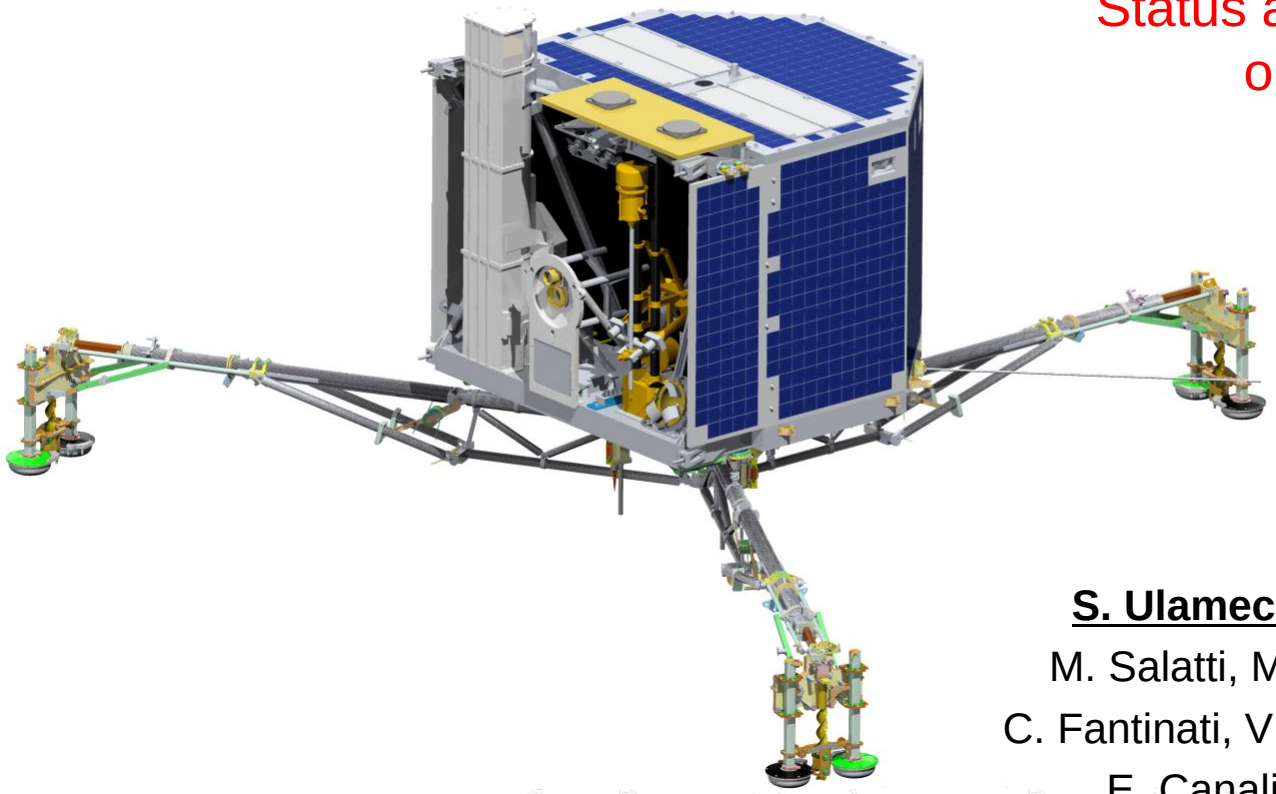
Rosetta Lander - Philae

Status after first landing on a comet



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Rosetta

- An ESA Cornerstone Mission to comet
- 67P/Churyumov Gerasimenko
- 11 Orbiter Instrumentes as well as a Lander
- Launch: March, 2004
- Exit Hibernation January 20th, 2014
- Arrival at Comet August 6th
- Landing of Philae: November 12th 2014

Core Questions addressed with Lander Science

- Is dust in the coma modified as compared to surface mineral or organic matter?
- Is the surface pristine? Or do we have to penetrate a „crust“?
- What are the volatiles embedded in the bulk material?
- What are the physical properties (strength, thermal conductivity, thermal inertia..) of the surface material
- What is the internal structure of the nucleus?

Technical Challenge

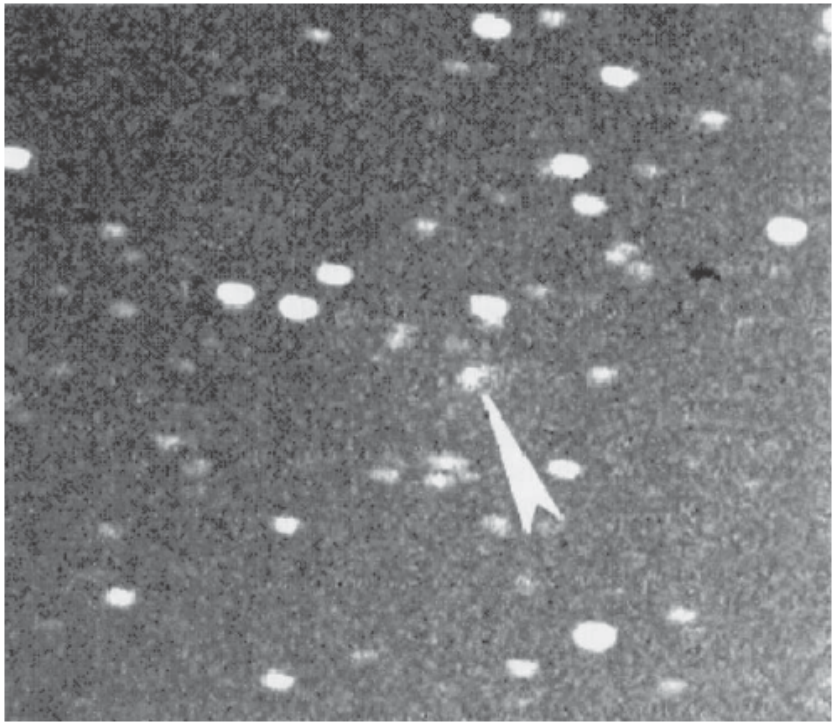
- Soft Landing on a Comet -
  Nobody has tried this till then...
- Seize, mass, day-night period, temperature and surface properties of the comet were only vaguely known, when the mission was designed
- Longterm Operations of a Lander in Deep Space without RTG´s
- 10 Science Instruments aboard a 100 kg Lander

