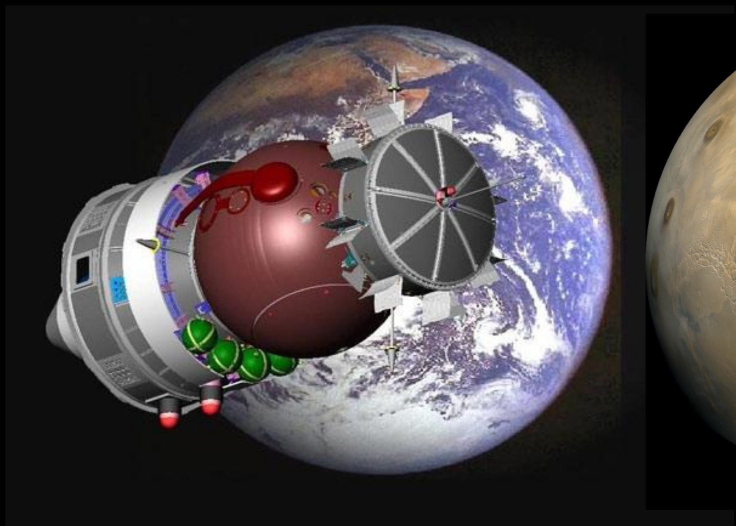
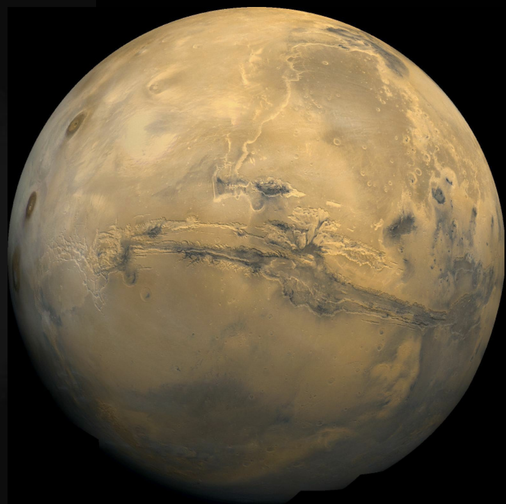
10 Tage im All:

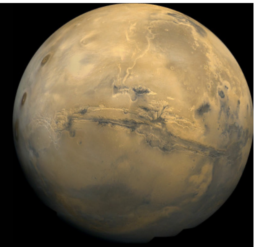
Alpine Flechten und die Wahrscheinlichkeit der Marsumwelt zu widerstehen


DLR-Status-Seminar Strahlen-/Astrobiologie 13.06.2008

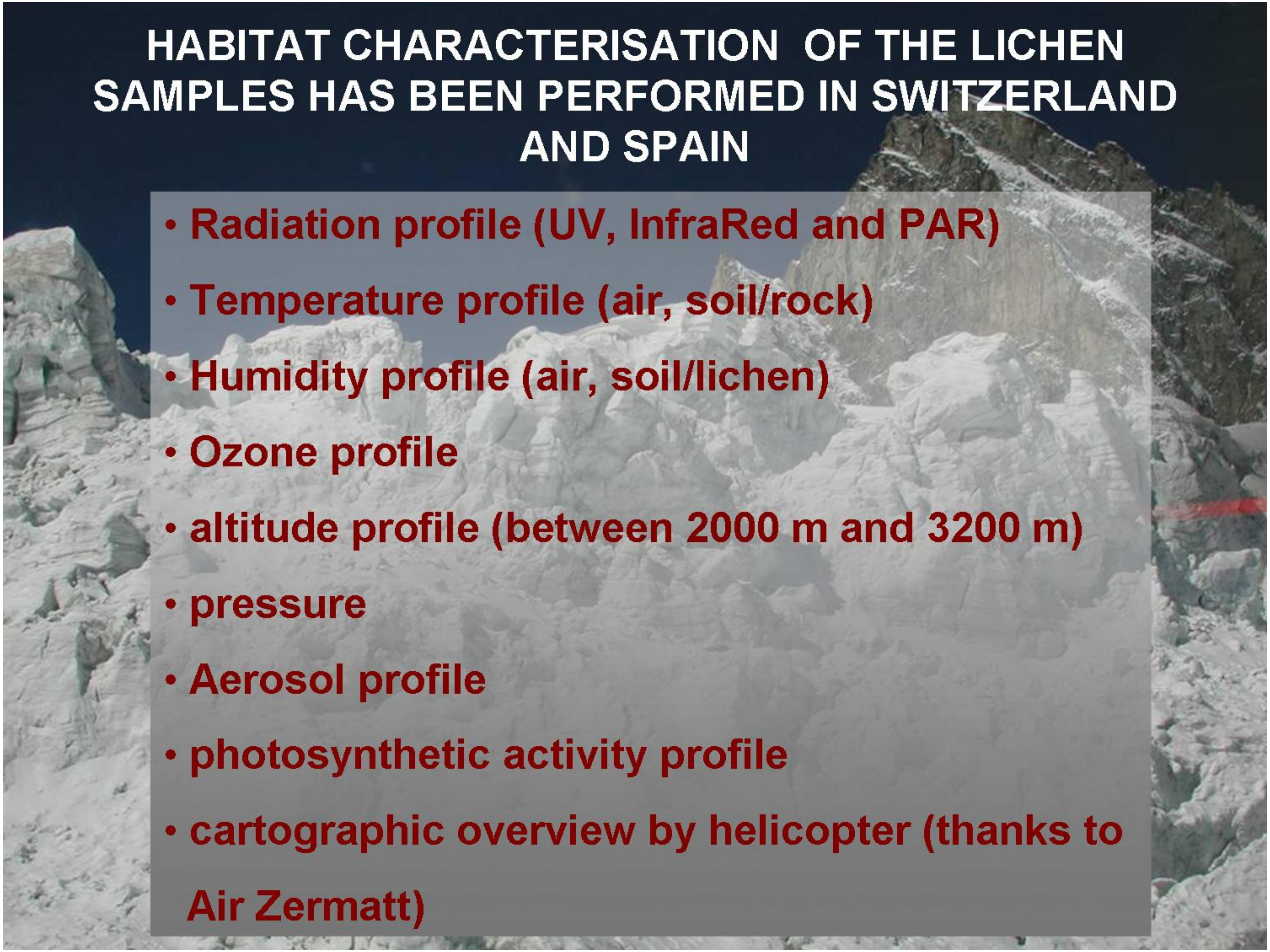
Jean-Pierre de Vera, S. Ott

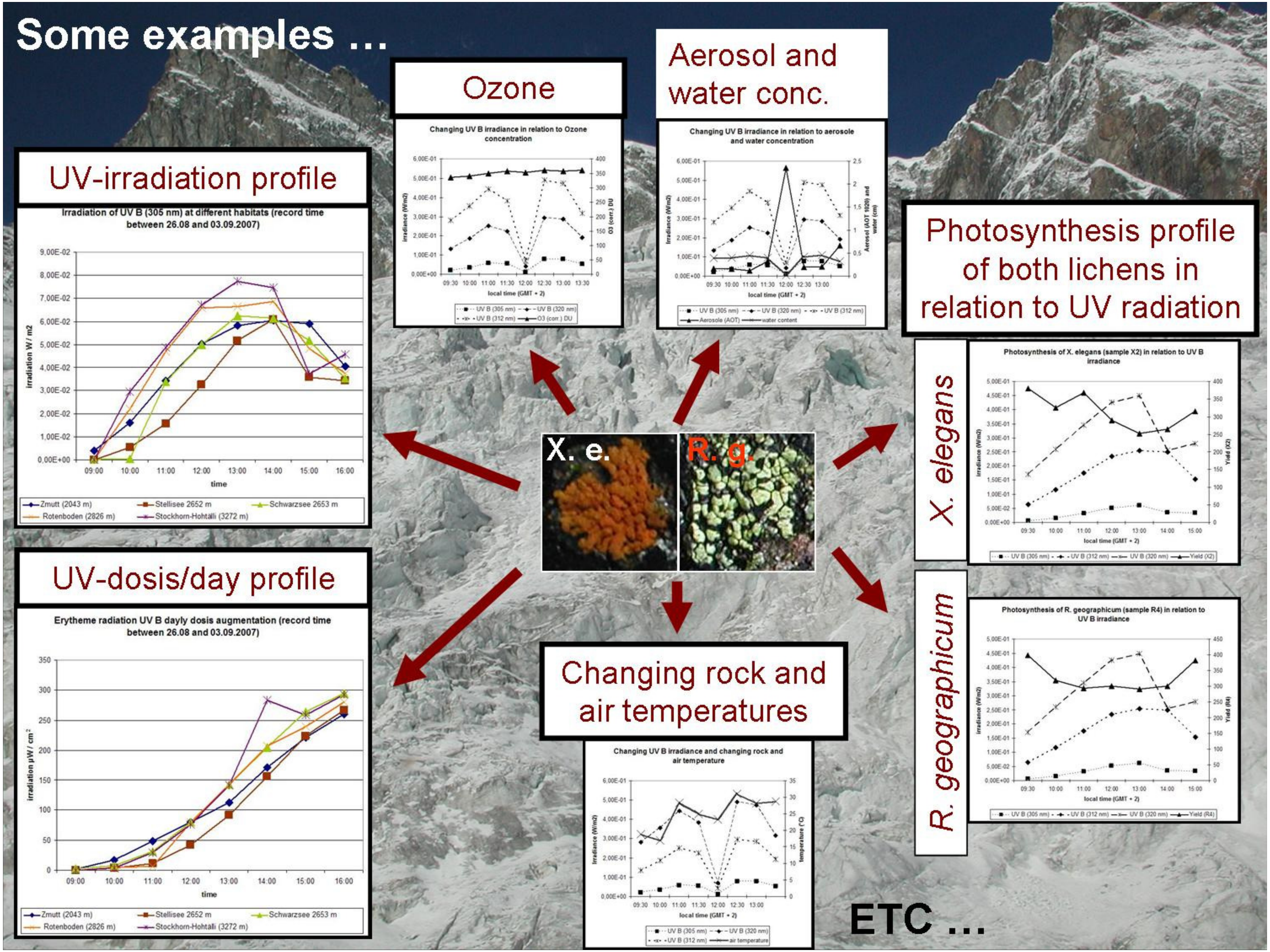
Earth/Mars-Charakteristics



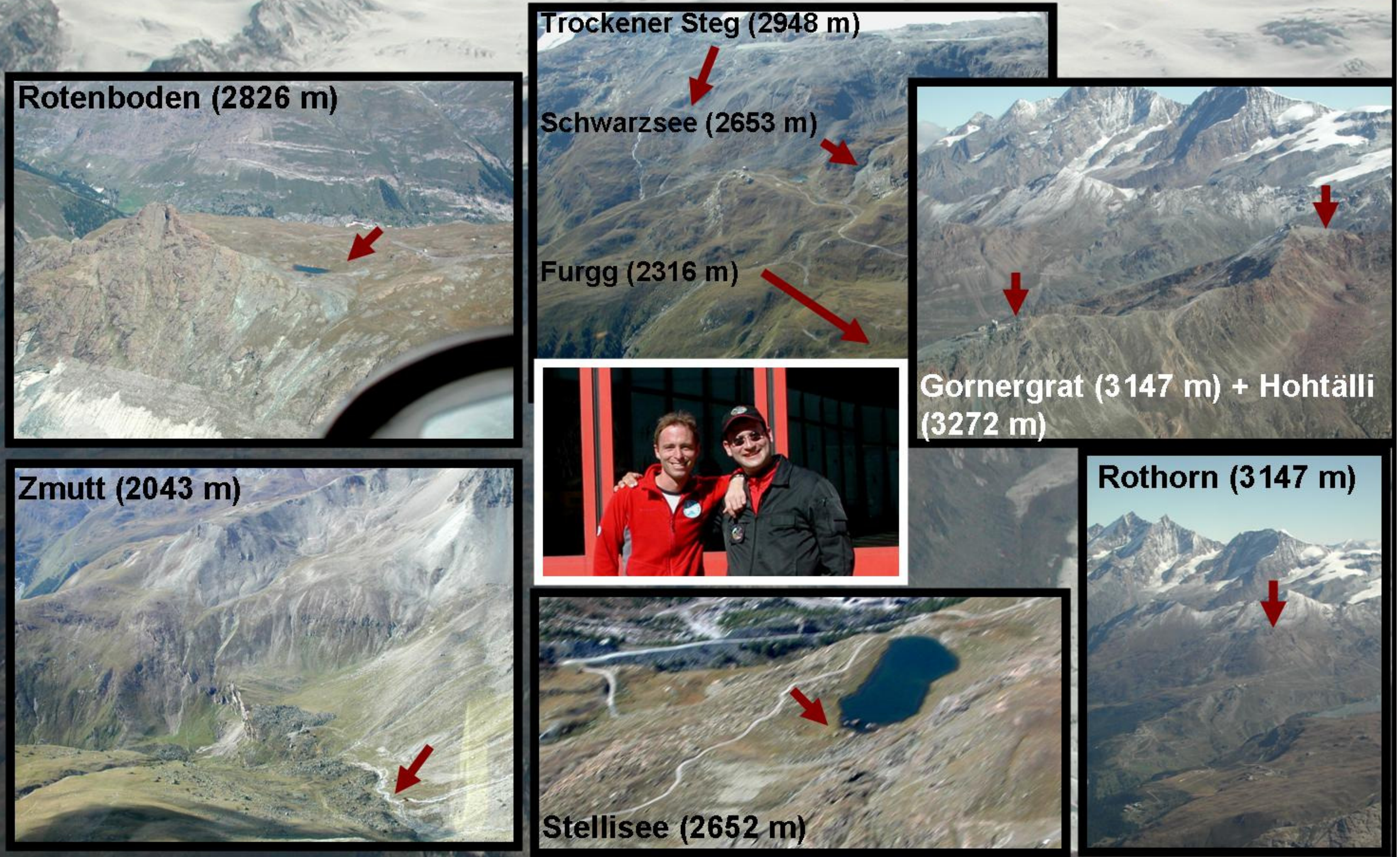
PARAMETER	ERDE	MARS
Mittlerer Sonnenabstand:	149,6 Mio. km	227,9 Mio. km
Mittlere Umlaufzeit um die Sonne:	365,25 Tage	686,98 Tage
Rotationsperiode:	Ca. 23 h 56 min	Ca. 24 h 37 min
Äquatorialdurchmesser:	12.756 km	6794 km
Mittlere Oberflächentemperatur:	+22^0 Grad Celsius	-55° Grad Celsius
Mittlere Sonneneinstrahlung:	1,37 kW/m^2	0,6 kW/m2
Mittlerer Atmosphärendruck an der Oberfläche:	1013 mbar	6-10 mbar
Zusammensetzung der Atmosphäre:	78% Stickstoff 21% Sauerstoff 0,93% Argon 0,035% Kohlendioxid	0,3% Sauerstoff 2-3% Stickstoff 1-2% Argon 95% Kohlendioxid
Monde	Luna	Phobos und Deimos

Important for simulation


HABITAT CHARACTERISATION OF THE LICHEN SAMPLES HAS BEEN PERFORMED IN SWITZERLAND AND SPAIN
• Radiation profile (UV, InfraRed and PAR)
• Temperature profile (air, soil/rock)
• Humidity profile (air, soil/lichen)
• Ozone profile
• altitude profile (between 2000 m and 3200 m)
• pressure
• Aerosol profile
• photosynthetic activity profile
• cartographic overview by helicopter (thanks to Air Zermatt)

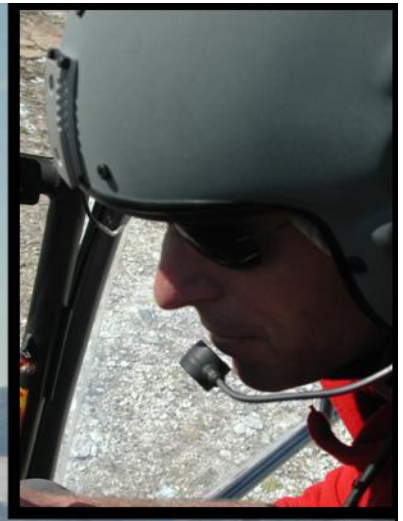

Some examples …
Ozone
Changing UV B irradiance in relation to Ozone concentration
Aerosol and water conc.
Changing UV B irradiance in relation to aerosole and water concentration
UV-irradiation profile
Irradiation of UV B (305 nm) at different habitats (record time between 26.08 and 03.09.2007)
Zmutt (2043 m)
Stellisee 2652 m
Schwarzsee 2653 m
Rotenboden (2826 m)
Stockhorn-Hohtälli (3272 m)
Photosynthesis profile of both lichens in relation to UV radiation
X. elegans
Photosynthesis of X. elegans (sample X2) in relation to UV B irradiance
X. e.
R. g.
UV-dosis/day profile
Erytheme radiation UV B dayly dosis augmentation (record time between 26.08 and 03.09.2007)
Changing rock and air temperatures
Changing UV B irradiance and changing rock and air temperature
R. geographicum
Photosynthesis of R. geographicum (sample R4) in relation to UV B irradiance
ETC …

Habitat area characterization of *Rhizocarpon geographicum* and *Xanthoria elegans* by an overview out of the helicopter

