40 % pyroxene, 10% plag, actinolite, oligoclase, quartz
	Mineral type (for mineral sample): N.A.
	Chemistry: Any bulk chemical analyses if available otherwise any information that is relevant e.g. Fe-rich or Ti-rich etc
Physical Properties	**Density:** TBD
	Hardness/Compressive strength: TBD
	Porosity measurement: TBD
	Any other relevant physical properties data: TBD
Location	Africa/South Africa/Barberton/Komatii river, GPS: -26.035556, 30.998611
Links to other WPs	
Further comments, information	E.g. useful reference(s), any information you consider important

Perspectives

- Complete list (also with biological and chemical samples)
- Choose best analogues of each catagory/type of rock at next meeting (2 days between 18-20 May)
- Need specialists
- Iterate list with WP 4, 2
- Final report