Discovery of 67P/Churyumov-Gerasimenko

- The Comet was discovered 1969 by K. Churyumov and S. Gerasimenko
- Close (0.05 AU) encounter at Jupiter February 1959 [perihel dropped from 2.7 to 1,3 AU]

Post-discovery perihelia and corresponding designations of comet 67P/Churyumov–Gerasimenko.

New-style designation	Old-style designation	Provisional designation	Perihelion passage Calendar date and JD (CT)	Orbit
67P/1969 R1	1969 IV	1969h	1969-Sep-11.0372 = 2440475.5372	(1)
67P/1975 P1	1976 VII	1975i	1976-Apr-07.2328 = 2442875.7328	(2)
67P	1982 VIII	1982f	1982-Nov-12.0994 = 2445285.5994	(3)
67P	1989 VI	1988i	1989-Jun-18.3919 = 2447695.8919	(4)
67P	–	–	1996-Jan-17.6564 = 2450100.1564	(5)
67P	–	–	2002-Aug-18.2375 = 2452504.7375	(6)



Discovery Image of
67P Churyumov-Gerasimenko, from 1969


Creo Parametric Advanced Rendering Extension

Lander FM
Thermal-Vacuum
Test in IABG,
Oktober 2001

(Planned) Landing Scenario

- Eject from Orbiter
- Descent (ballistic)
- Stabilization with flywheel
- *Activation of comt gas system (ADS)*
- *Anchoring*

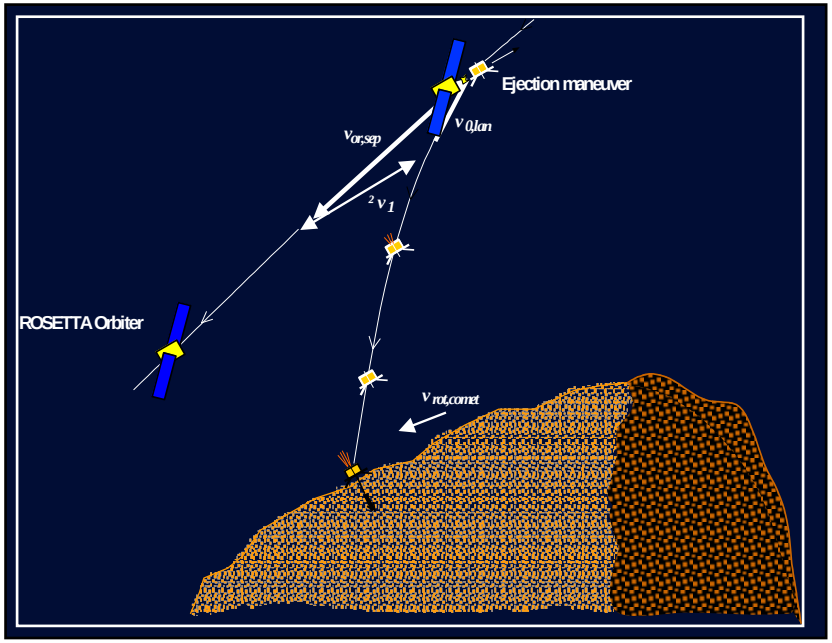
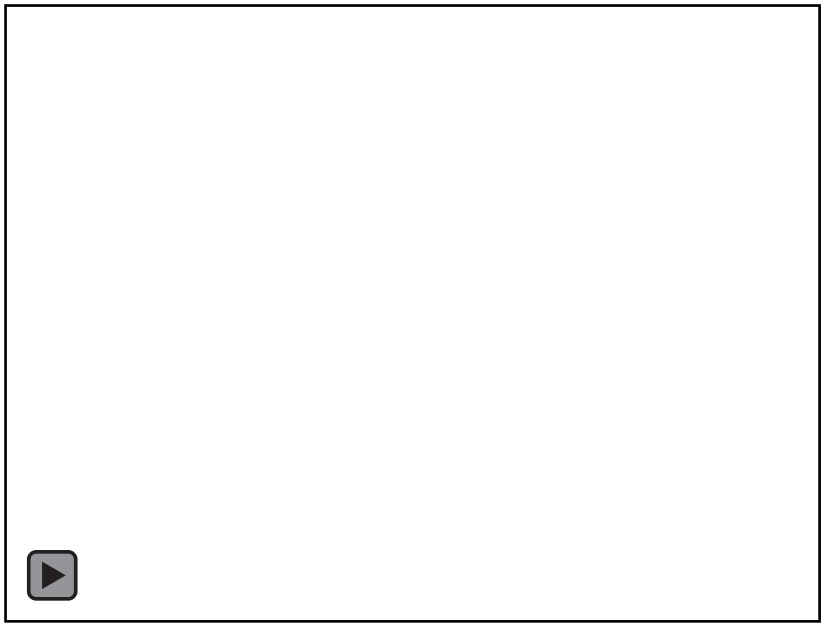