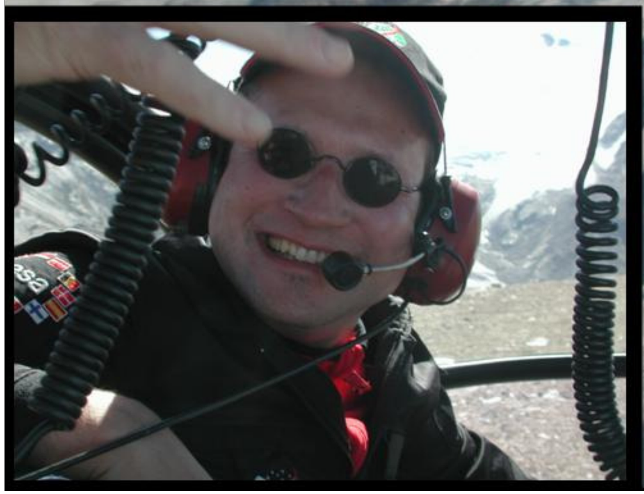


Habitat area characterization by an overview out of the helicopter

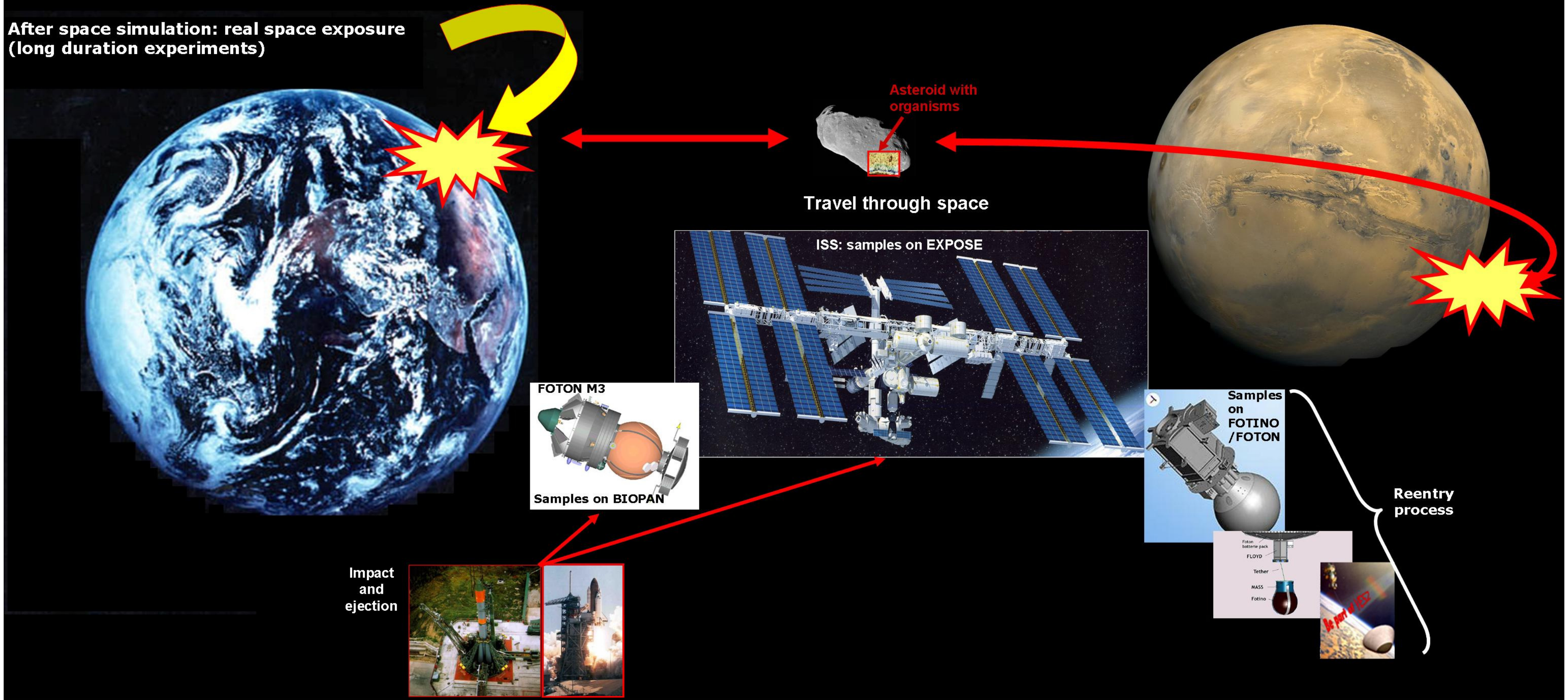
Conclusion



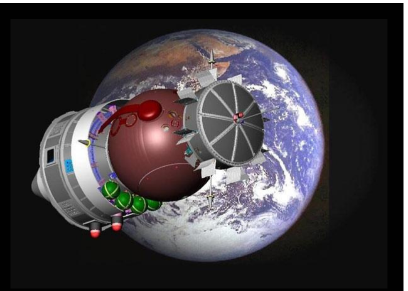
- The habitats are mostly on exposed high altitudes with high UV radiation income
- The soil humidity is 2/3 of the year between 20 and 47 %
- Water availability by ice, snow-melting, fog and rain (but half of the year under snow)
- Some valleys and mountain peaks are more dominated by *Rhizocarpon geographicum* and others by *Xanthoria elegans*
- Soil composition varies between calciferous rocks, serpentinite and gneiss



Lithopanspermia



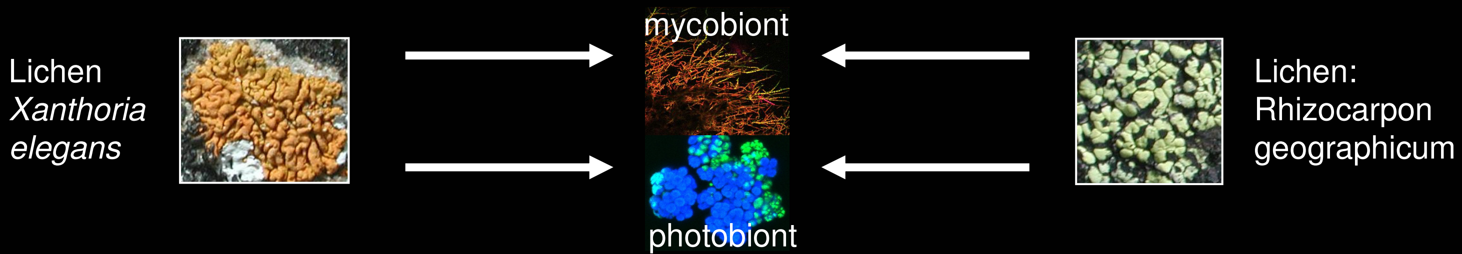
BIOPAN 6 / Lithopanspermia



Science objectives

Viability, resistance and adaptation mechanisms of lichens and their symbionts (mycobiont / photobiont) / maintenance or conservation of photosynthetically active cells in space.

The role of symbiosis and the likelihood of Lithopanspermia of an eukaryotic system



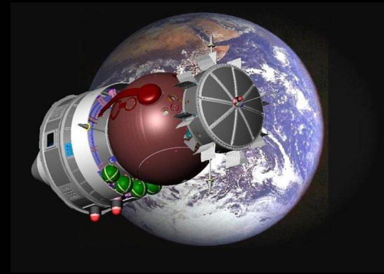
Expected science results

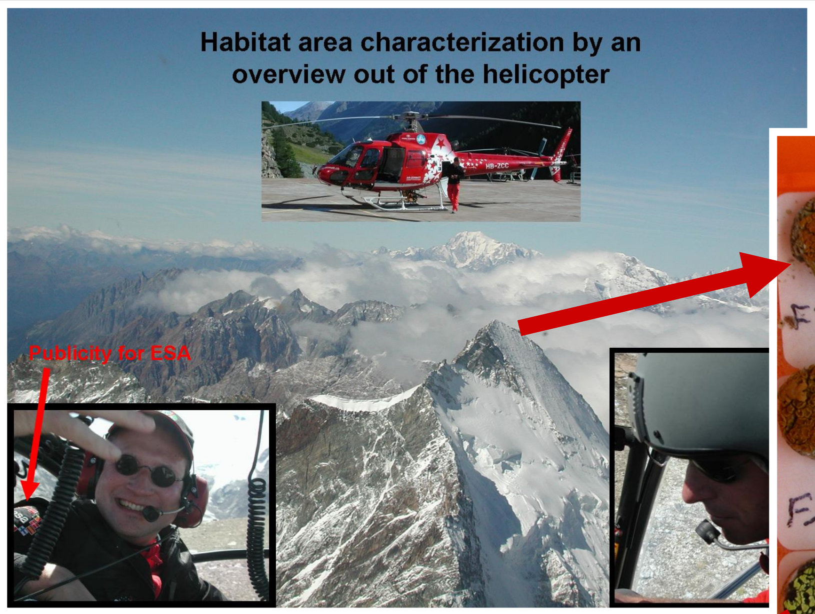
- Preservation of life processes (e.g. growth and germination capacity) due to resistance and adaptation mechanisms
- determination of the most resistant symbiont in the lichen community
- detection of the capacity of photosynthesis preservation after space exposure (Panspermia)
- the influence of space parameters on the DNA on an eukaryotic system / micro-ecology
- the influence of space environment on physiological processes

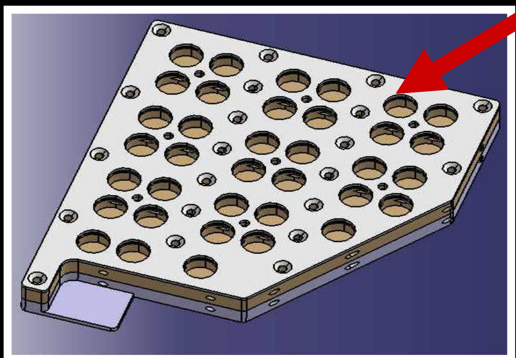
Space-relevance

-– the likelihood of Lithopanspermia (natural transfer of eukaryotes, evolution aspects)

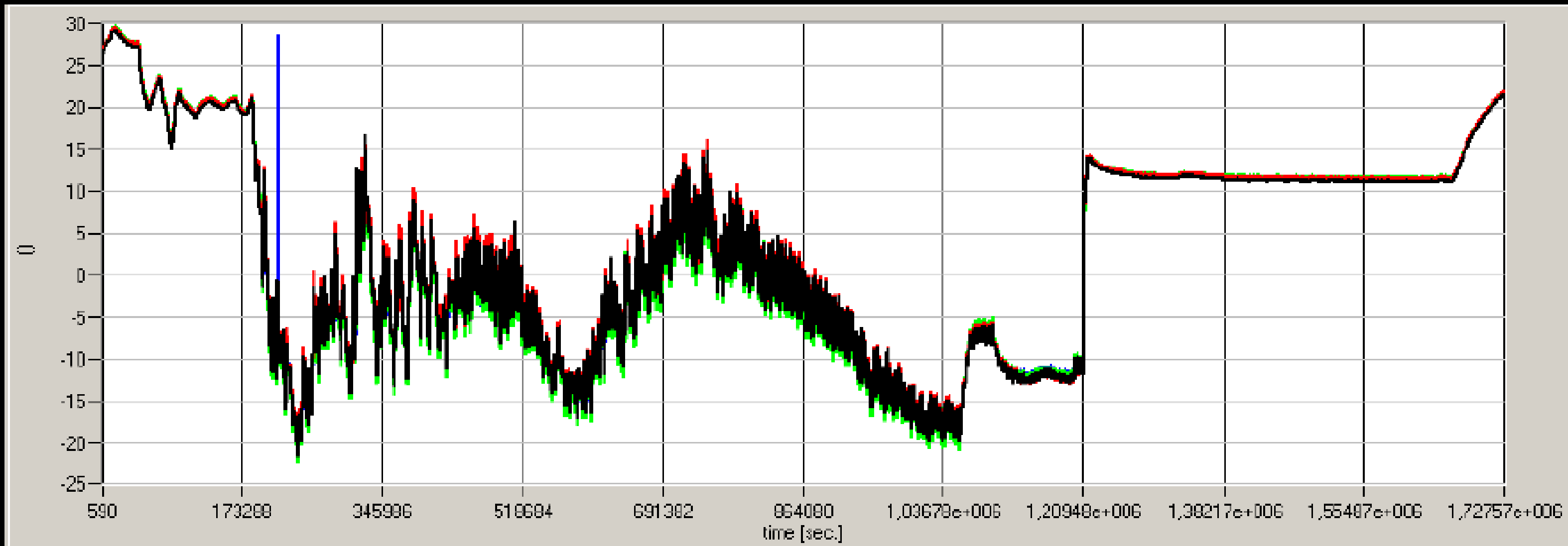
Samples: fruiting bodies and thalli of *Rhizocarpon geographicum and Xanthoria elegans*



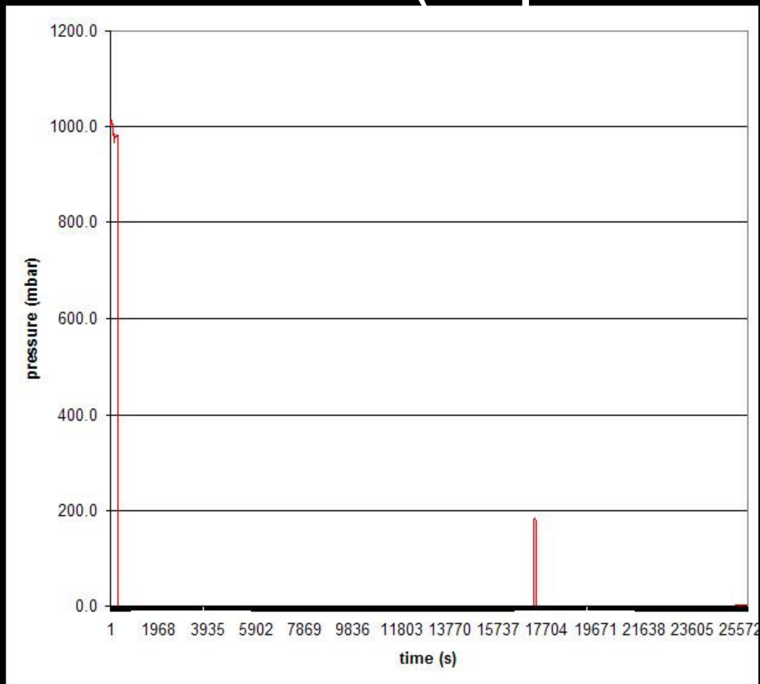




Temperature on BIOPAN



Pressure on BIOPAN (Endpressure ~ 0.4 mbar)



Dose on BIOPAN (SCh = solar constant hour)

mission	Biopan lid open	Biopan sensors		R3D-B sensors	
		total dose	daily dose	total dose	daily dose
Biopan-6	240 h = 10.0 d	24 SCh	2.4 SCh	36.3 SCh	3.63 SCh
		11.8 kJ cm^{-2}	1.18 kJ cm^{-2}	17.9 kJ cm^{-2}	1.79 kJ cm^{-2}

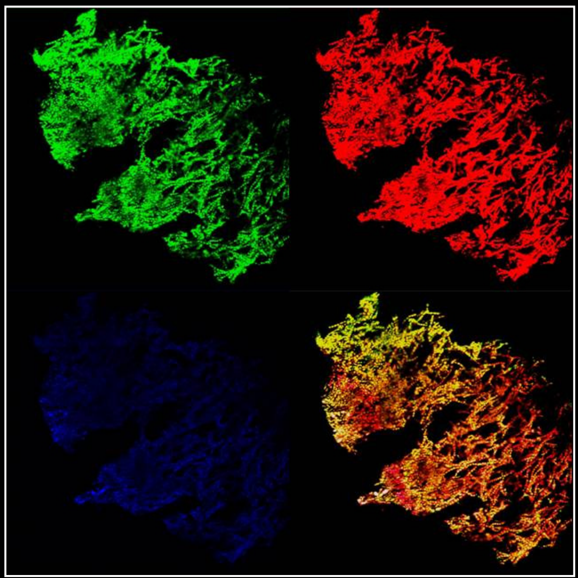
MEHODS:

vitality check

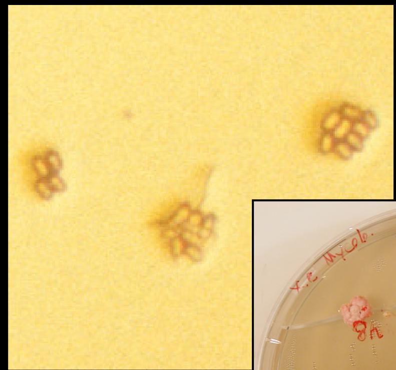
Physiology / LIVE/DEAD

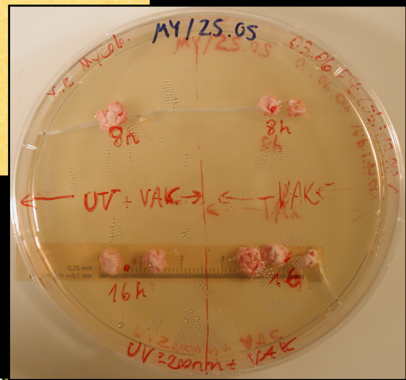
FUN I + SYTOX-green

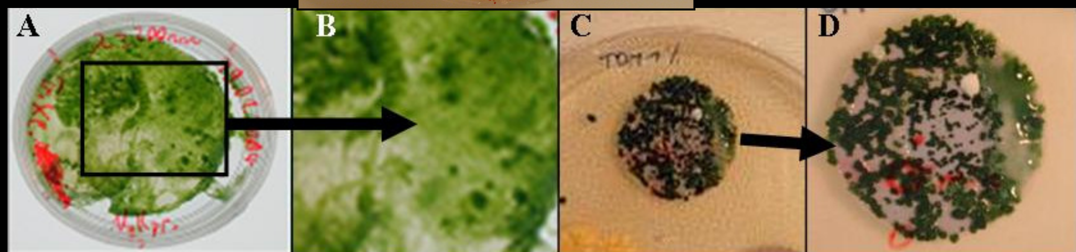
Image-Tool / Statistics



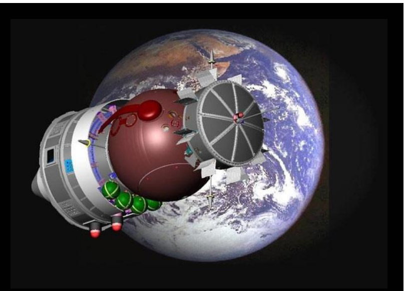
Growth capacity of symbionts / germination capacity of ascospores



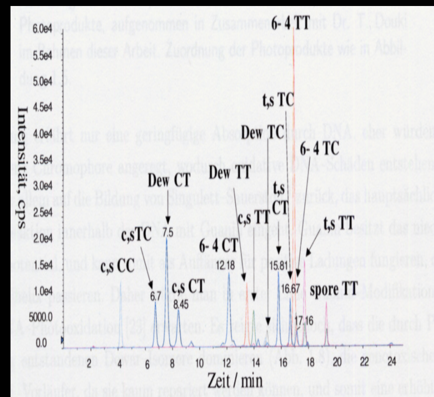




mutagenity

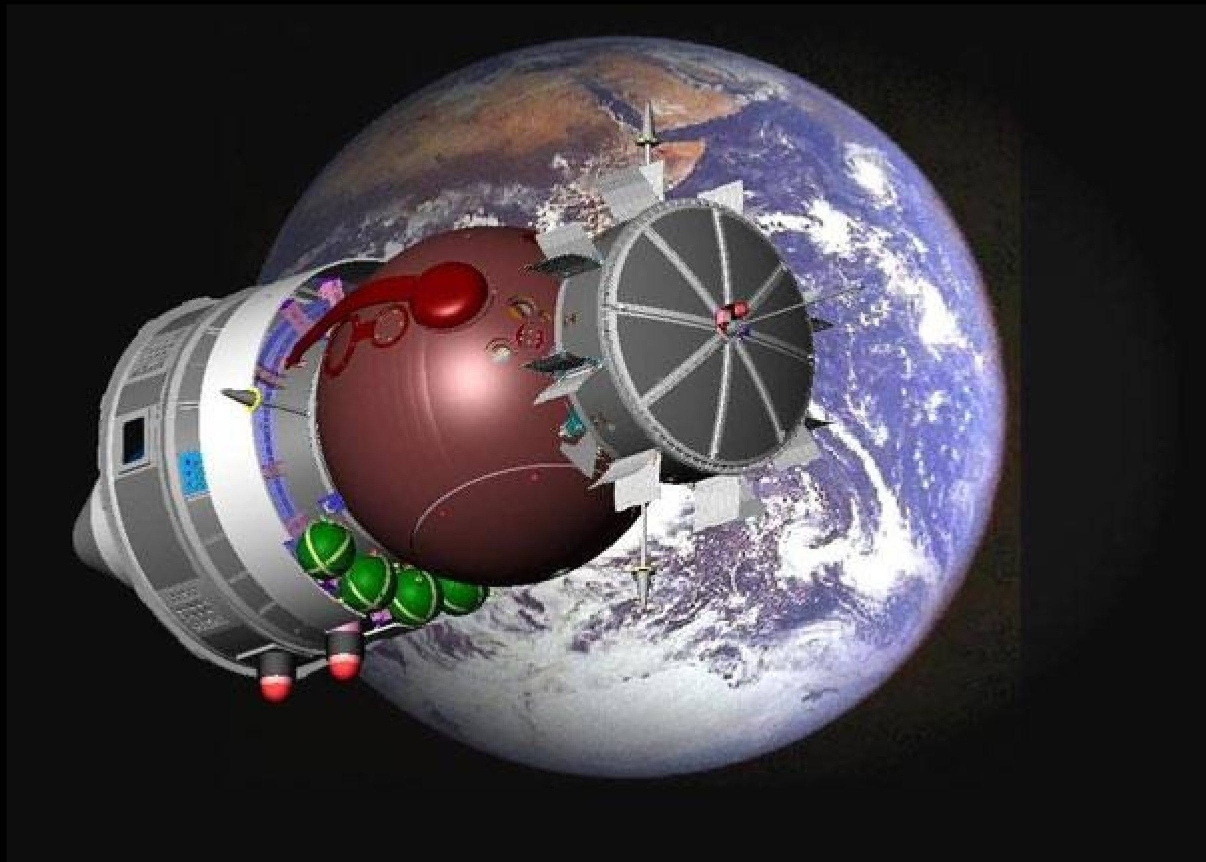


T-T-photoproducts in the DNA after UV radiation



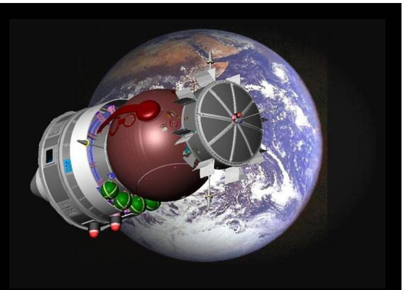
Results

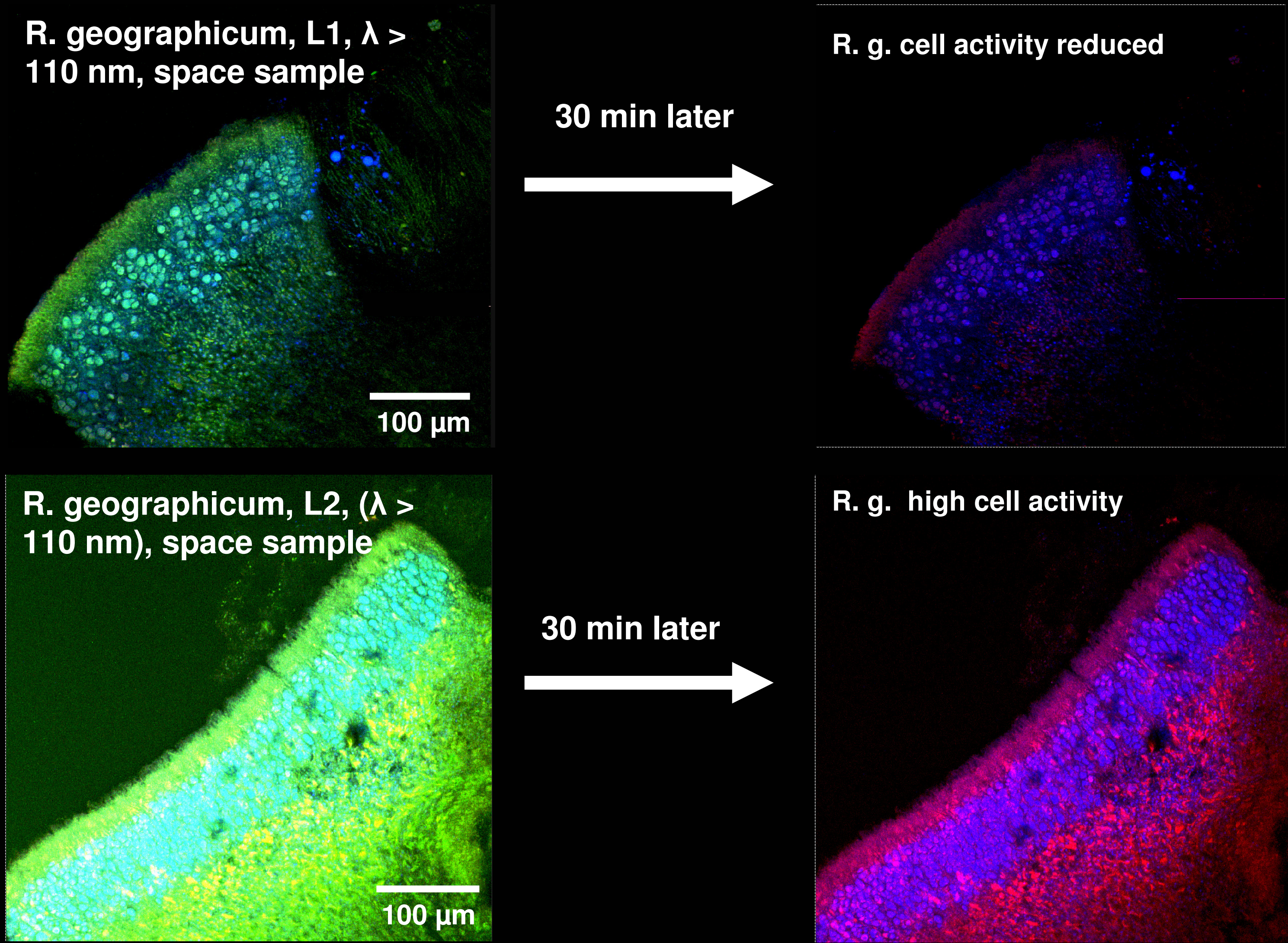
LIVE / DEAD analysis by CLSM

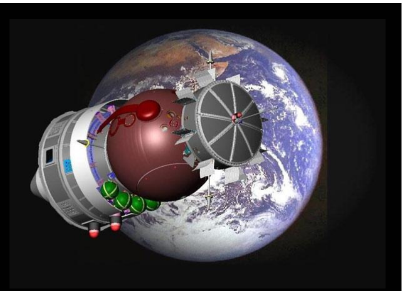


RESULTS:

CLSM Analysis by the use of LIVE/DEAD dye



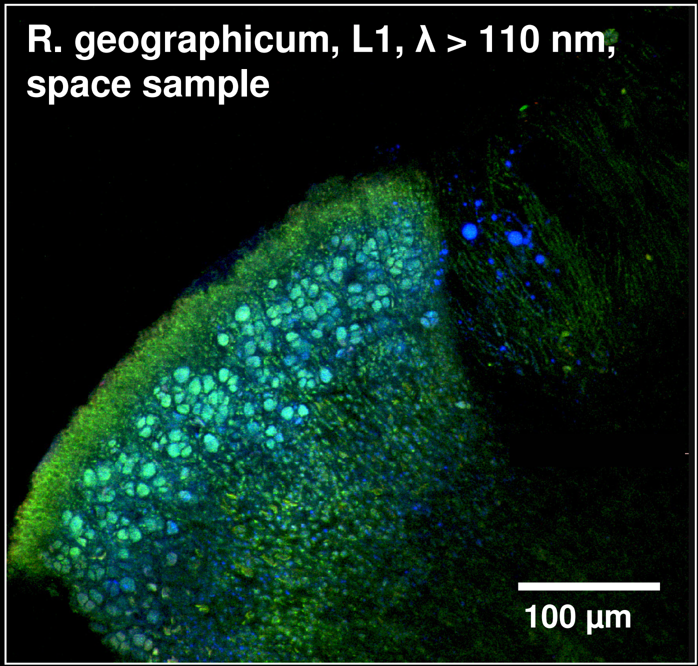


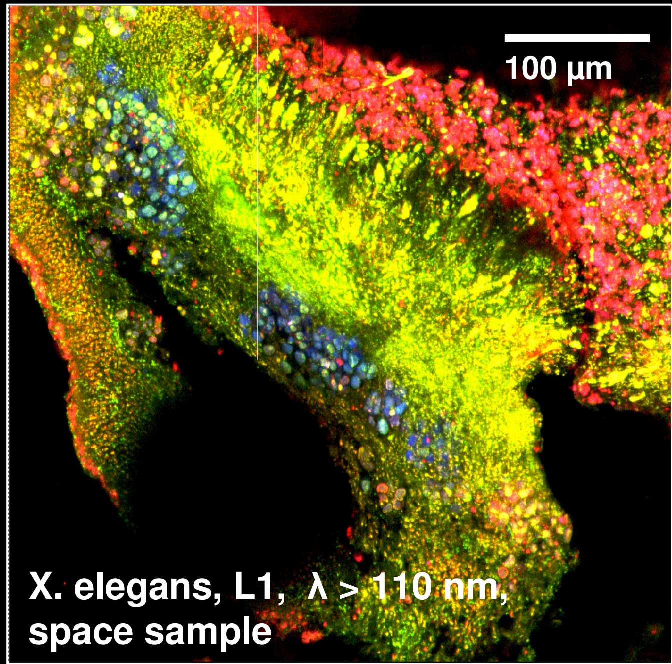


RESULTS:

CLSM Analysis by the use of LIVE/DEAD dye

Comparison between R. geographicum and X. elegans





Photobiont cells of R.g. are more vital than those of X.e.

Mycobiont cells of X.e. are more vital than those of R.g.

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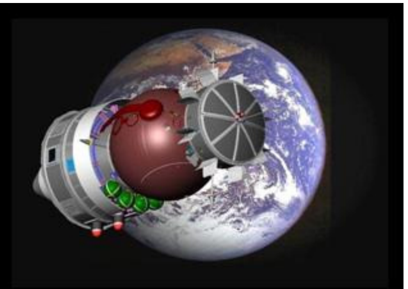
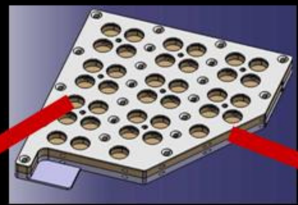
RESULTS: samples from space

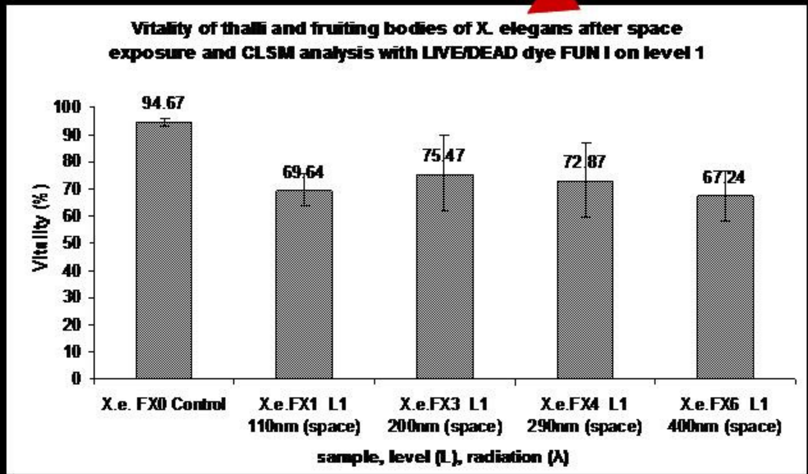
Quantified results after Analysis of CLSM images by the use of Image J

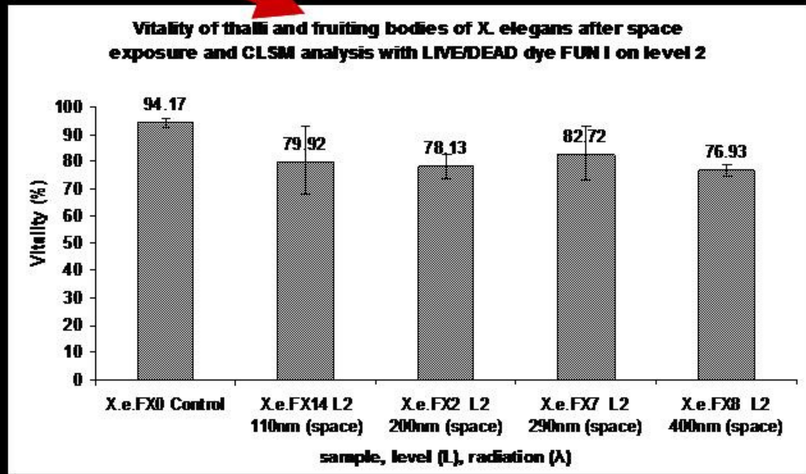


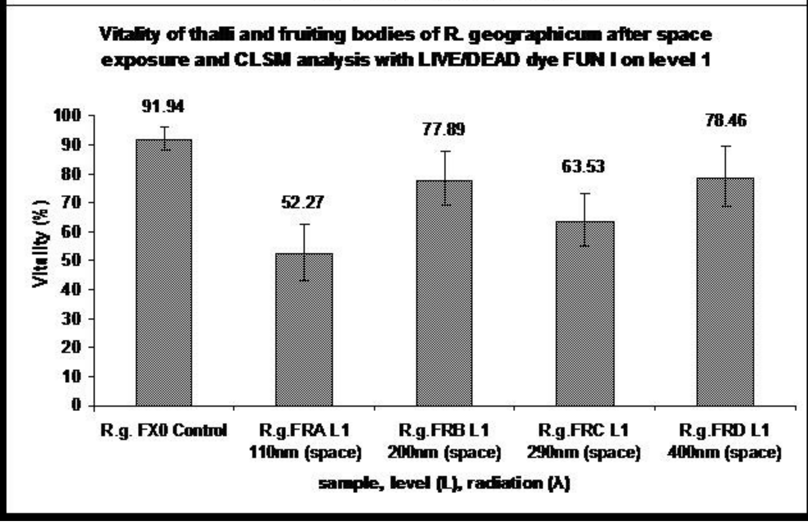


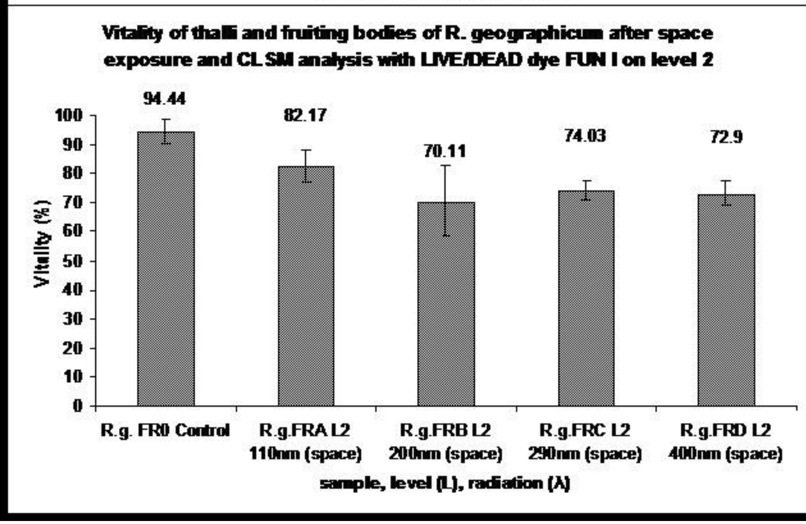
L 1

L 2



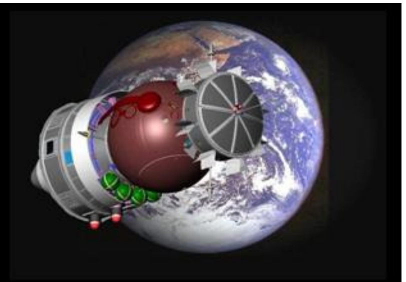


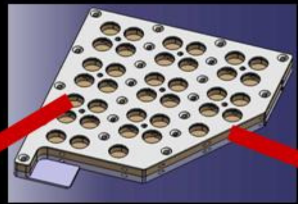




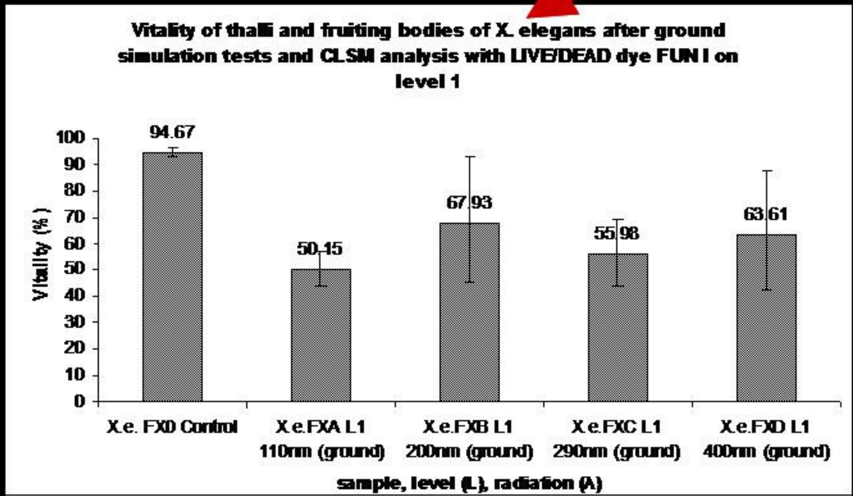
RESULTS: simulation tests

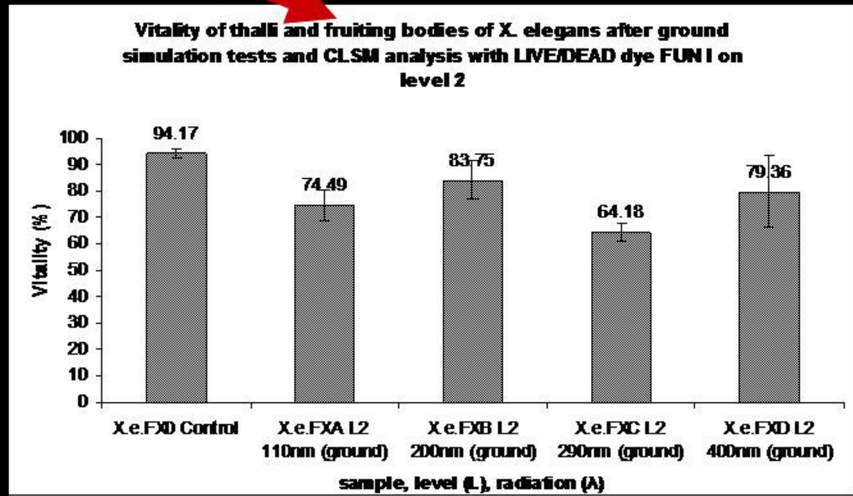
Quantified results after Analysis of CLSM images by the use of Image J