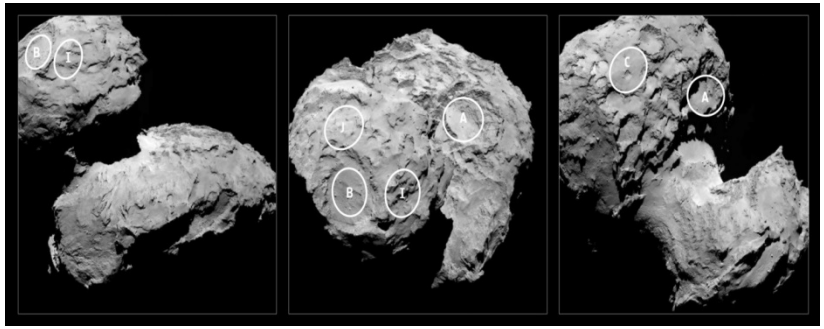
Image: OSIRIS NAC (from 50 km)

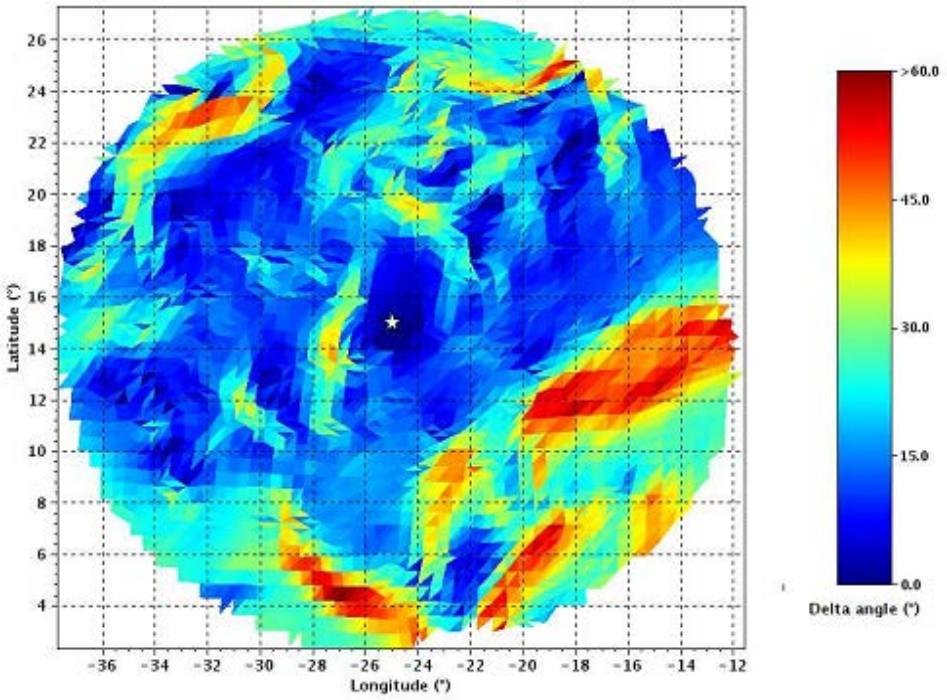
Landing Site Selection: Technical Criteria

- **Landing site**:
  - Solar illumination profile
  - Topology
  - Surface roughness
  - Soil mechanical strength
- **Flight dynamics**:
  - Orbiter visibility profile
  - Pre & post-delivery orbit feasibility
  - Nominal & backup descent trajectory feasibility
- **Science operations**:
  - FSS feasibility
  - LTS Feasibility
  - CONSERT

Reminder: our site J, (Agilkia)