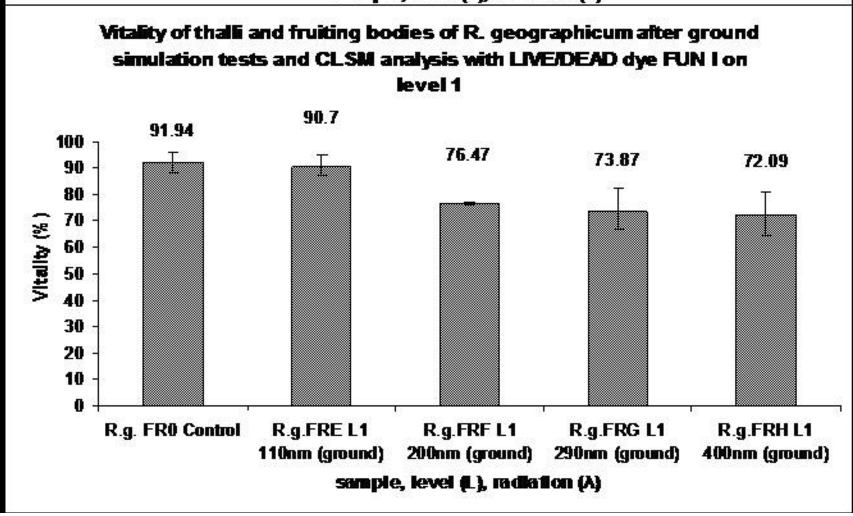


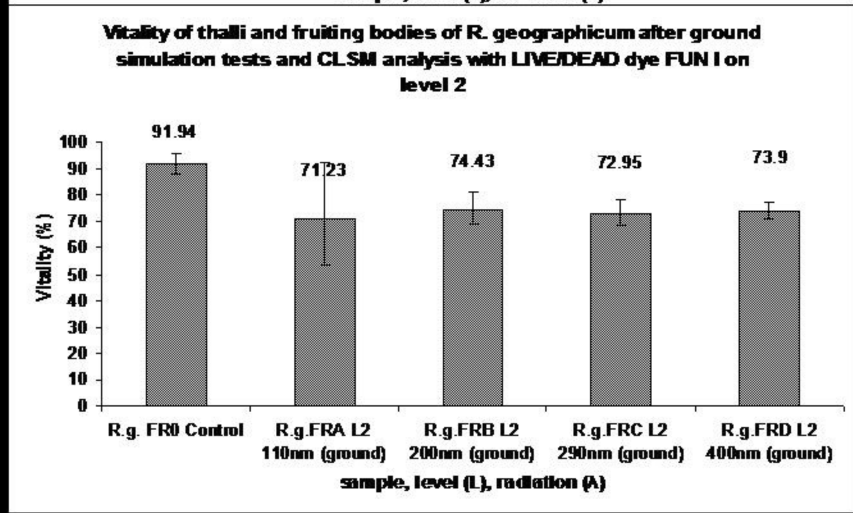


L 1 L 2



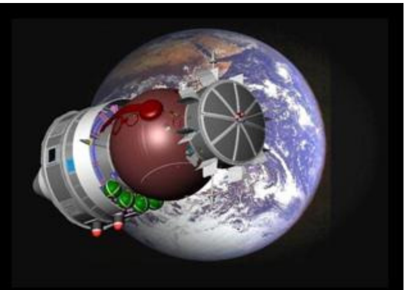


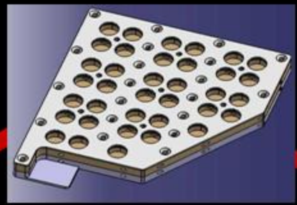




RESULTS: summary

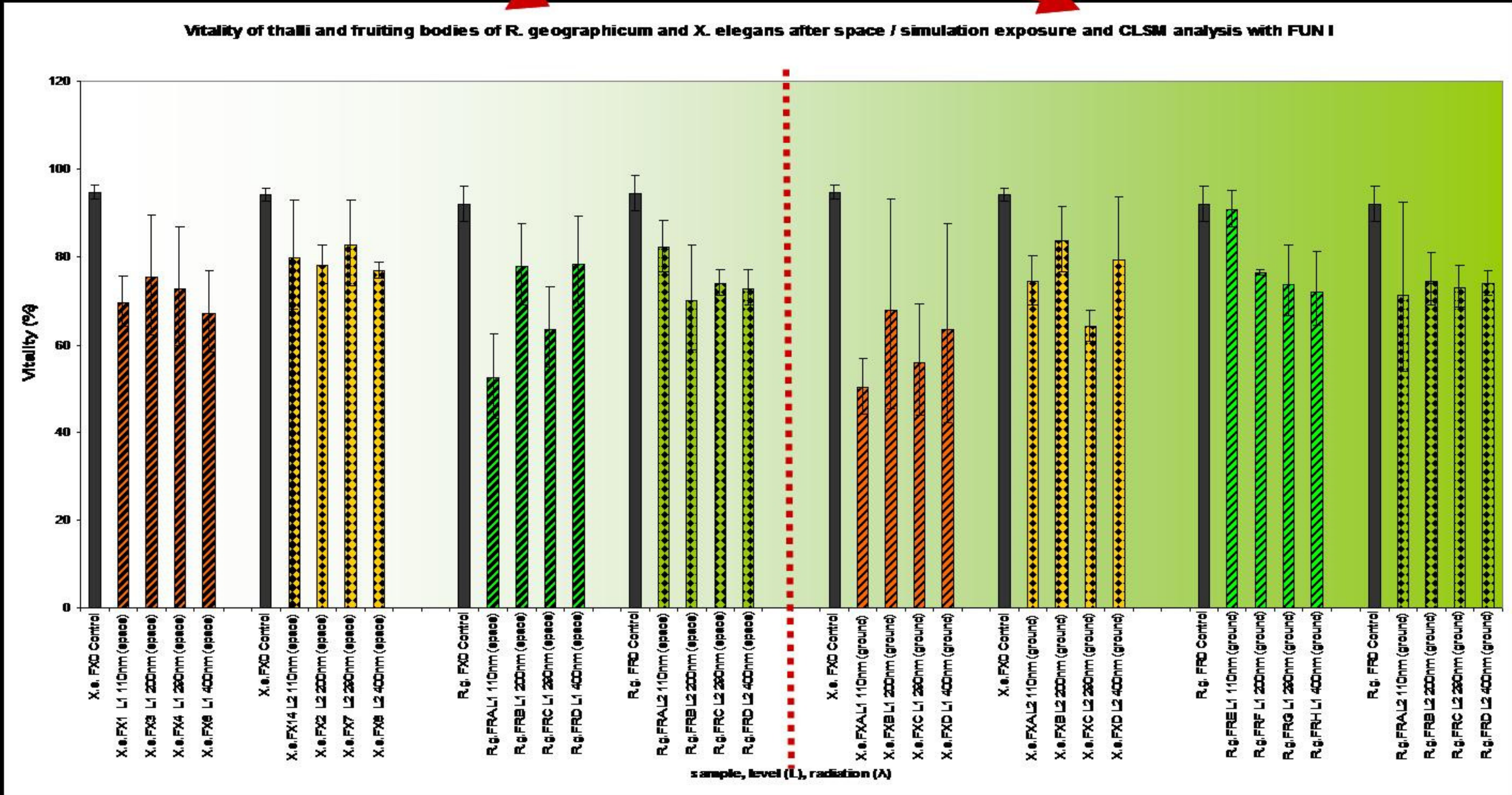
Quantified results after Analysis of CLSM images by the use of Image J



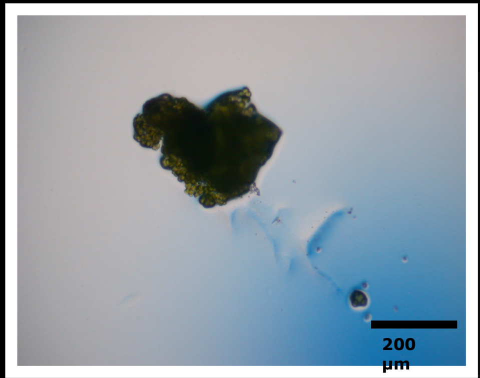


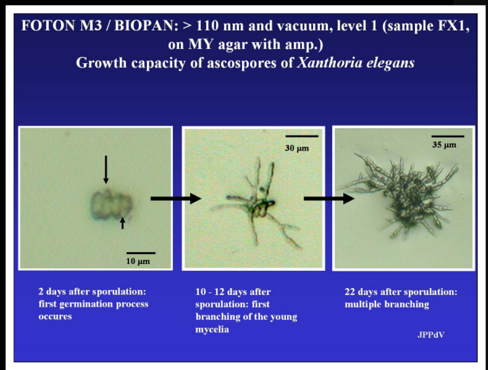
Space exposure

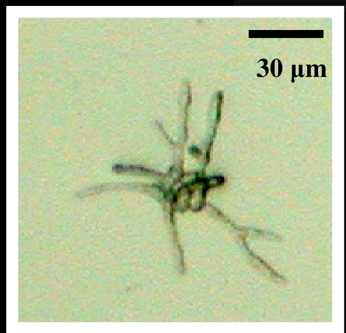
Simulation tests

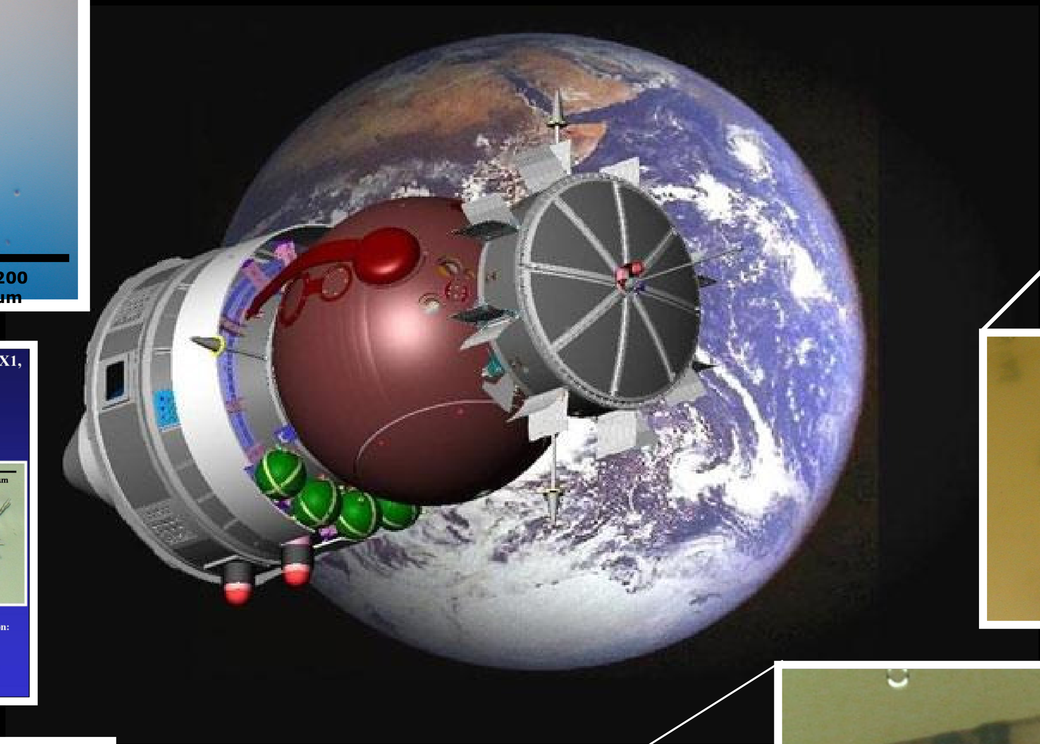


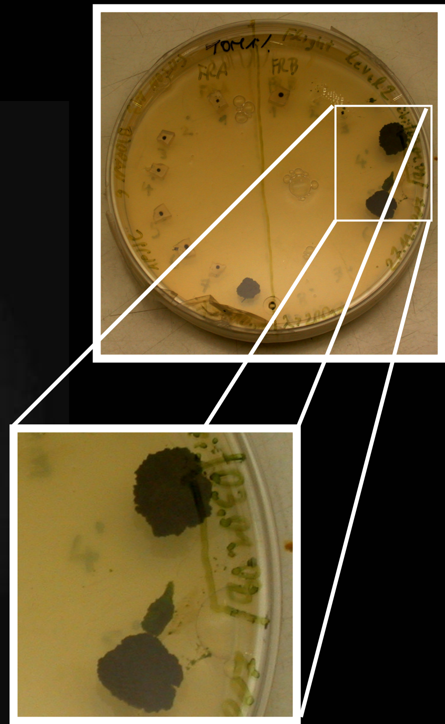
Germination / Growth capacity

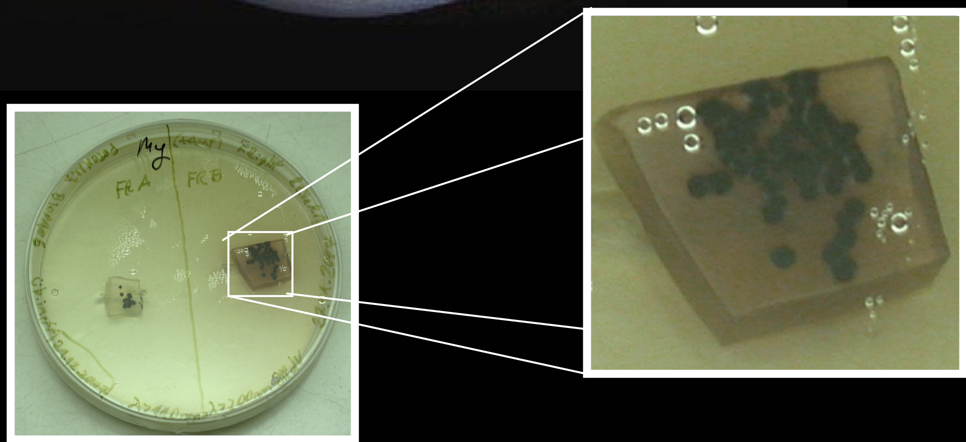






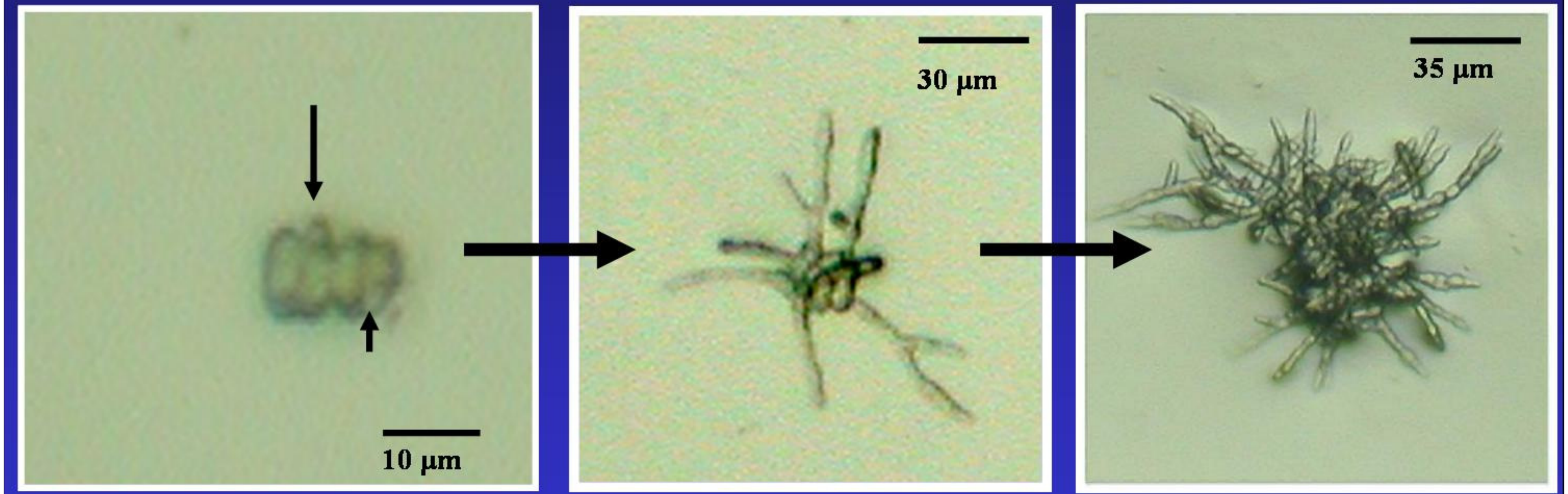






FOTON M3 / BIOPAN: > 110 nm and vacuum, level 1 (sample FX1, on MY agar with amp.)

Growth capacity of ascospores of *Xanthoria elegans*



2 days after sporulation: first germination process occures

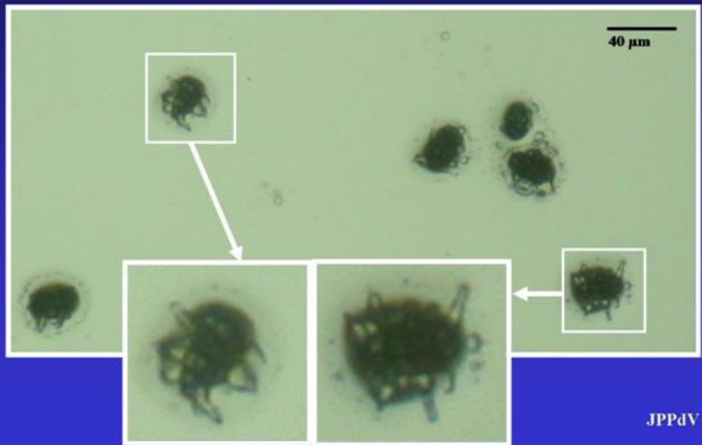
10 - 12 days after sporulation: first branching of the young mycelia

22 days after sporulation: multiple branching

JPPdV

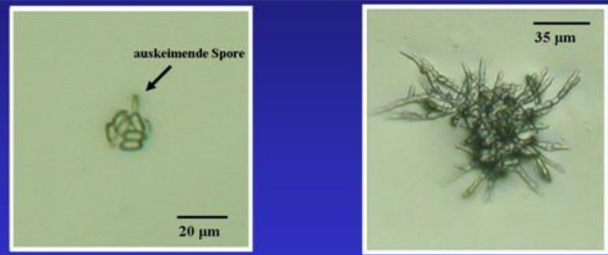
Germination and Growth capacity of ascospores

FOTON M3 / BIOPAN: > 290 nm and vacuum, level 1 (sample FR, on MY agar with amp.) Germination capacity of ascospores of *Rhizocarpon geographicum*; 3 days after sporulation



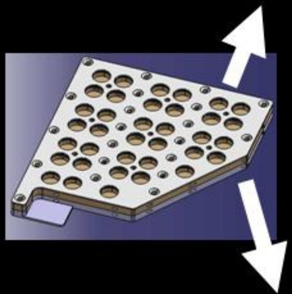
JPPdV

FOTON M3 / BIOPAN: >110 nm and vacuum, level 1 (sample FX on MY agar with amp.). Germination capacity of ascospores of *Xanthoria elegans*, 2 days after sporulation and growth of mycelia after 22 days

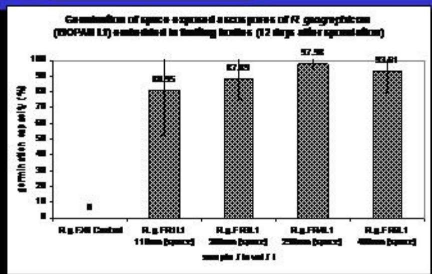


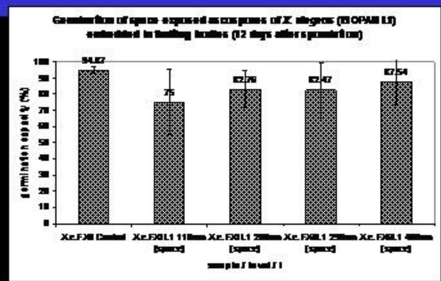
JPPdV

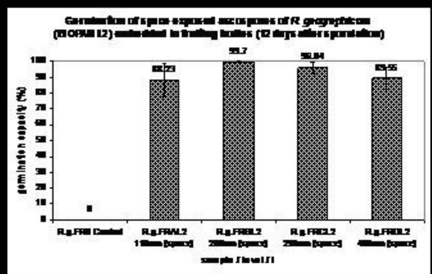
Level 1

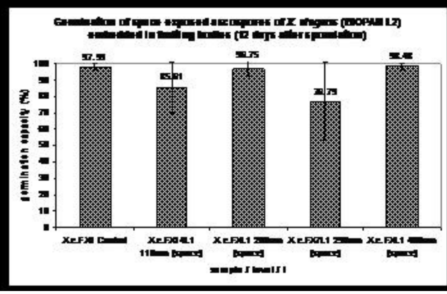


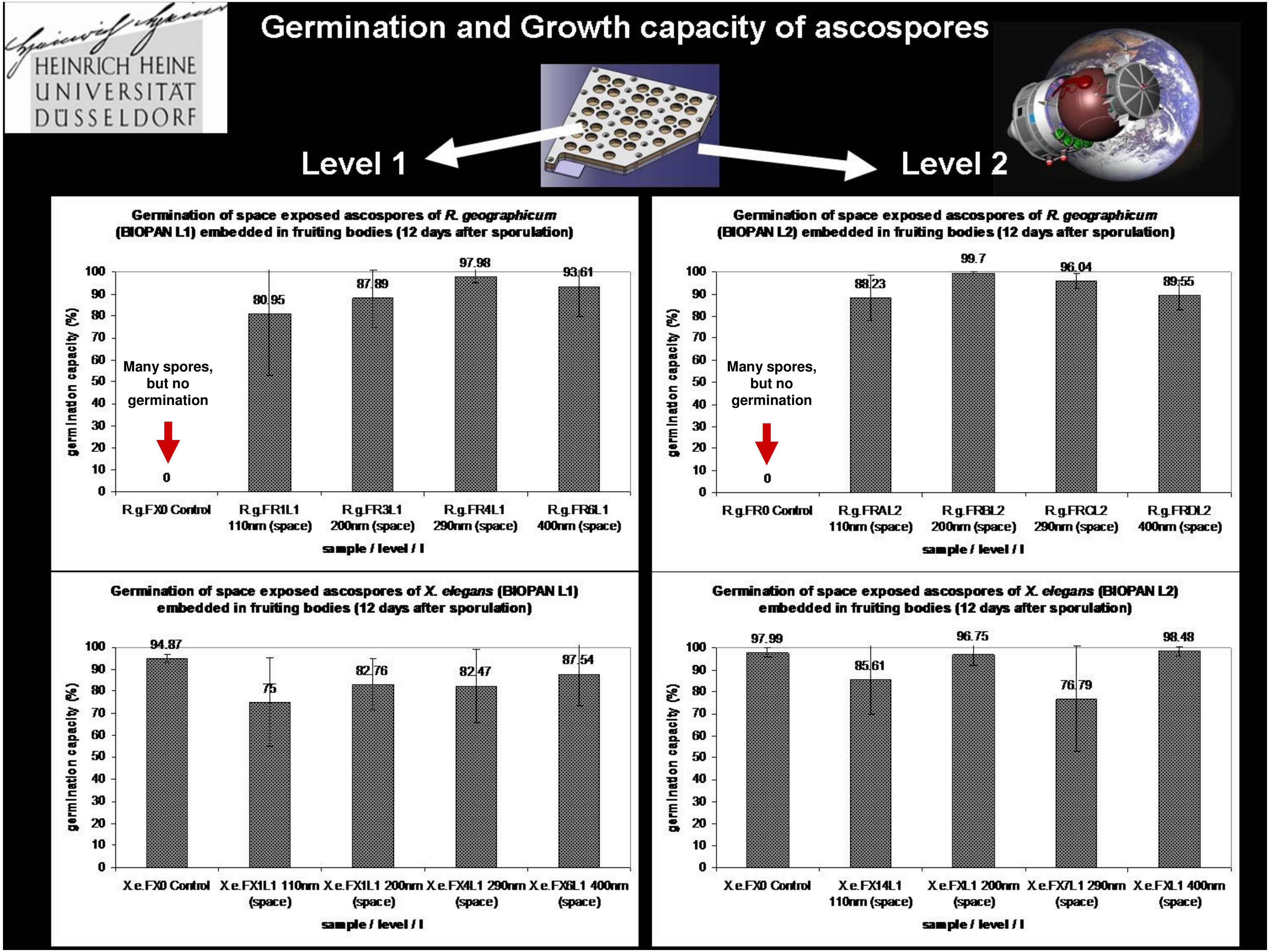
Level 2







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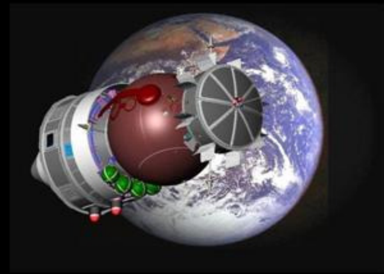
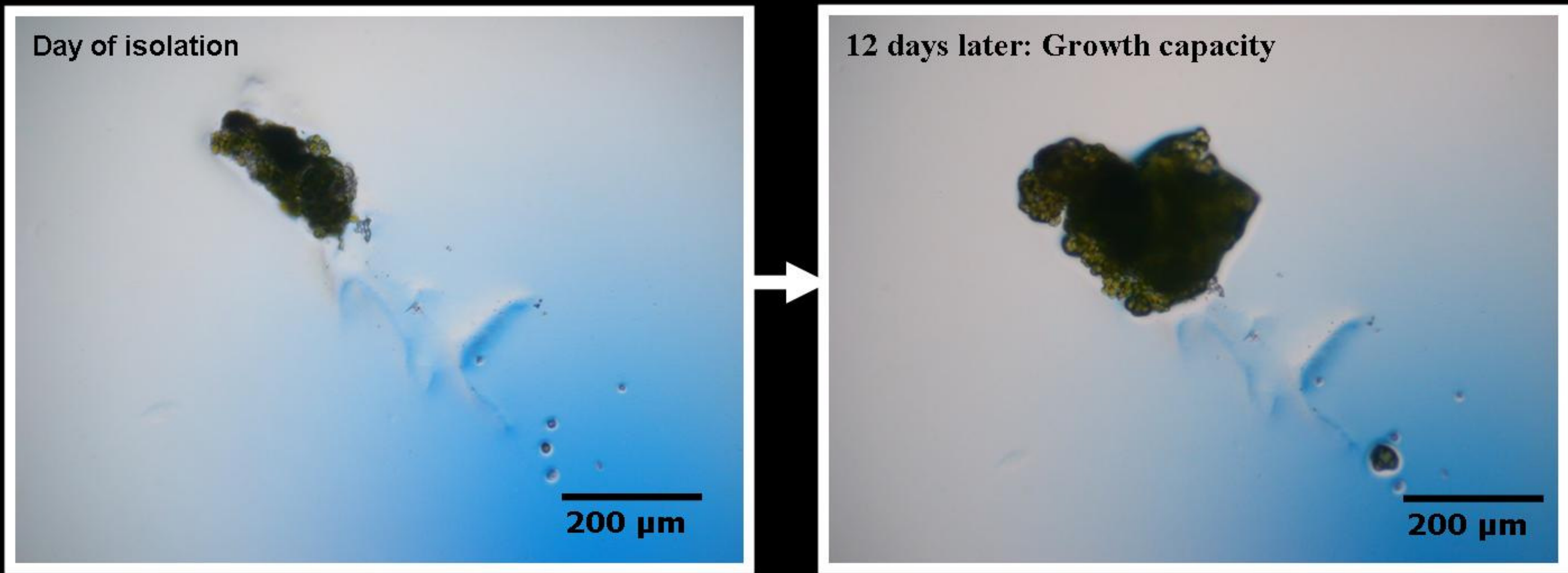
Germination and Growth capacity of ascospores
Level 1
Level 2
Germination of space exposed ascospores of R. geographicum (BIOPAN L1) embedded in fruiting bodies (12 days after sporulation)
germination capacity (%)
100
90
80
70
60
50
40
30
20
10
0
Many spores, but no germination
0
80.95
87.89
97.98
93.61
R.g.FX0 Control
R.g.FR1L1 110nm (space)
R.g.FR3L1 200nm (space)
R.g.FR4L1 290nm (space)
R.g.FR6L1 400nm (space)
sample / level / I
Germination of space exposed ascospores of R. geographicum (BIOPAN L2) embedded in fruiting bodies (12 days after sporulation)
germination capacity (%)
Many spores, but no germination
0
88.23
99.7
96.04
89.55
R.g.FR0 Control
R.g.FRAL2 110nm (space)
R.g.FRBL2 200nm (space)
R.g.FRCL2 290nm (space)
R.g.FRDL2 400nm (space)
sample / level / I
Germination of space exposed ascospores of X. elegans (BIOPAN L1) embedded in fruiting bodies (12 days after sporulation)
germination capacity (%)
94.87
75
82.76
82.47
87.54
X.e.FX0 Control
X.e.FX1L1 110nm (space)
X.e.FX1L1 200nm (space)
X.e.FX4L1 290nm (space)
X.e.FX6L1 400nm (space)
sample / level / I
Germination of space exposed ascospores of X. elegans (BIOPAN L2) embedded in fruiting bodies (12 days after sporulation)
germination capacity (%)
97.99
85.61
96.75
76.79
98.48
X.e.FX0 Control
X.e.FX14L1 110nm (space)
X.e.FXL1 200nm (space)
X.e.FX7L1 290nm (space)
X.e.FXL1 400nm (space)
sample / level / I

Growth capacity of photobiont cells after space exposure



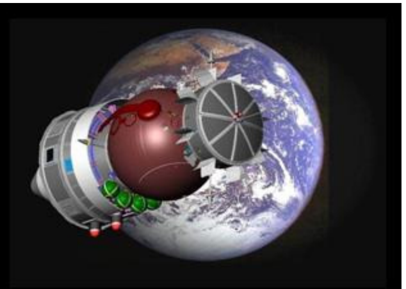
Photobiont of *Rhizocarpon geographicum (>110 nm, vacuum, Level 1)*

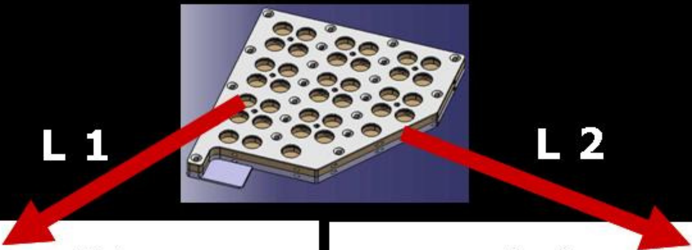


The work is further going on…

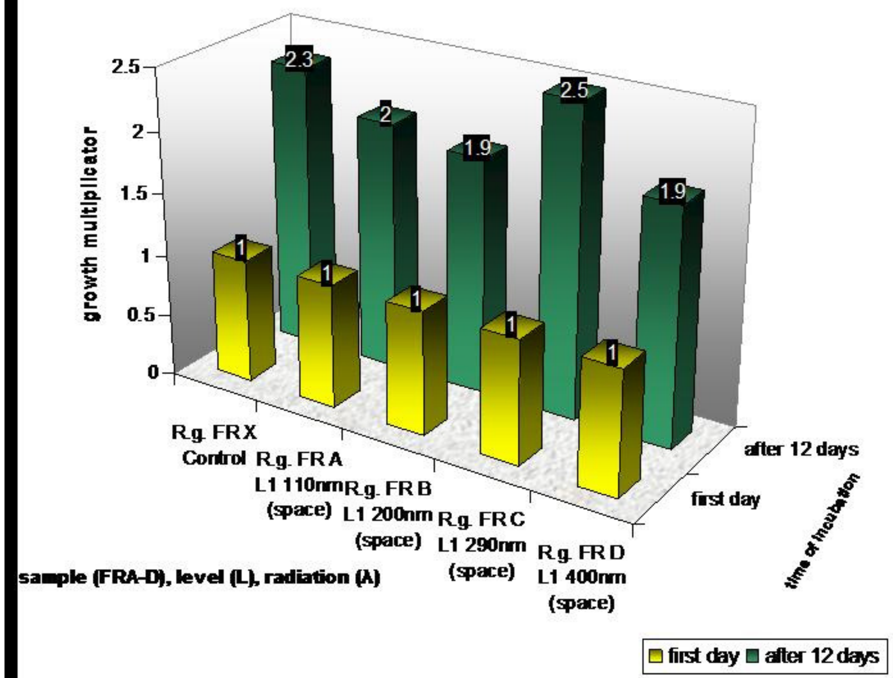
RESULTS:

Growth potential of photobiont cells of R. geographicum

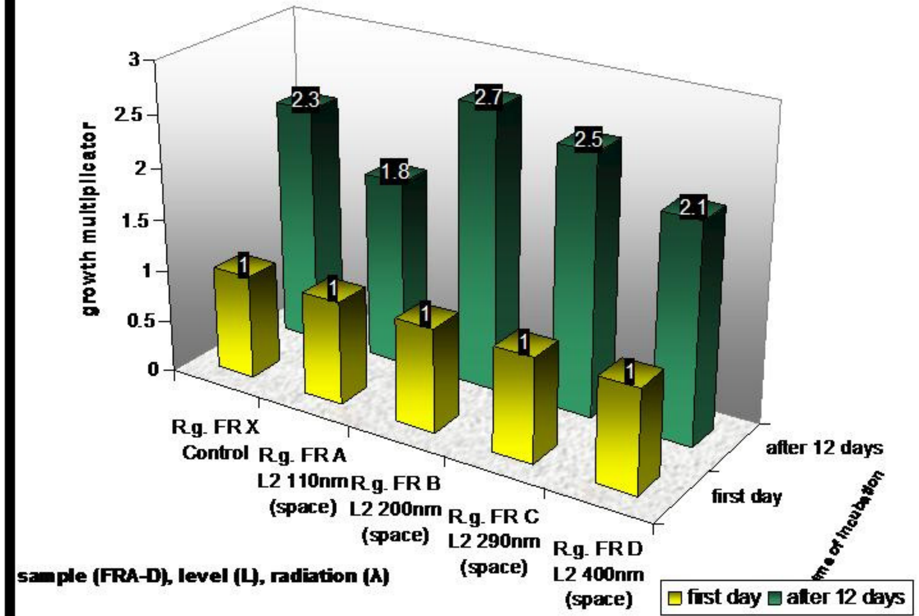




Growth capacity of photobiont cells of the exposed lichen R. geographicum (BIOPAN, L1, space)



Growth capacity of photobiont cells of the exposed lichen R. geographicum (BIOPAN, L2, space)



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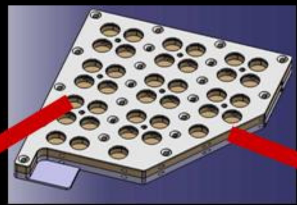
RESULTS:

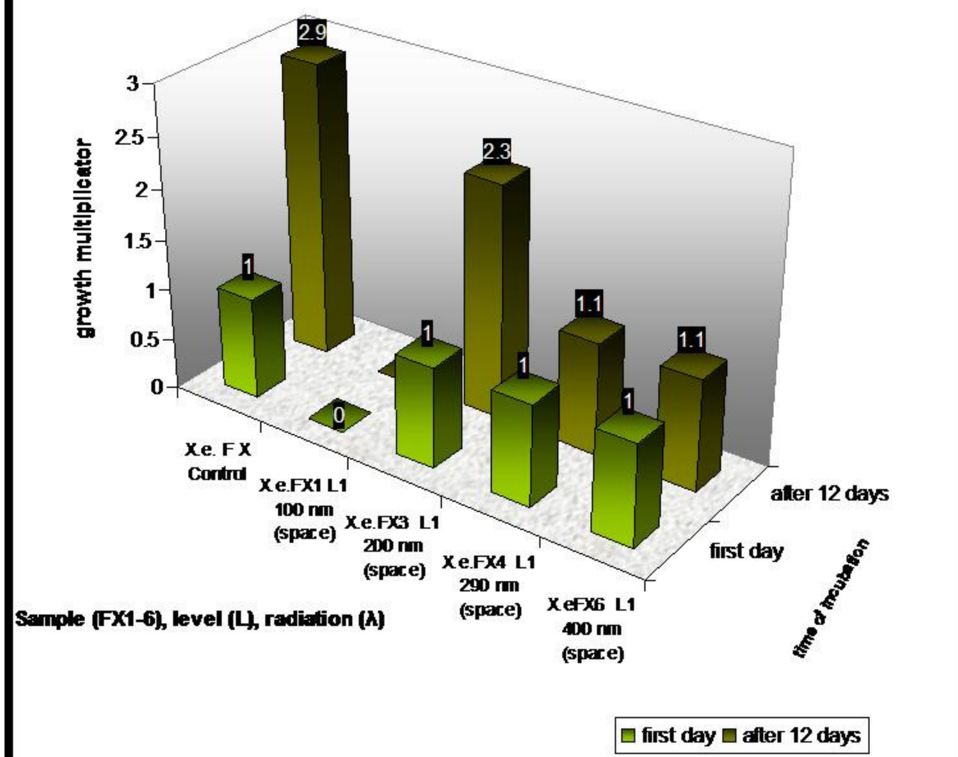
Growth potential of photobiont cells of X. elegans



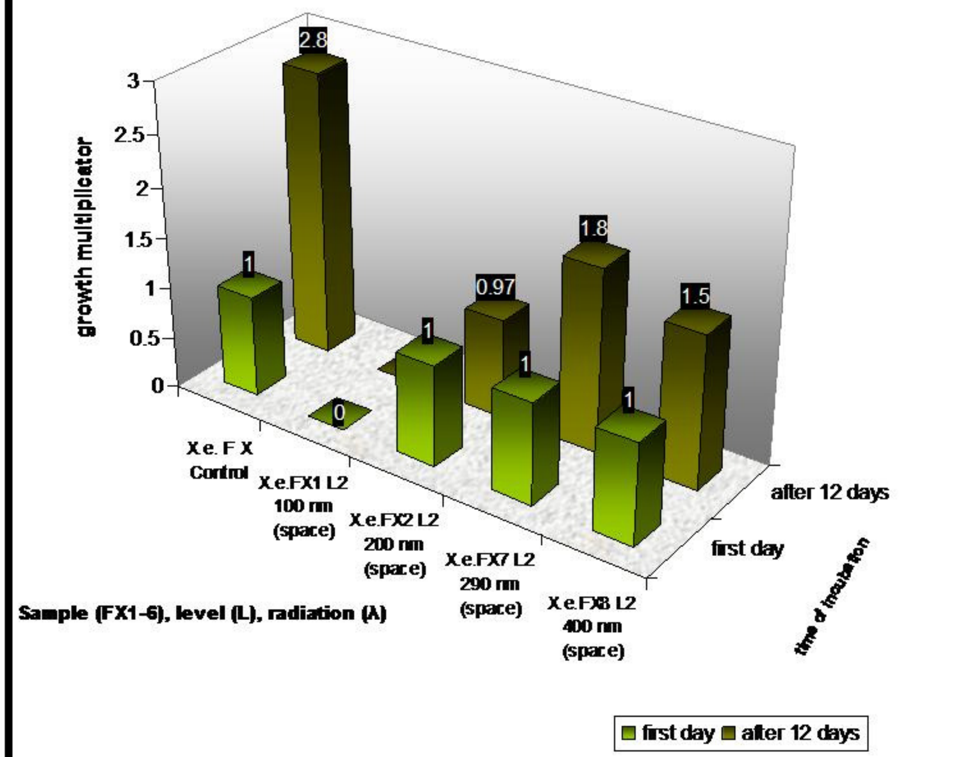
L 1

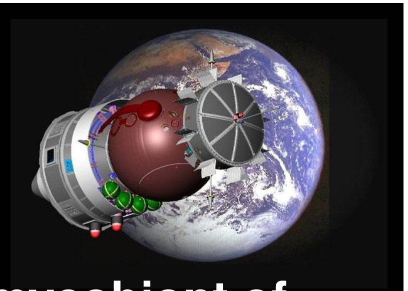
L 2

Growth capacity of photobiont cells of the exposed lichen X. elegans (BIOPAN, L1, space)



Growth capacity of photobiont cells of the exposed lichen X. elegans (BIOPAN, L2, space)





Preliminary

CONCLUSIONS

• In space the mycobiont of *X. elegans* is more resistant than the mycobiont of *R. geographicum*

• In space the photobiont of *R. geographicum* is more resistant than the photobiont of X. elegans

• The germination capacity of ascospores of both lichens after space exposure is nearly the same compared to the control

• In case of *R. geographicum* it can be postulated: "Germination induction by vacuum"

• 10 days under Mars conditions are probably without damaging effects on the investigated lichens

Photosynthesis under Martian conditions

Das Feuchtemesslabor HUMILAB (Quelle: DLR/Berlin)

Die Experimentierkammer (Quelle: DLR/Berlin)

Das Gasmischsystem (Quelle: DLR/Berlin)

HEINRICH HEINE UNIVERSITÄT DÜSSELDORF

DLR

RESULTS

Fig. 1: The MARS-simulation humidity-lab "HUMILAB" (DLR/Berlin)

Fig. 2: The Mars-simulation chamber (DLR/Berlin)

Fig. 3: The gas-mixing system for creation of a Martian atmosphere (DLR/Berlin)

Fig. 4: Photosynthetic activity in Earth atmosphere with decreasing pressures down to 6 mbar (Mars like pressure = blue line). The photosynthetic activity is represented by the red line (Yield value). No remarkable influence occurs.