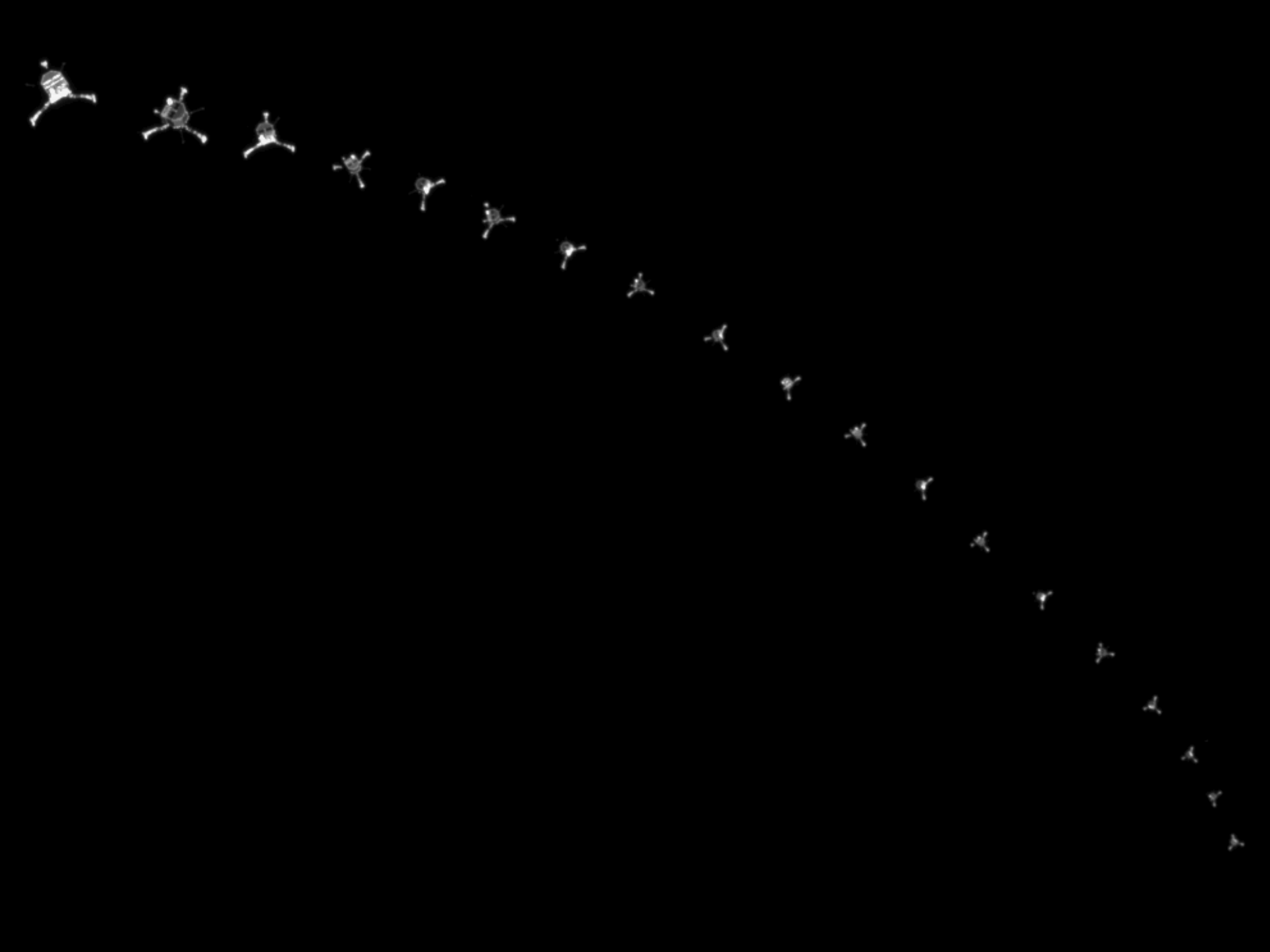


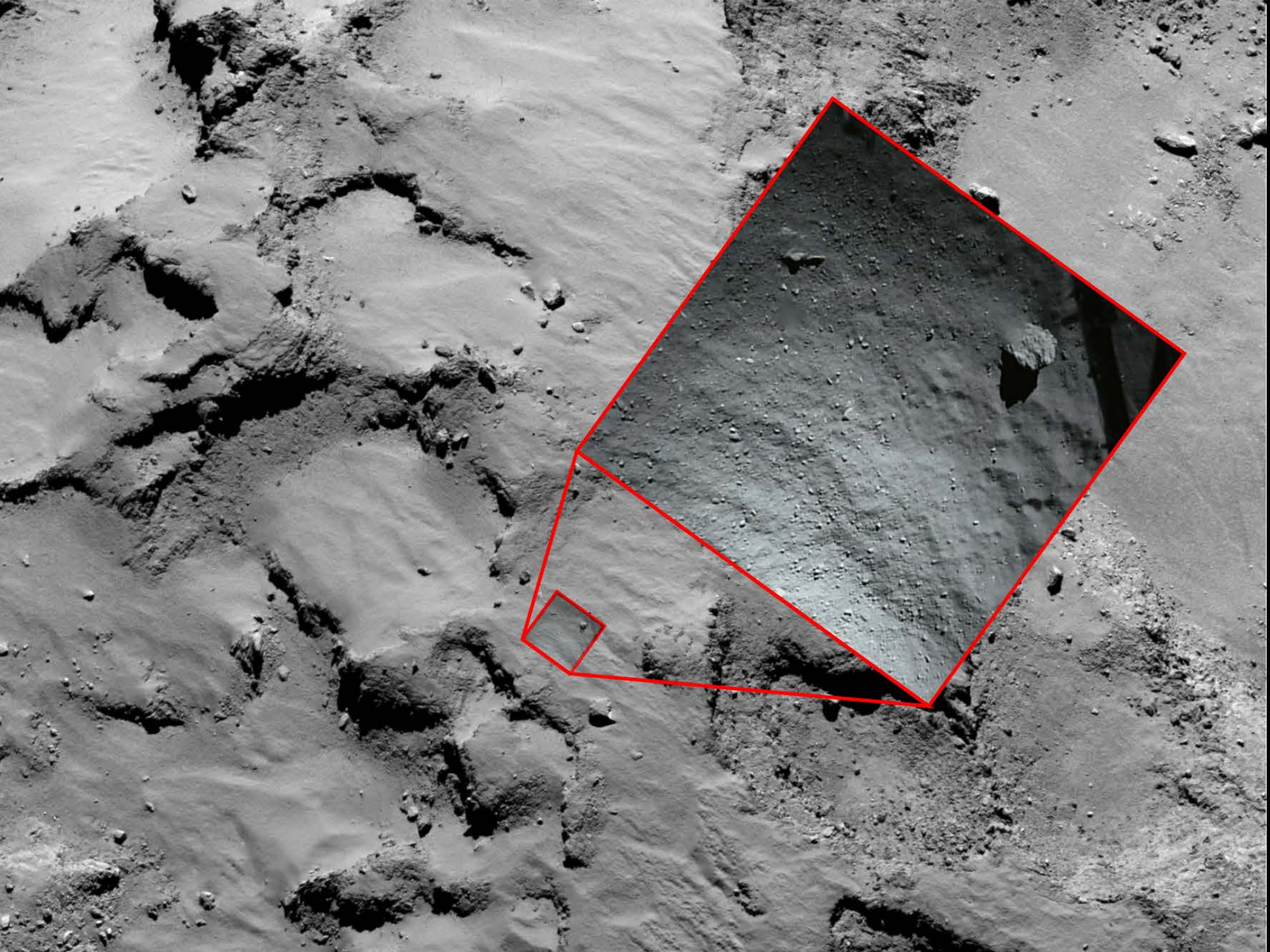


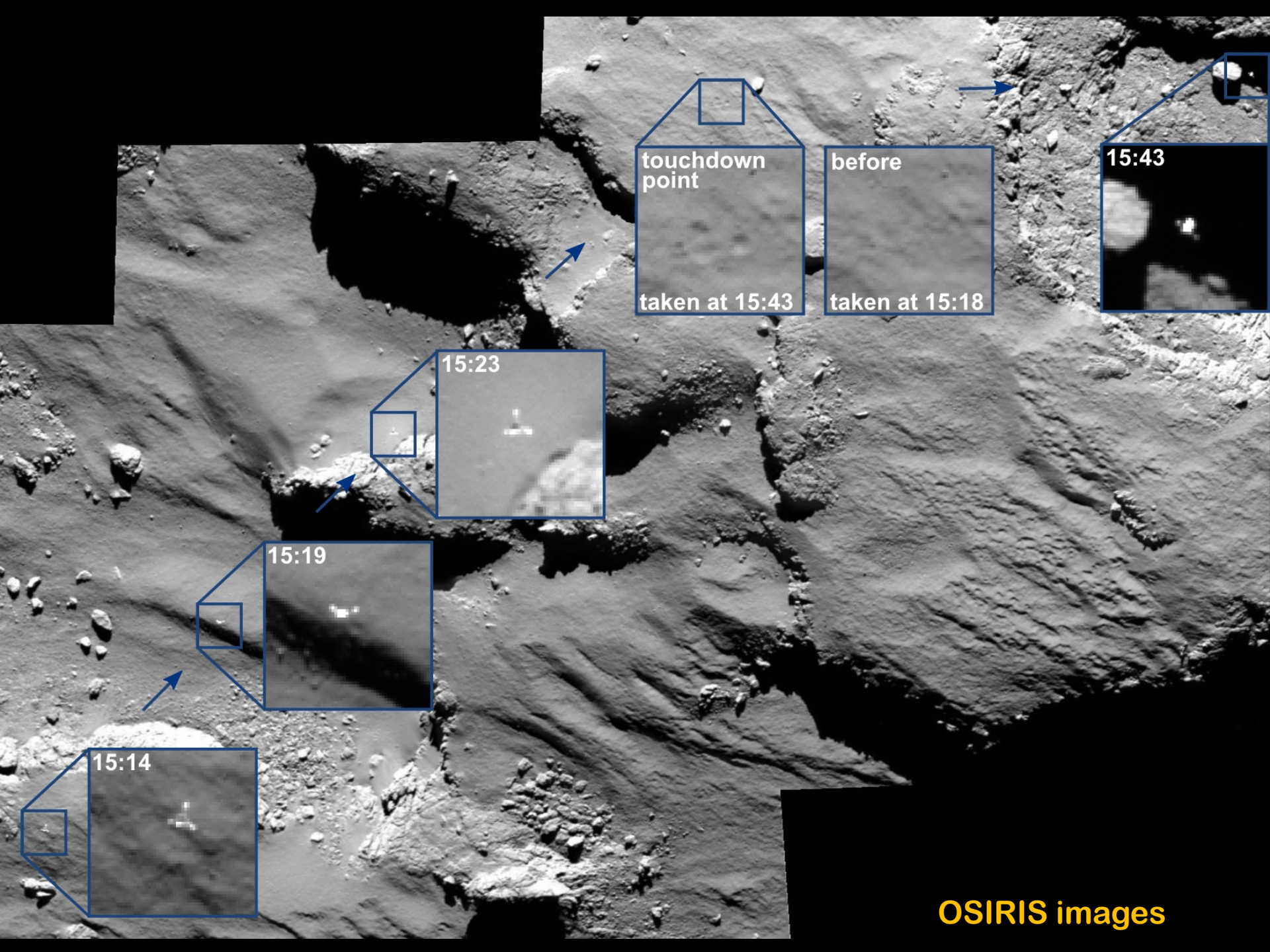
OSIRIS DTM

The week around Landing

- Landing Preparations
  - Lander switch-on: booting failed, at first attempt
  - In Cologne: Carnival season begins…..
  - ADS tank opening – failed
  - Situation critical
- Separaition
  - ADS still closed
  - GO from Lander and Orbiter
  - 12.11.14, 08:35: separation! Perfect!
- Descent and (first) touchdown
  - RF link established 2h after separation
  - **Touchdown at 15:34:04**
  - We thought.. Everything was fine **or maybe not ??**






touchdown point
taken at 15:43
before
taken at 15:18
15:43
15:23
15:19
15:14
OSIRIS images