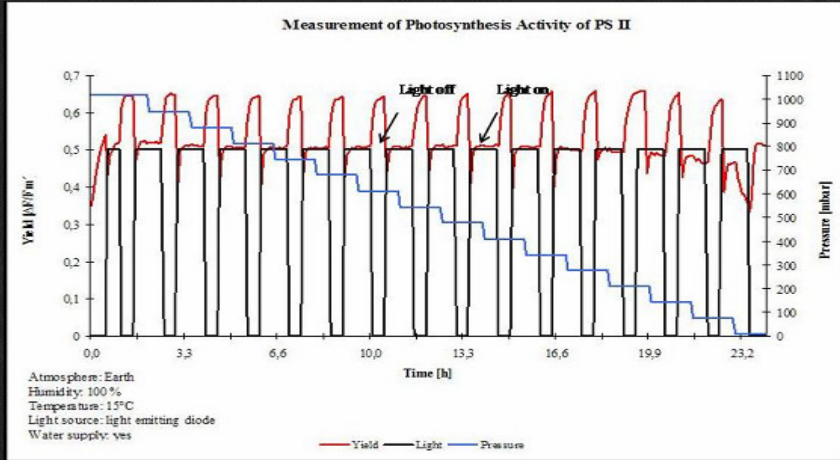


Fig. 5: The Photosynthetic activity in a Mars like atmosphere (95 % CO2) with decreasing pressures down to 6 mbar at 15°C. The photosynthetic activity (Yield value) is increasing with decreasing pressure and reaches higher levels as at 5°C what is similar to Earth conditions.

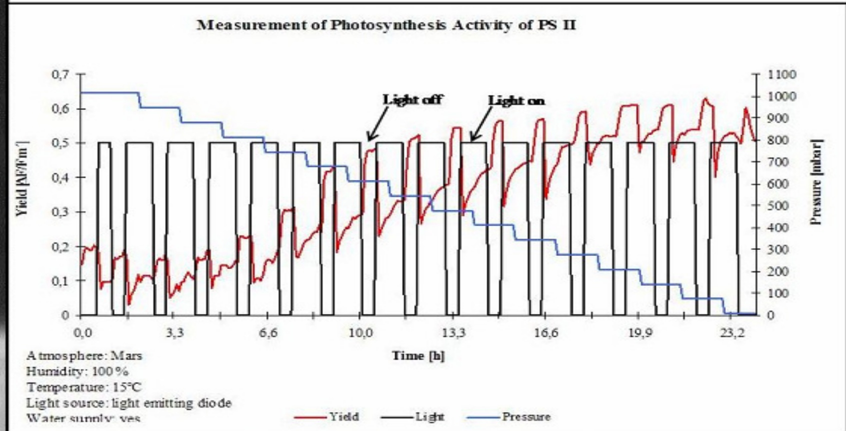
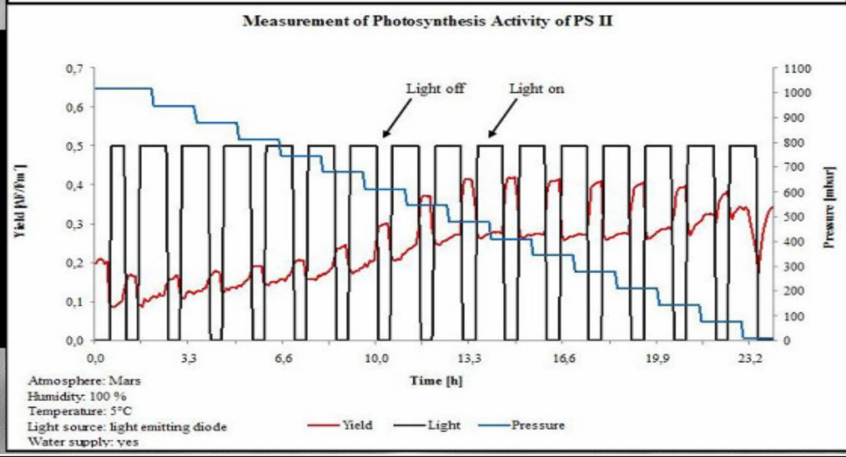
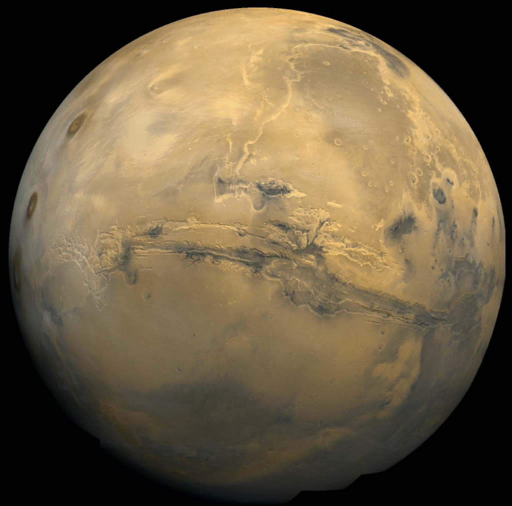


Fig. 6: The Photosynthetic activity in a Mars like atmosphere (95 % CO_2) with decreasing pressures down to 6 mbar at 5°C. The photosynthetic activity (Yield value, red curve) is increasing with decreasing pressure.

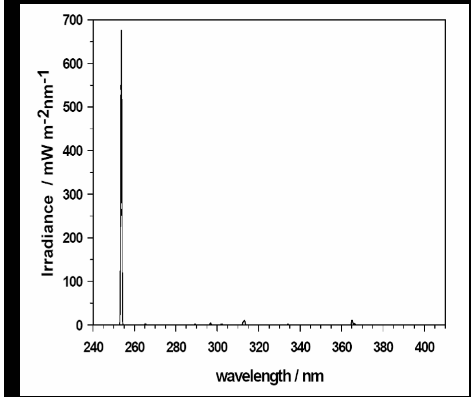


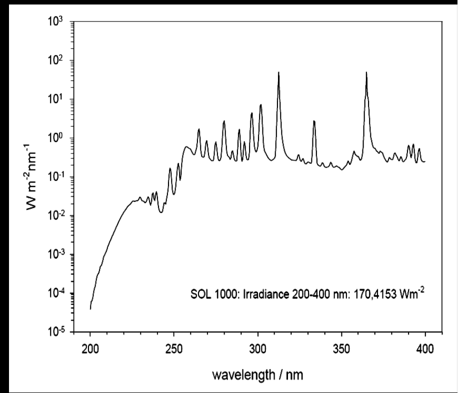
Low Pressure and the high CO_2 concentration seem not to be limiting factors for photosynthsis on Mars

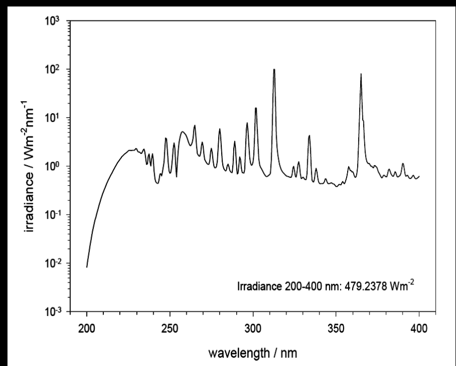


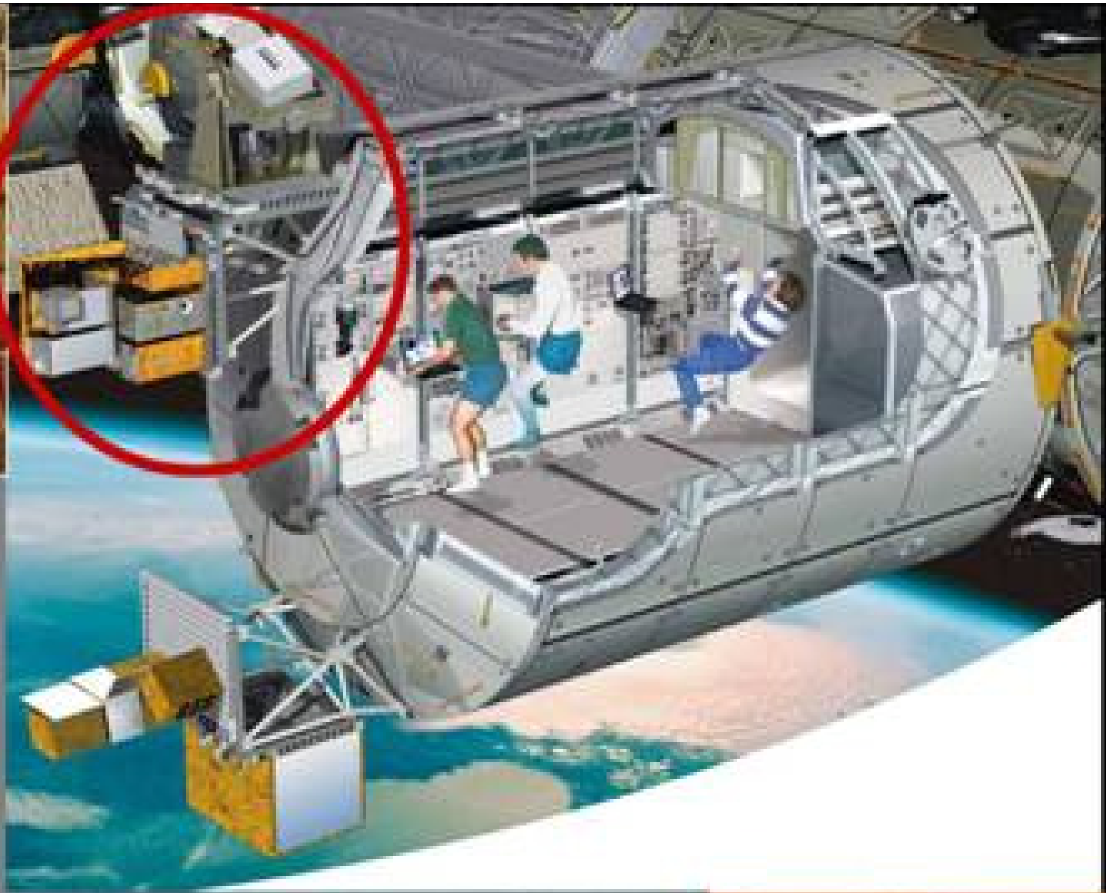
Low temperatures and high UV radiation may disturbe photosynthetic activity much more!!!

Preparation for EXPOSE on the ISS and Outlook









Expose-EuTEF: Flugmodell
Expose-EuTEF: Flight Model

Expose-EuTEF: Behälter für die Proben
Expose-EuTEF: Sample Containers

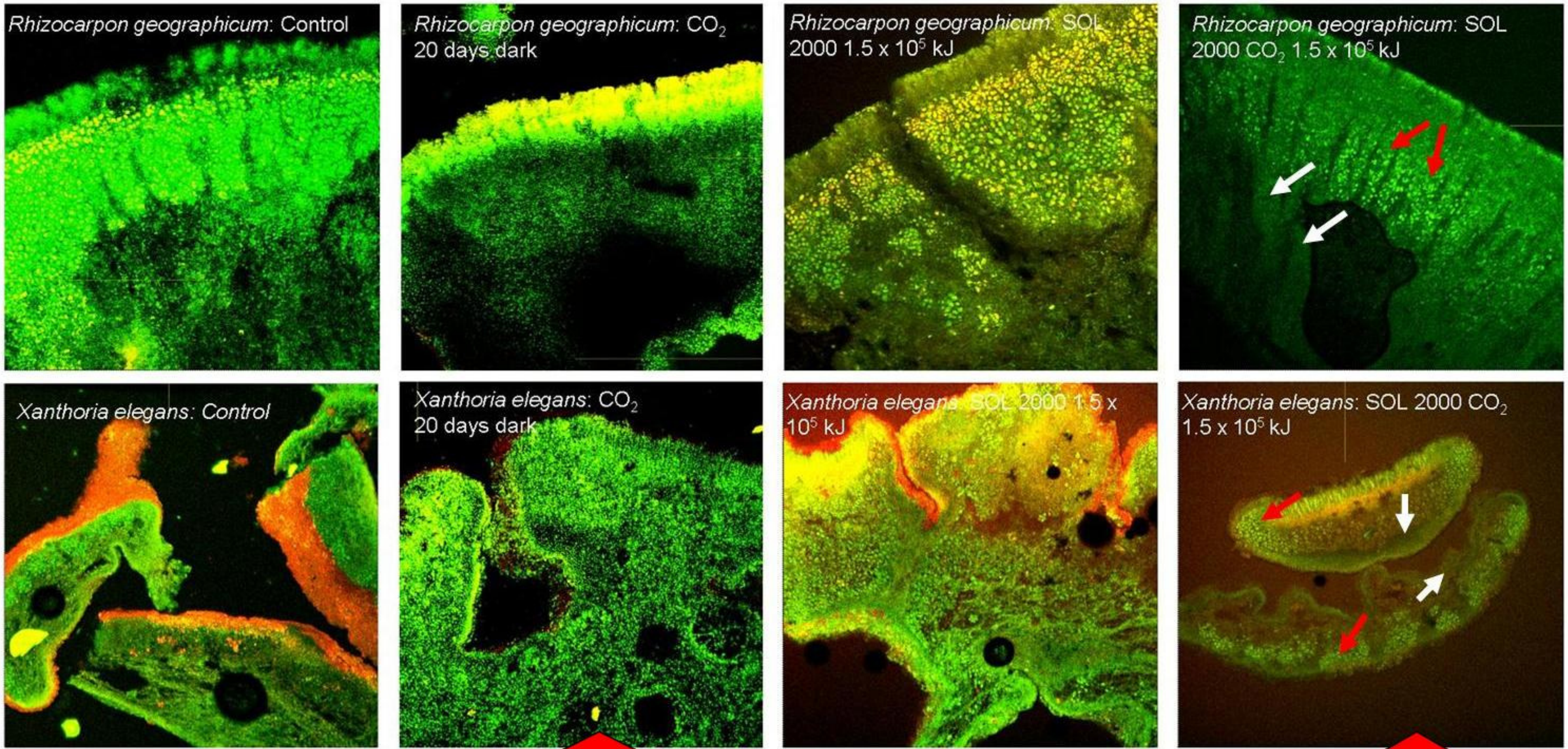
Proben

EVT: Selected and combined space simulation parameters

EVT	parameter	duration/exposition		no. samples
E1				
	Vacuum 10^{-5} Pa	1 h	1.3×10^{-5} Pa	3
		1 wk	2.3×10^{-6} Pa	3
	Temperature oscillation 50 cycles -20 °C to +20 °C, 1 atm air	2 wk		3
	UV-C irradiation monochromatic 254 nm, 1 atm air, 71.4 µW/cm^2	14 s	10 Jm^{-2}	3
		2 min 20 s	100 Jm^{-2}	3
		23 min 20 s	1000 Jm^{-2}	3
	UV irradiation polychromatic 200-400 nm, 1 atm air	3 s (SOL2000)	1,44 kJm^{-2}	3
		52 min (SOL2000)	1.5×10^3 kJm^{-2}	3
		87 h (SOL2000)	1.5×10^5 kJm^{-2}	3
	total number of samples EVT-E1			27

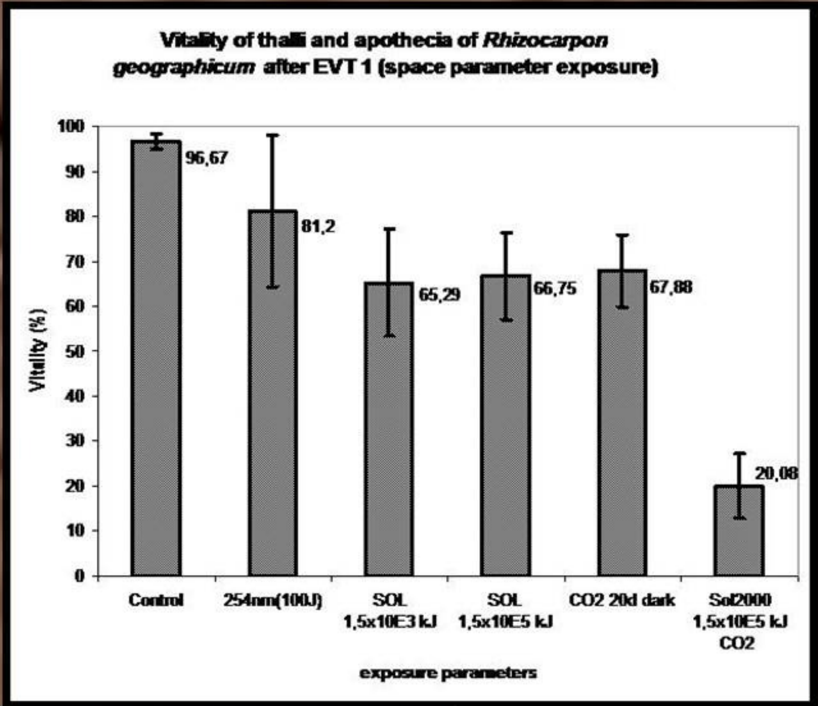
E2	parameter	duration	exposition	no. samples
	Vacuum 10^{-5} Pa (Dark)	22 days		3
	Vacuum 10^{-5} Pa + UV irradiation polychromatic (200-400 nm)	22 days 244.5 h (SOL1000)	1.5×10^5 kJm^{-2}	3
	Mars atmosphere 600 Pa (Dark)	21 days		3
	Simulated CO_2 Mars atmosphere 600 Pa + UV irradiation polychromatic (200-400 nm)	21 days 18 min (SOL2000) + 10 dd 3 h 40 min 48 s (SOL1000)	1.5×10^5 kJm^{-2}	3
	total number of samples EVT-E2			12
Control				
	Room temperature, dark, 1 atm air	2 months		3

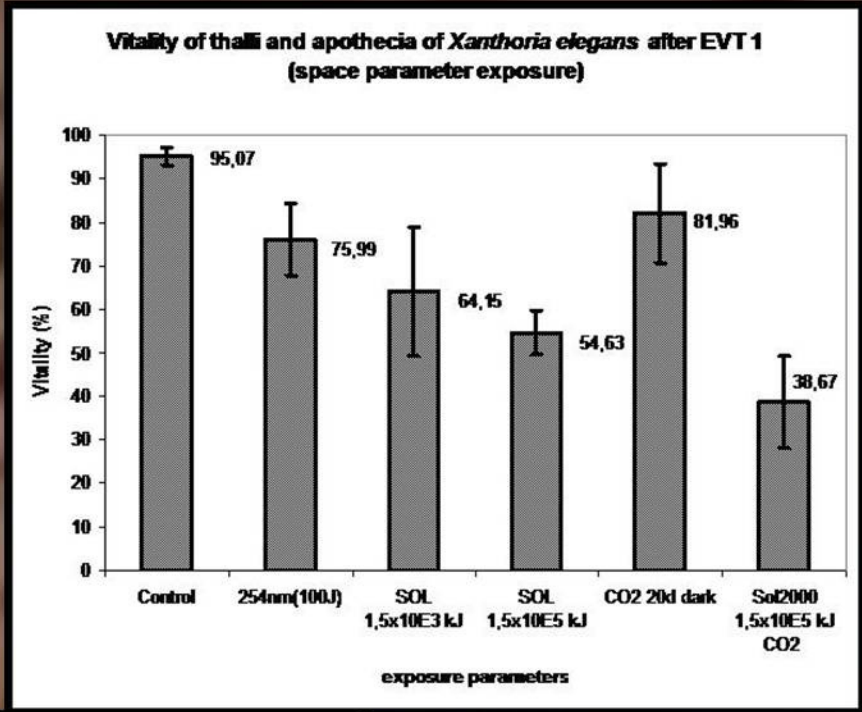
Results of EVT experiments

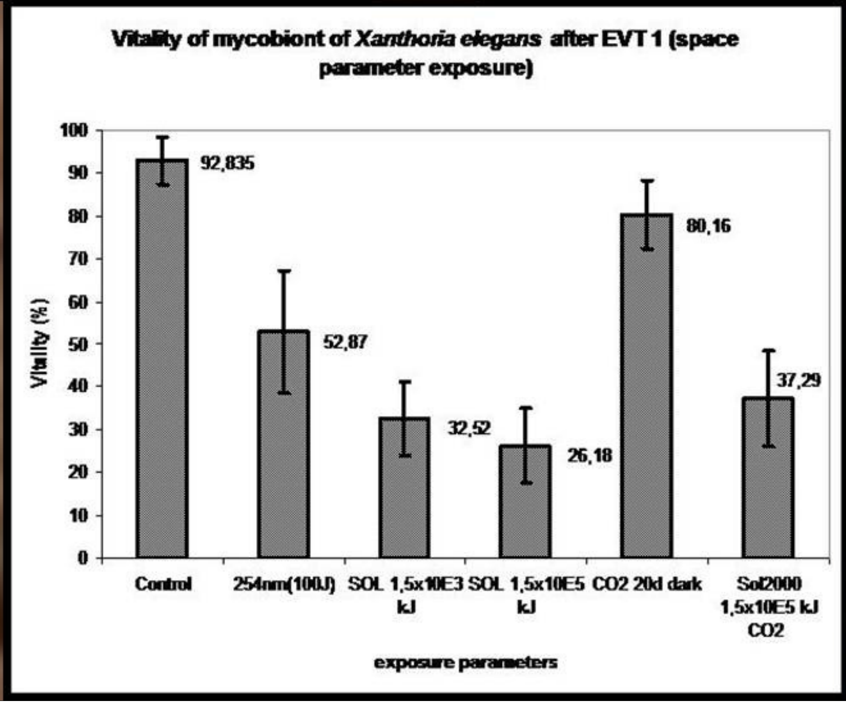


CO_2-Effects: More vitality reduction effects on the fungal part (mycobiont) in the lichen of *R. geographicum* than in the lichen of *X. elegans*. The alga (photobiont) is less influenced / green color = vital cells. Yellow, red and orange color = physiological activity

Radiation and CO_2 effects: in both lichens the mycobiont is more influenced (white arrow). The photobiont survived better (red arrow) due to protecting surrounding fungal hyphae and secondary lichen metabolites.