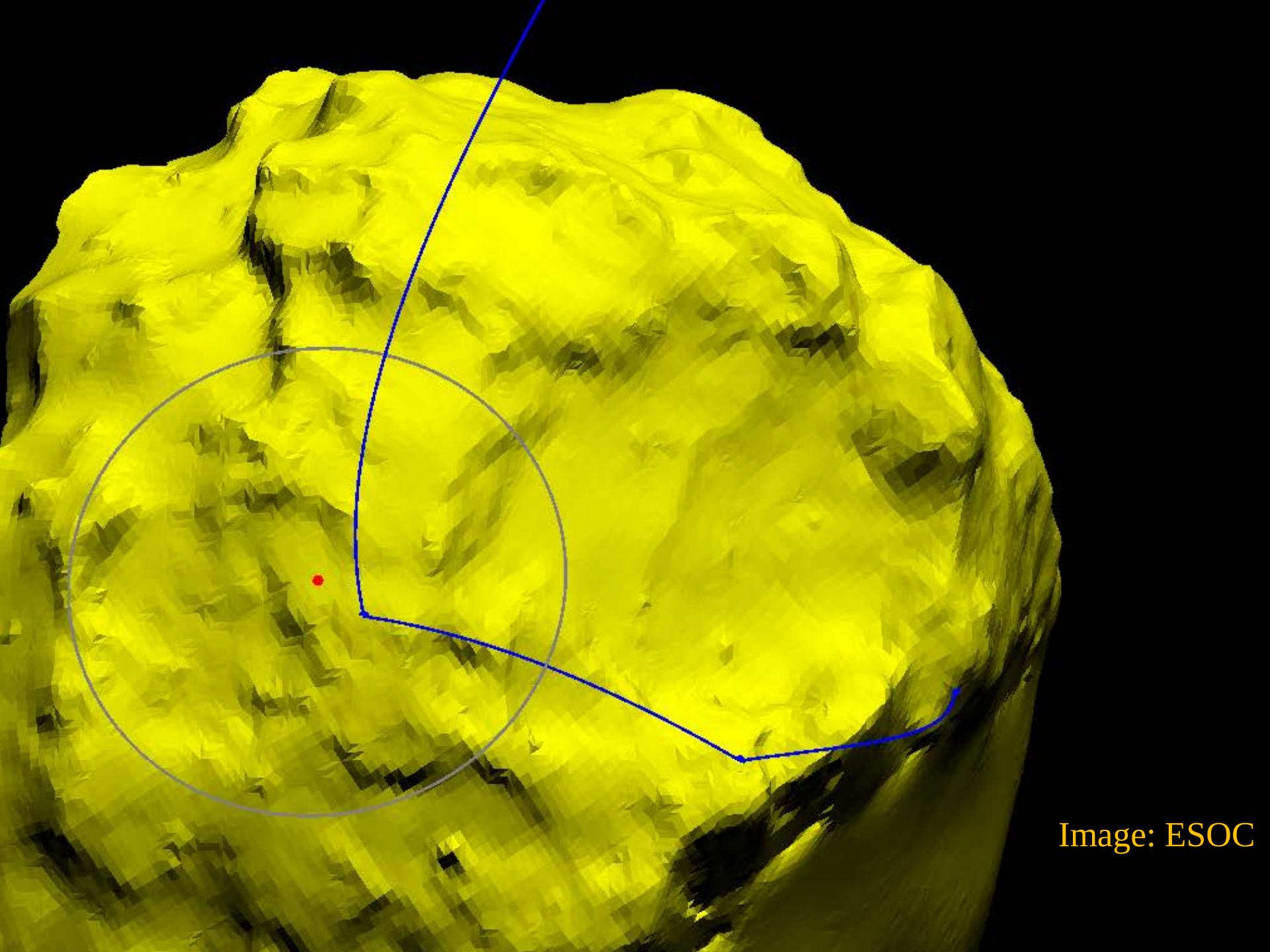
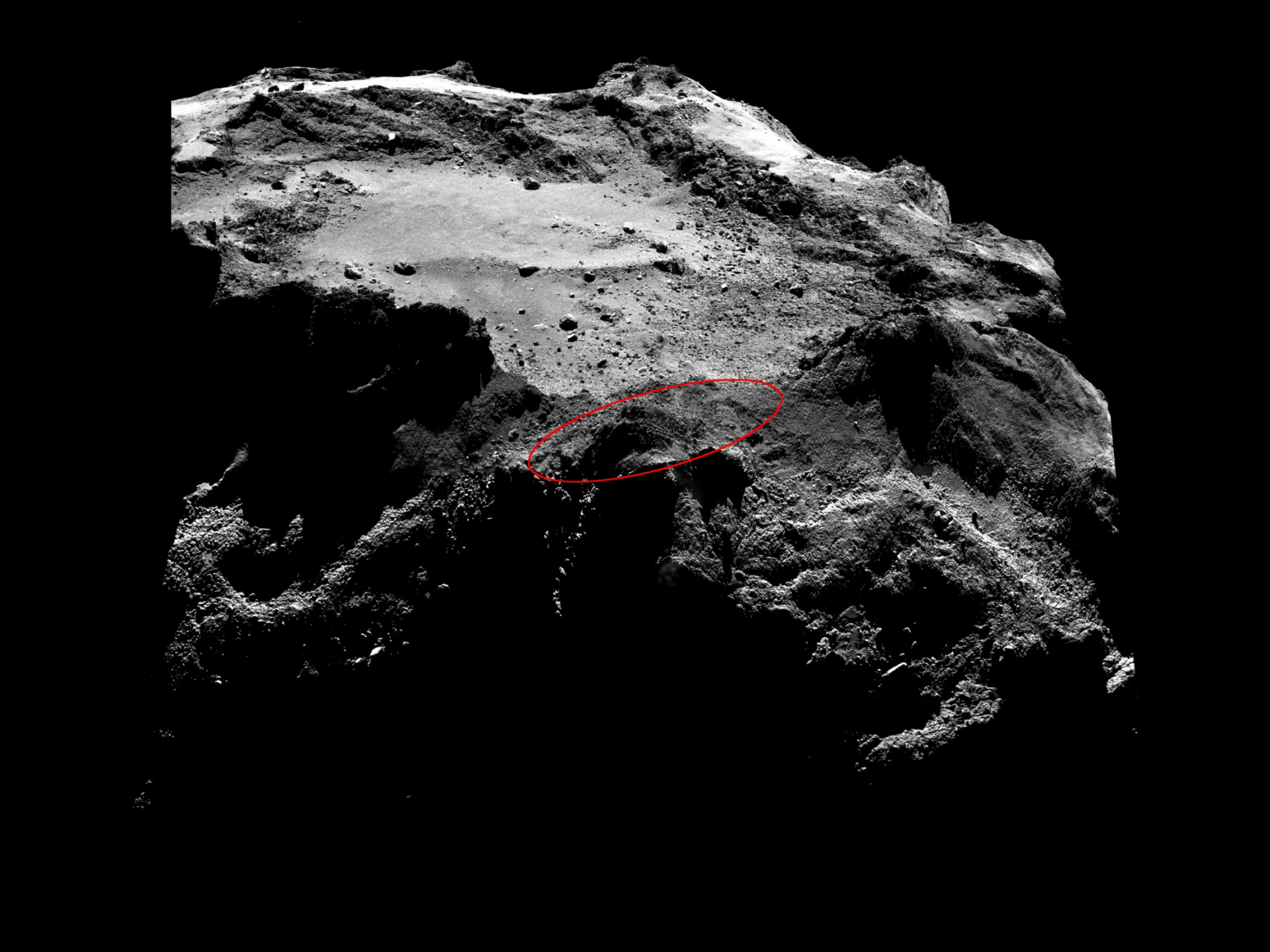