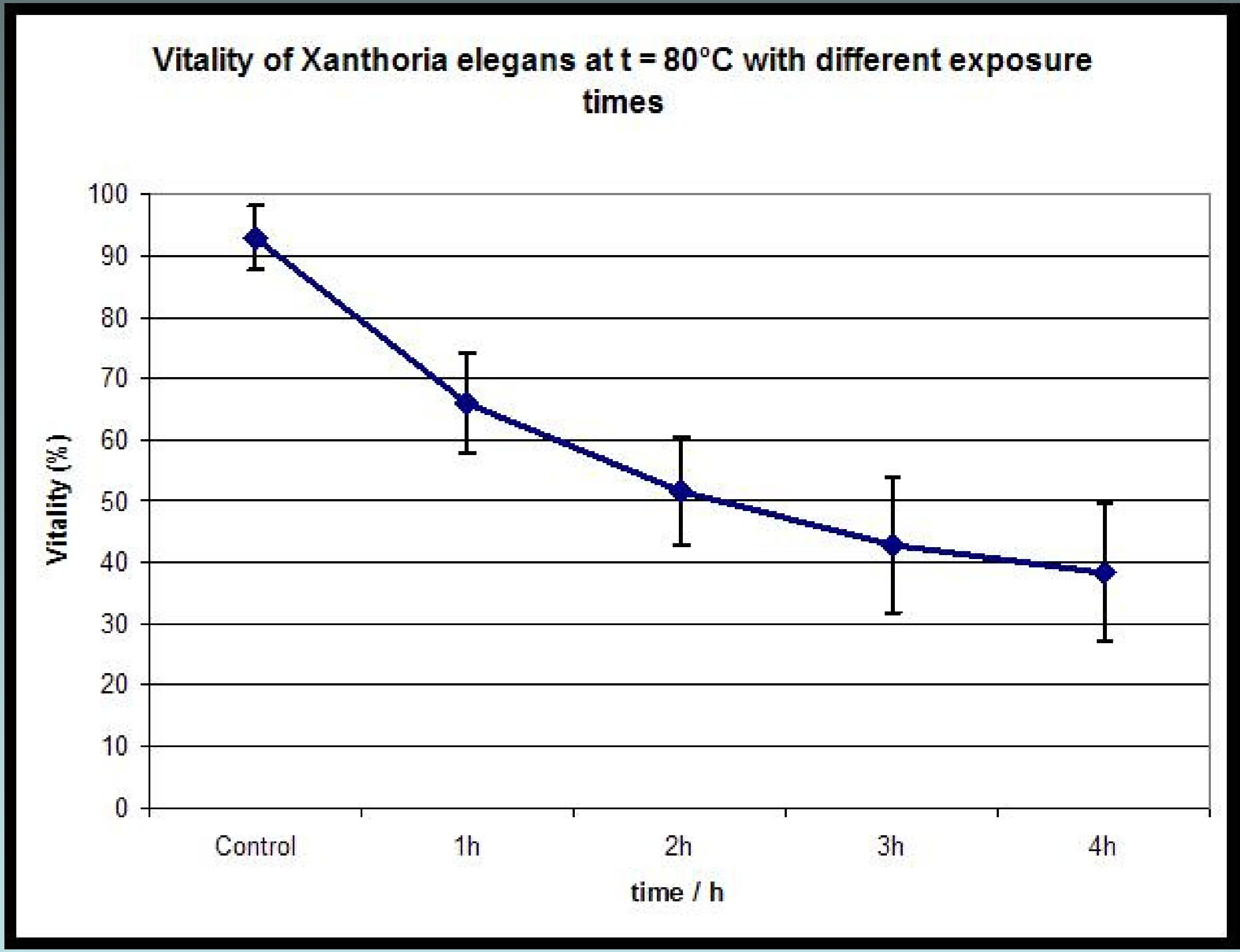






During the simulation tests no cultures of the mycobiont of *R. geographicum* were available

Temperature resistance

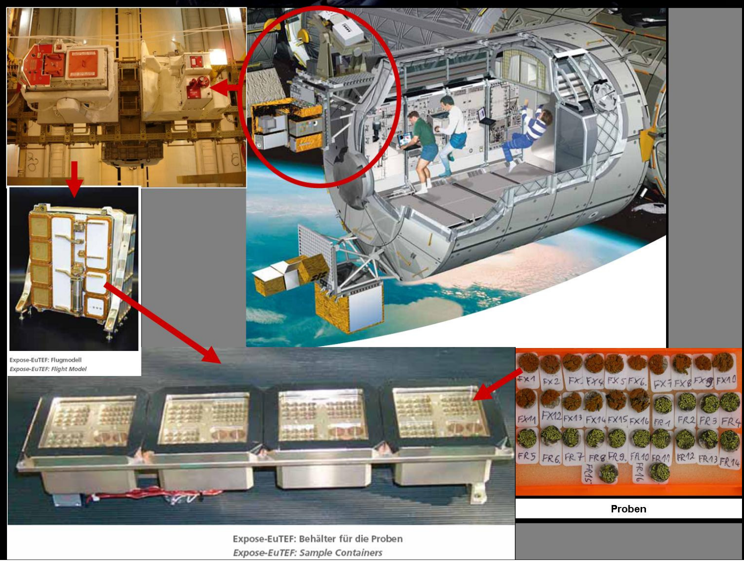


Additional check

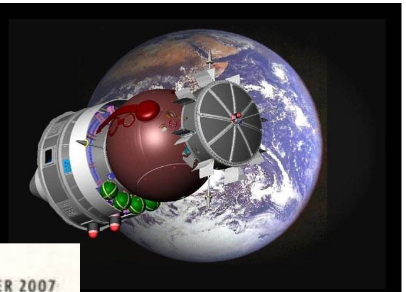
DNA damage of the lichen *X. elegans* and its symbionts induced by monochromatic UV radiation

				Parameter		Photoprodukte			DNA
	Proben-Nr.	Probenart	λ (nm)	Dosis (kJm^{-2})	t_e (h)	Cyclo-TT	(6-4) TT	Spore TT	Masse (µg)
photobiont	1	P^C	0	0	0	0	0	0	0,019
	2	P	254	5,04	2	31,7	8,2	7,5	0,007
	3	P		10,08	4	23,9	11,7	10,6	0,011
	4	P		20,16	8	63,5	13,5	13,2	0,006
mycobiont	5	M^C	0	0	0	0	0	0	0,007
	6	M	254	5,04	2	0	0	0	0,018
	7	M		10,08	4	0	0	0	0,012
	8	M		20,16	8	0	0	0	0,013
lichen	9	Xe^C	0	0	0	0	0	0	0,054
	10	Xe	254	5,04	2	0	0,5	0	0,027
	11	Xe		10,08	4	2,3	1,2	2,6	0,054
	12	Xe		20,16	8	1,4	3,3	4,5	0,037
	19	XeApo	0	0	0	0	0	0	0,017
	20	XeApo	254	5,04	2	0	0	0	0,046
	21	XeApo		10,08	4	0	0	0	0,016

Other experiments are further going on .... On EXPOSE!!!



PUBLICITY AND OUTREACH



Der Countdown läuft

Wenn am Donnerstag die Raumfähre Atlantis zur internationalen Raumstation ISS startet, drücken mindestens zwei Wissenschaftler der Heinrich-Heine-Universität fest die Daumen: Sieglinde Ott und Jean-Pierre de Vera vom Botanischen Institut schicken Proben mit ins All.

VON DIRKE KÖPP

Eigentlich könnten Sieglinde Ott und Jean-Pierre de Vera ganz ruhig sein: Die Crew für den Flug der Atlantis-Raumfähre am Donnerstag steht schon fest, und das „Go" für den Start hat die Nasa auch bereits gegeben. „Aber wir sind trotzdem nervös", gesteht Sieglinde Ott, Professorin am Botanischen Institut der Uni, und ihr Kollege, der Wissenschaftler Jean-Pierre de Vera, fügt hinzu: „Man fragt sich immer: Klappt alles?" Das Interesse der Düsseldorfer Forscher an der Mission der Nasa ist nicht ganz uneigennützig: Wenn das Spaceshuttle Atlantis am Donnerstag, 16.31 Uhr amerikanischer Zeit, vom Weltraumbahnhof Cape Kennedy in Florida zur internationalen Raumstation ISS startet, haben die Astronauten auch „Gepäck" der Heine-Universität an Bord: Proben von Flechten, einem Symbiose-Organismus aus Alge und Pilz.

„Flechten sind höhere Organismen als Bakterien. Dass sie im All überleben, ist ein gutes Zeichen"

Schon im September hatte die Arbeitsgruppe um Ott und de Vera zusammen mit spanischen Forschern unter Leitung von Rosa de la Torre Noetzel zwei Kapseln mit Flechten ins All geschickt. Sie wollten wissen, wie die Organismen auf die weite Reise unter extremen Bedingungen reagieren. Tage lang kreisten Sojus und Flechten in knapp 300 Kilometern Höhe im All. Partner für das Millionenprojekt zur Grundlagenforschung war damals und ist diesmal das Deutsche Zentrum für Luft- und Raumfahrt in Köln (DLR).

Das aktuelle Experiment ist für die Wissenschaftler noch spektakulärer: „Diesmal bleiben die Proben mehr als zwei Jahre im All und werden zudem außen an der Raumstation angebracht", beschreibt de Vera. Dafür müssen zwei Astronauten aussteigen und sie dort befestigen. Die Flechten sind in einer speziellen Box, dank derer sie zeitweilig vor der allzu intensiven Sonnenhitze geschützt werden können. „Es ist wichtig, dass dieser Mechanismus funktioniert", so Ott.

Wenn das **Atlantis-Spaceshuttle** am Donnerstag gen Raumstation ISS **startet**, hat es auch die Proben der Heine-Uni an Bord. FOTO: DON THOMAS/NASA

Die Wissenschaftler **Jean-Pierre de Vera** und **Sieglinde Ott** müssen sich rund zwei Jahre gedulden, bis die Flechten aus dem All zurück sind. FOTOS: PRIVAT

Kontrolle — 100 µm — 100 µm

Mikroskopbilder eines Querschnitt der Flechte **Xanthoria elegans**: Links (vorher) sind lebende Zellen grün/türkis gefärbt, rechts (nachher) sind sie noch lebendig.

Mit ihrem Experiment wollen die Wissenschaftler, zu denen außer den spanischen Kollegen auch Silvano Onofri in Viterbo (Italien) und Elke Rabbow vom DLR zählen, herausfinden, wie resistent die Flechten gegen die extrem lebensfeindliche Umwelt des Weltraums sind und was sich daraus für die Forschung ableiten lässt. Etwa könne man das Wissen über die Struktur resistenter Flechten bei der Entwicklung von Strahlenschutz-Kleidung oder – aber erst in ferner Zukunft, wie Ott und de Vera betonen – in der Krebsforschung nutzen.

Erste Ergebnisse aus Untersuchungen der Flechten, die im September im All waren, lassen hoffen: „Mehr als 90 Prozent der Sporen (so etwas wie Samen) keimen und wachsen", sagt de Vera. Auch habe man nachweisen können, dass der Stoffwechsel der Zellen intakt sei und die Algen Photosynthese betrieben. „Nun müssen wir die Proben weiter beobachten", erklärt Ott. „Hören sie auf zu wachsen? Verhalten sie sich anders als Flechten, die nicht im All waren? Zudem waren die Proben verschiedenen Dosen von UV-Licht ausgesetzt – auch die Reaktion darauf prüfen wir." Insgesamt sind die Forscher sehr zufrieden: „Flechten sind höhere Organismen als Bakterien. Dass sie die Weltraumbedingungen überleben, ist ein gutes Zeichen."

INFO

Langzeitexperiment

Der Langzeitversuch mit den Flechten an der internationalen Raumstation ISS wird mehr als zwei Jahre dauern. Bei der erweiterten Weltraumuntersuchung mit Namen „LIFE" (Lichen and Fungi Experiment) werden außer den **Flechten** auch im Gestein lebende Organismen wie **Cyanobakterien** (Blaualgen) und antarktische **Mikropilze** studiert.

SERVICE

„Saufen ist uncool": Schüler zeigen ab heute Plakate

(gök) Es ist eine besondere Ausstellung, die Bürgermeister Dirk Elbers heute um 11 Uhr zusammen mit Michael Baltes, Leiter des Ursulinen-Gymnasiums, im Weiterbildungszentrum eröffnet: „Saufen ist uncool" lautet der Titel der Schau, die die Schüler der Klasse 9e des St.-Ursula-Gymnasiums konzipiert und umgesetzt haben. Zu sehen sind 14 Plakate, die sich mit Alkoholkonsum von Jugendlichen beschäftigen. Ausgangspunkt der Klasse waren Sprüche wie „Komasaufen" und „Dicht ist Pflicht", mit denen sie sich im Biologie-Unterricht auseinandergesetzt haben.

Bei der Umsetzung der Ergebnisse haben Kunstlehrerin Nicole Busch und Design-Professor Wilfried Korfmacher von der FH geholfen.

WBZ, Bertha-von-Suttner-Platz, Foyer. Zu sehen ist die Schau bis 19. Dezember

Kneipp-Verein wandert im Dezember

(lian) An drei Tagen im Dezember lädt der Kneipp-Verein Düsseldorf zum Wandern ein. Heute wird ein Spaziergang am Rundwanderweg angeboten. Treffpunkt ist um 14.30 Uhr an der Haltestelle der Straßenbahnlinie 703 auf der Burgmüllerstraße. Für Samstag, 8. Dezember, ist ein Ausflug zum Rosenhof geplant. Treffpunkt hierfür ist die Bushaltestelle der Line 730 am Knuppertsbrück. Für den letzen Tag, Samstag, 15. Dezember, ist ab 13 Uhr eine Fahrt nach Lörick geplant.

Kontakt Telefon 21 92 44 oder E-Mail: Kneipp-Verein-Duesseldorf@t-online.de

Tipps für Umgang mit Demenzkranken

(RP) Zu einem praxisnahen Vortrag zum Umgang und zur Kommunikation mit demenziell Erkrankten lädt der Caritasverband für heute um 17.15 Uhr in den Caritas Treffpunkt ein. Referent Andreas Kutschke möchte auch schwierige Themen und Situationen im Umgang mit Demenzkranken respektvoll, anschaulich und mit Humor darstellen.