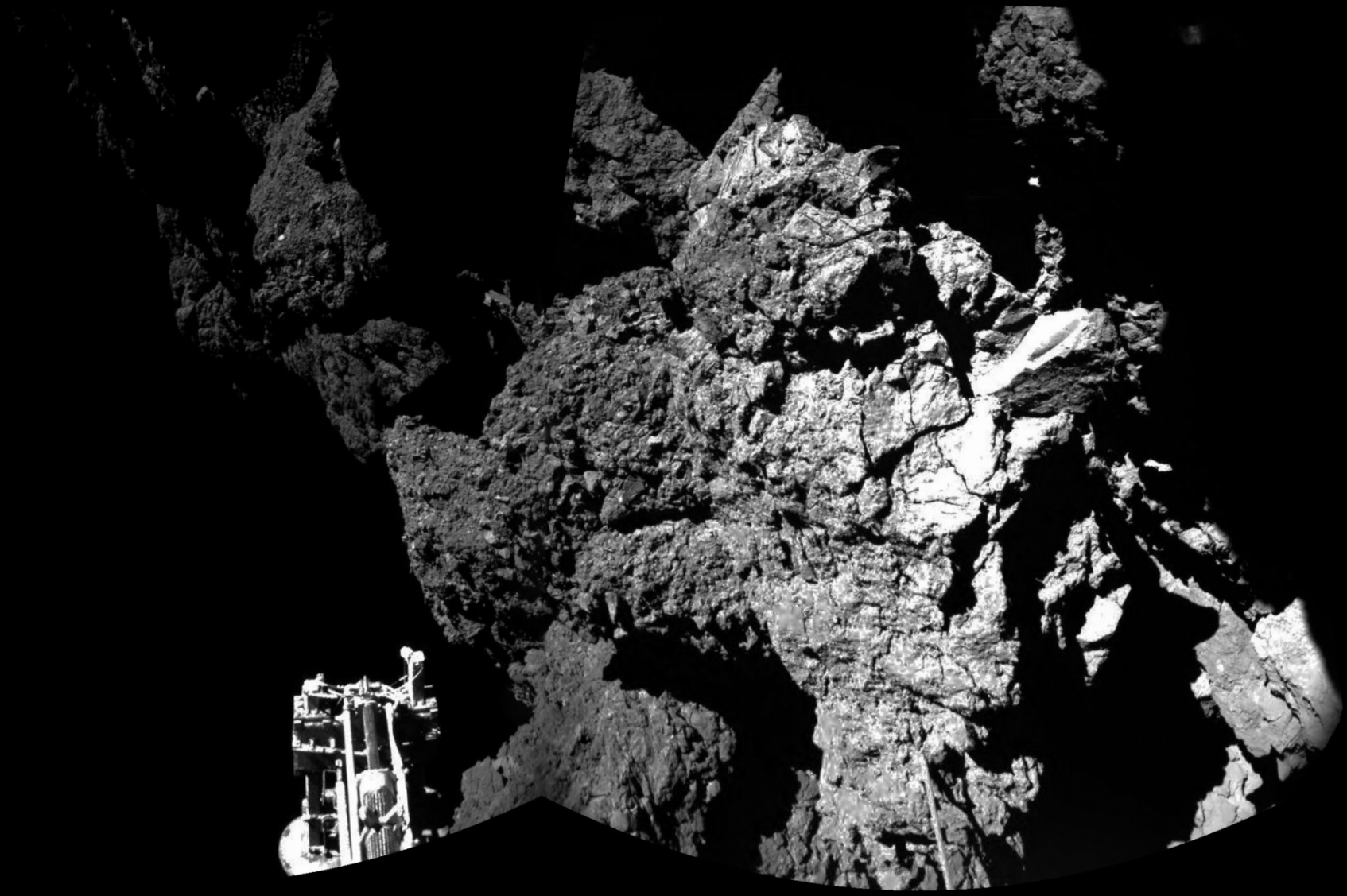
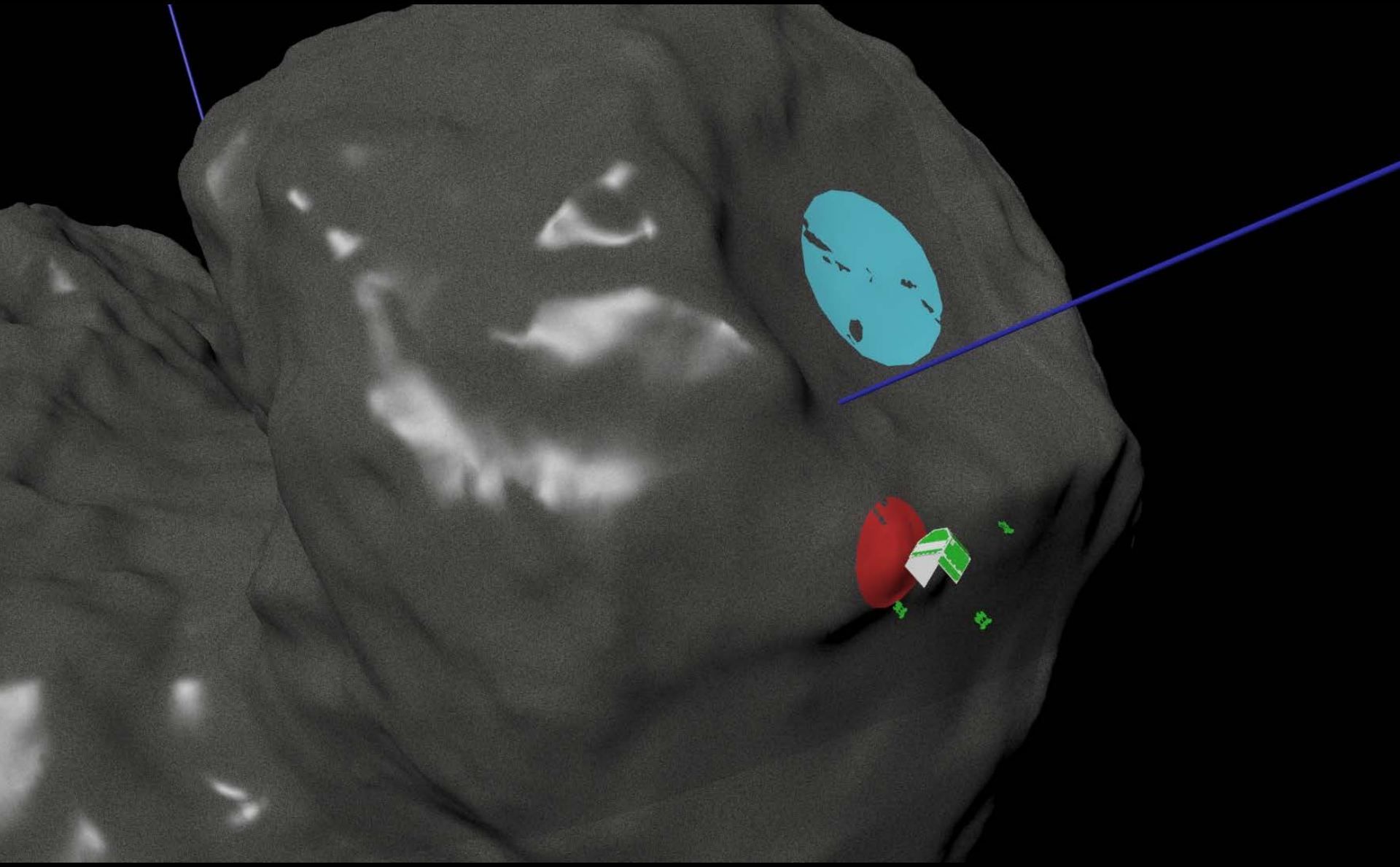