Caritas-Treffpunkt Oststraße 64

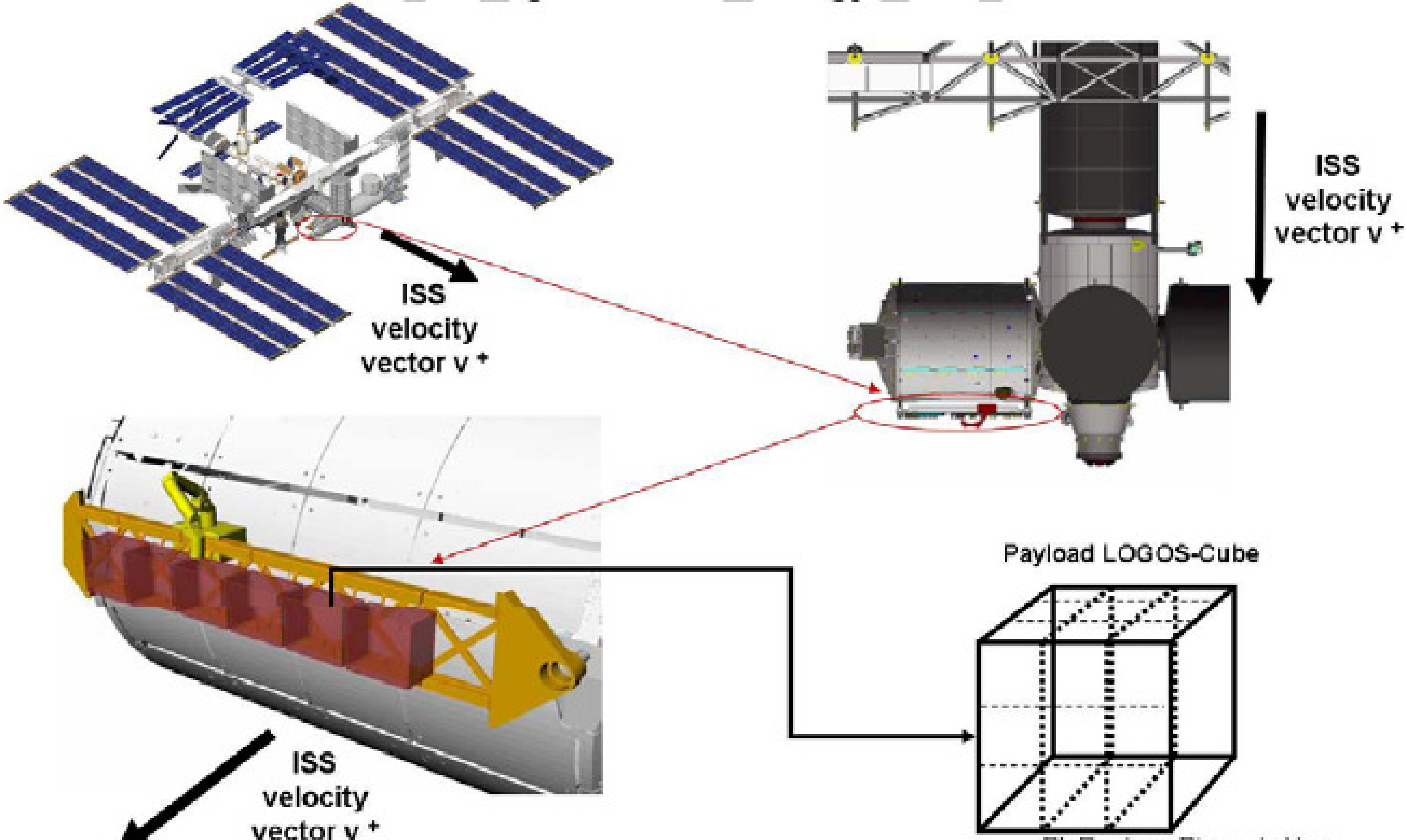
Über Hiroshima und


HEINRICH HEINE UNIVERSITÄT DÜSSELDORF
UNIVERSITÀ DEGLI STUDI DELLA Tuscia
DLR
HEINRICH HEINE UNIVERSITÄT DÜSSELDORF
Fraunhofer Institut Kurzzeitdynamik Ernst-Mach-Institut
International Cooperation
J.P.de Vera; C. Cockell; C. Meyer; G. Horneck
R. Möller
U. Hornemann
S. Ott
P. Inderbinen (Assistent, Walliser Hof, Zermatt)
M. Melles
P. Rettberg
TNT-experts
D. Stöffler
S. Dreesen, Pilot (Air Zermatt)
S. Onofri
Technicians of DLR/Cologne
J. Fritz
R. de la Torre Noetzel

Proposed facility / Payload:

LOGOS-CUBE and Experiment:

LOGOS – Life-Organics and Geology Orbit Science



PI: Dr. Jean-Pierre de Vera,

Proposed facility / Payload:

LOGOS-CUBE and Experiment:

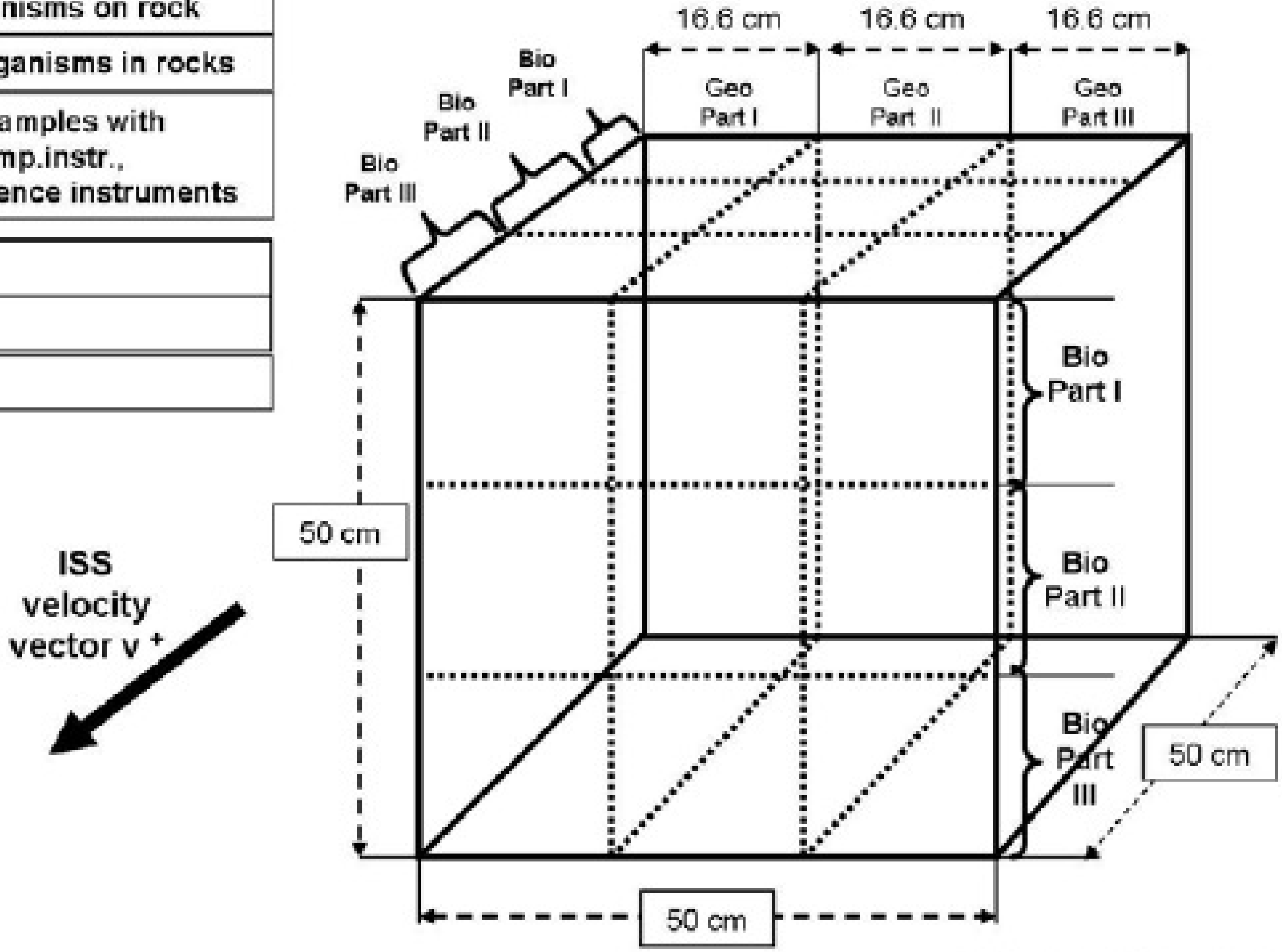
LOGOS – Life-Organics and Geology Orbit Science

Bio Part I: Epilithic organisms on rock
Bio Part II: Endolithic organisms in rocks
Bio Part III: Clean rock samples with integrated dosimeter, temp.instr., pressure instr., fluorescence instruments

Geo Part I:	sandstone
Geo Part II:	Dunit
Bio Part III:	Gabbro

A sophisticated autonomic payload facility for scientific tests: space weathering on organisms and rock and degradation or resistance of organics produced by life forms. Results will be essential for definition of real life markers/bio signatures as reference to the search of life in the universe.

Realisation of a space performed bio signature data bank (BSDB)



PI: Dr. Jean-Pierre de Vera,

Proposed facility / Payload:

LOGOS-CUBE and Experiment:

LOGOS – Life-Organics and Geology Orbit Science

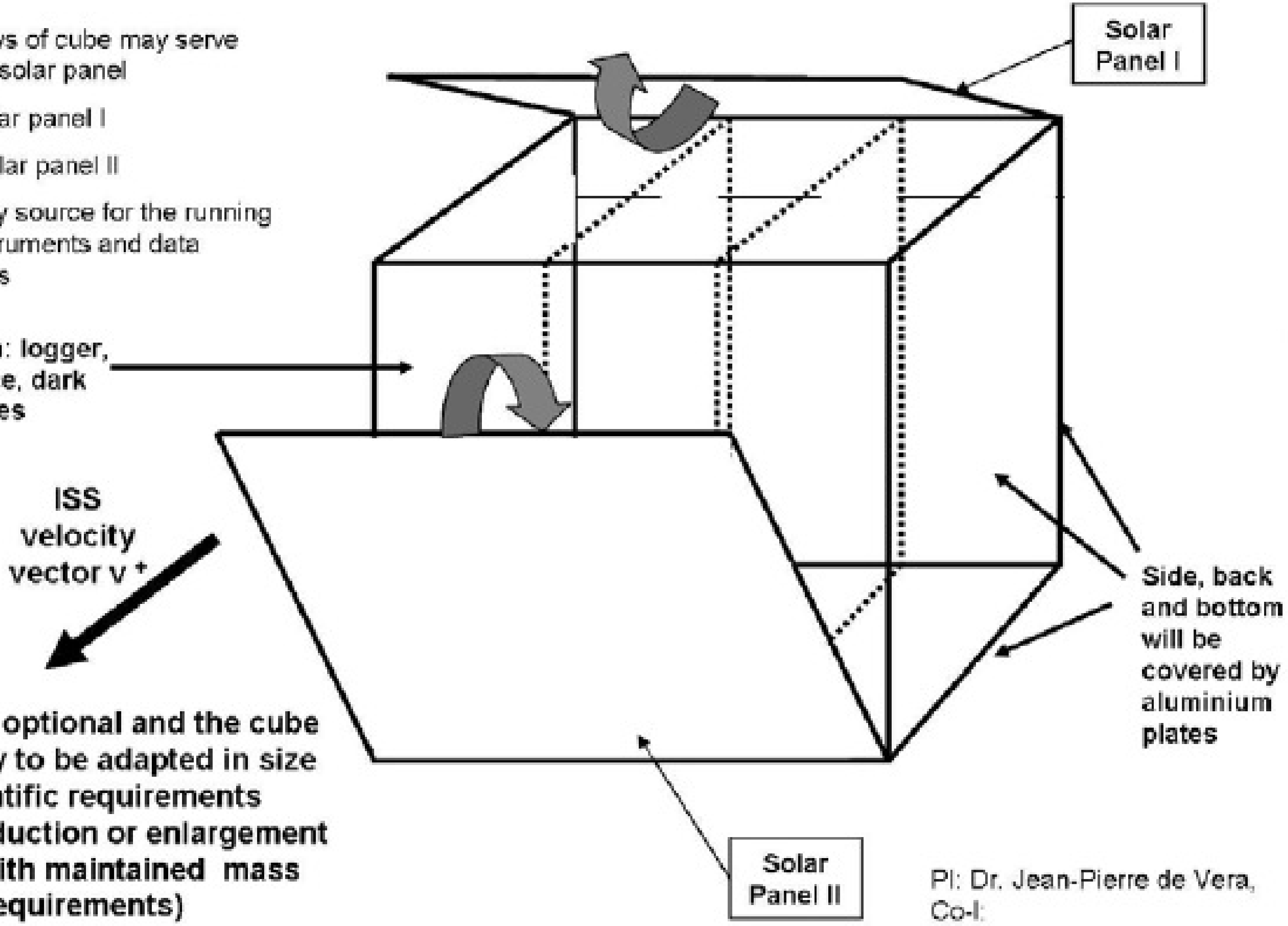
Option: windows of cube may serve additionally as solar panel

Window I = solar panel I

Window II = solar panel II

External energy source for the running measuring instruments and data transfer devices

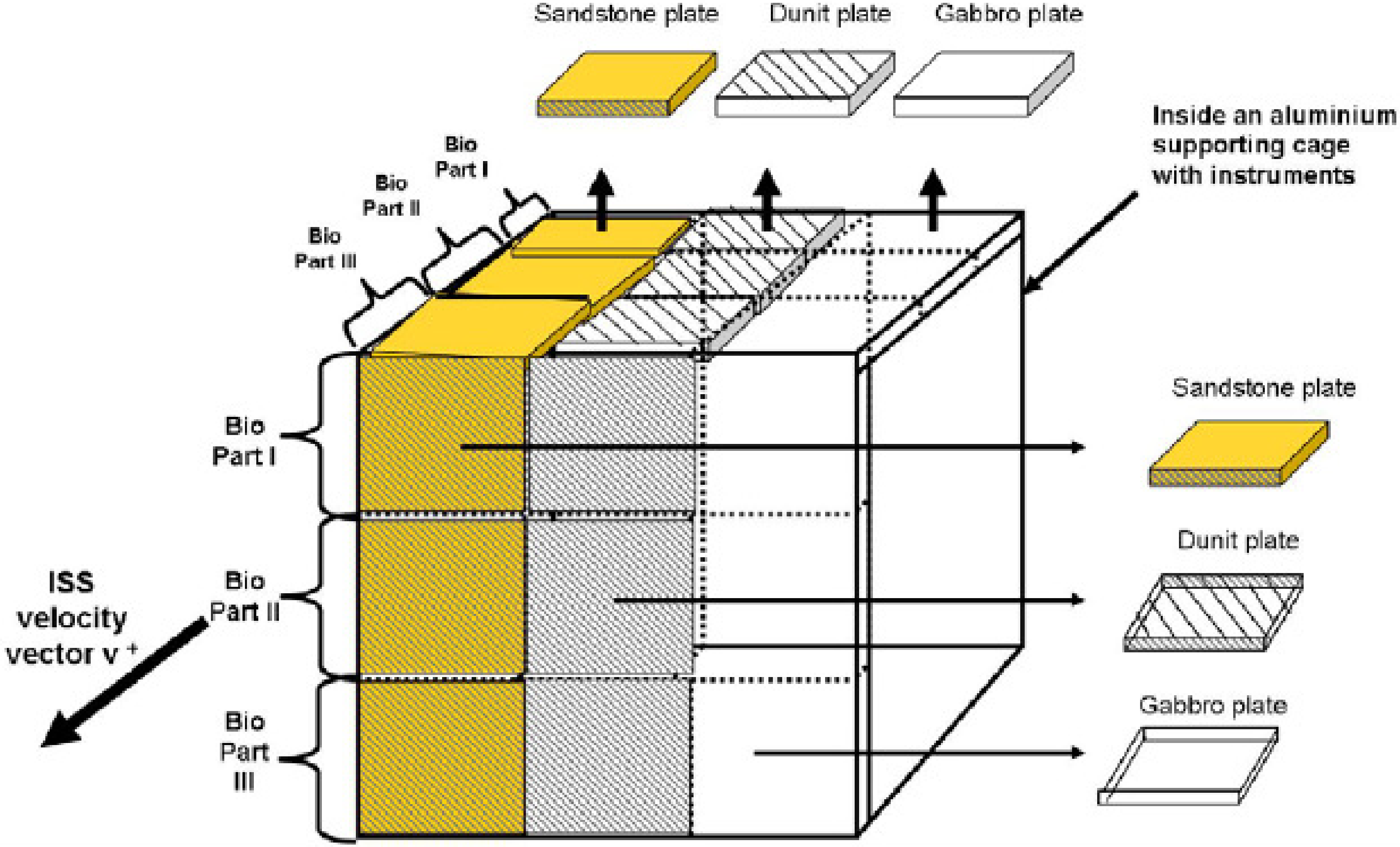
Inside, bottom: logger, memory device, dark control samples



Solar panels are optional and the cube has the flexibility to be adapted in size to different scientific requirements (flexibility for reduction or enlargement of the payload with maintained mass and low power requirements)

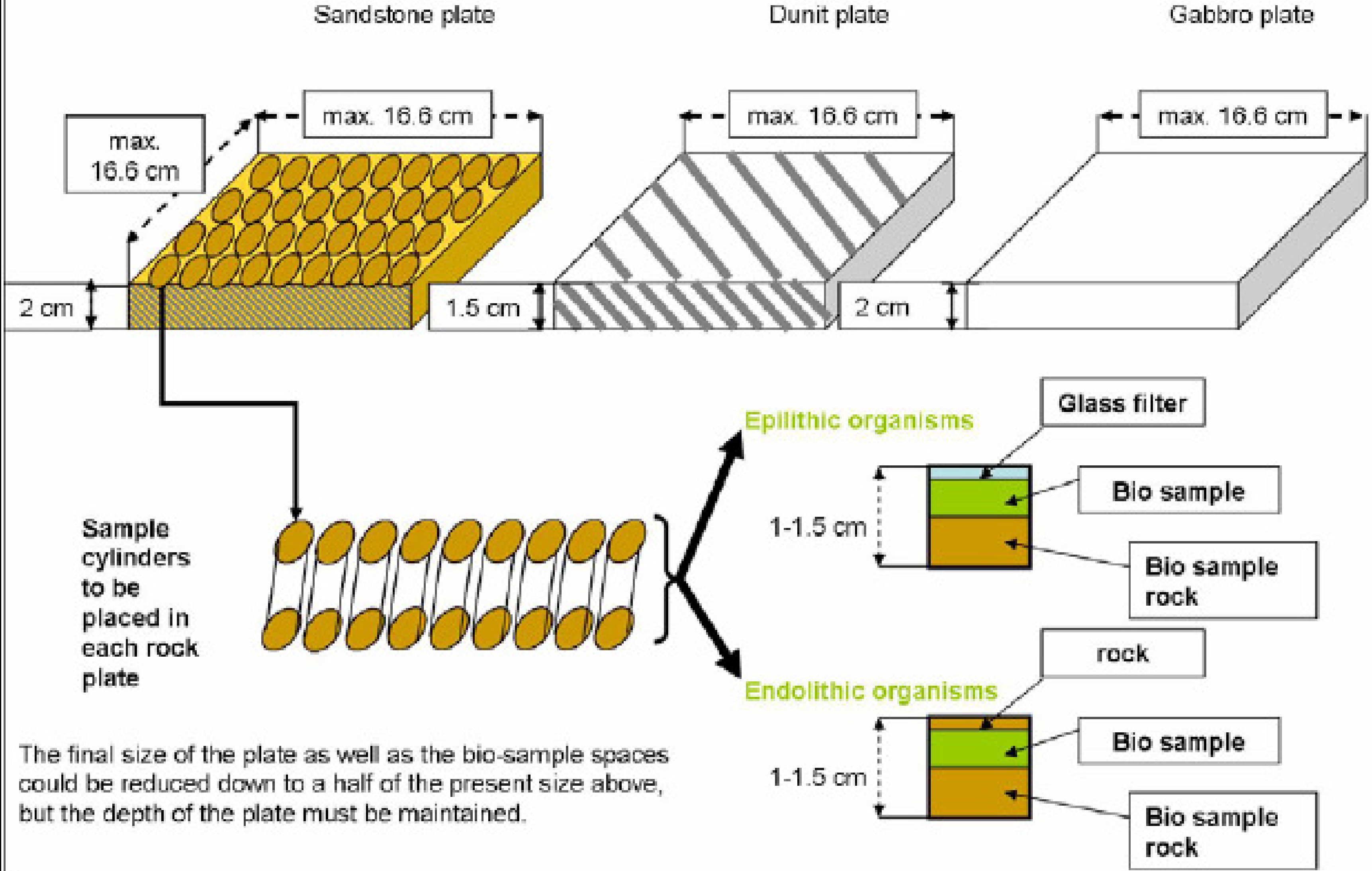
PI: Dr. Jean-Pierre de Vera,
Co-I:

Payload: LOGOS-CUBE Hardware Elements top and front surface



Experiment: LOGOS – Life-Organics and Geology Orbit Science

on Payload: LOGOS-CUBE-Hardware Plates for Biology and Geology



The final size of the plate as well as the bio-sample spaces could be reduced down to a half of the present size above, but the depth of the plate must be maintained.

Proposed Bio-Samples

List of proposed organisms:

1. Cyanobacteria (Chlorophyll)
2. Xanthoria elegans (Chlorophyll, Carotene, Parietin, Emodine, Chitin…)
3. Rhizocarpon geographicum (Chlorophyll, Melanin, Usnic acid, Chitin…)
4. Bacteria (*B. subtilis)*
5. Fungi (Melanin, Anthraquinones, Chitin, …)
6. Seeds (flavonoids, plastids…)

List of proposed isolates:

1. Chlorophyll a
2. Chlorophyll b
3. Carotene
4. Anthraquinones as Parietin
5. Chitin
6. Flavonoids
7. Plastids

The list could be enlarged, reduced or some of proposed isolates exchanged according to the requirements of each team member and ESA guide lines

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