Image: ESOC



CIVA panoramic at final TD site





Improvised FSS

- Block 1 (ROMAP, CONSERT COSAC/Ptolemy sniffing)
- safe blocks 1-4, (COSAC/Ptolemy sniffing, ROMAP, SESAME, MUPUS-TM)
- updated block 6, (CIVA, MUPUS-PEN, APX), CONSERT sounding
- updated block 8, (SD^2, COSAC), CONSERT sounding
- „final ops“ (LG, carousel, PTOLEMY, ROLIS CUC, CONSERT, last science
- All instruments activated !
- TM 15.11., 00:15 G.. AMST-0, all data saved to EEPROM .. battery empty and LOS at 15.11., 00:36 UTC (ground).
- Battery life: 63.73h

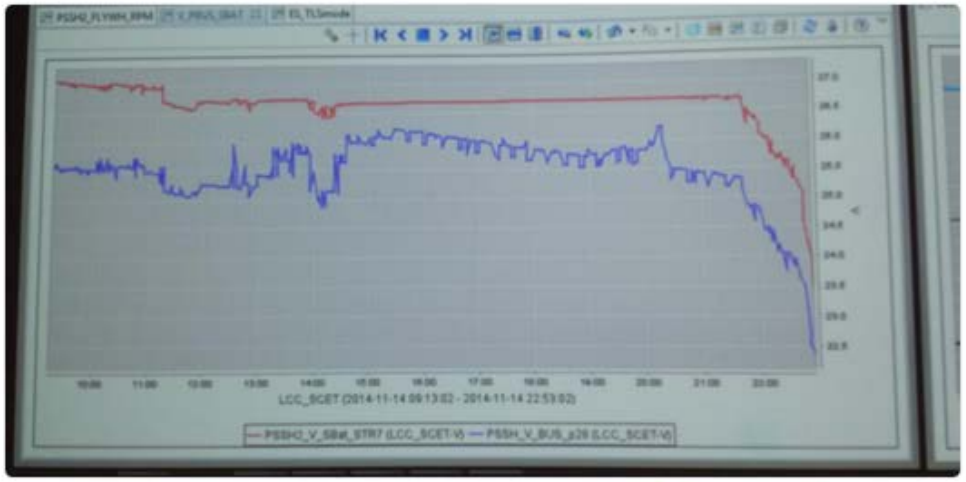
Philae Lander @Philae2014 · 15. Nov.

.@ESA_Rosetta I'm feeling a bit tired, did you get all my data? I might take a nap… #CometLanding

4,1 Tsd 3,2 Tsd

Philae Lander @Philae2014 · 14. Nov.

So much hard work.. getting tired... my battery voltage is approaching the limit soon now



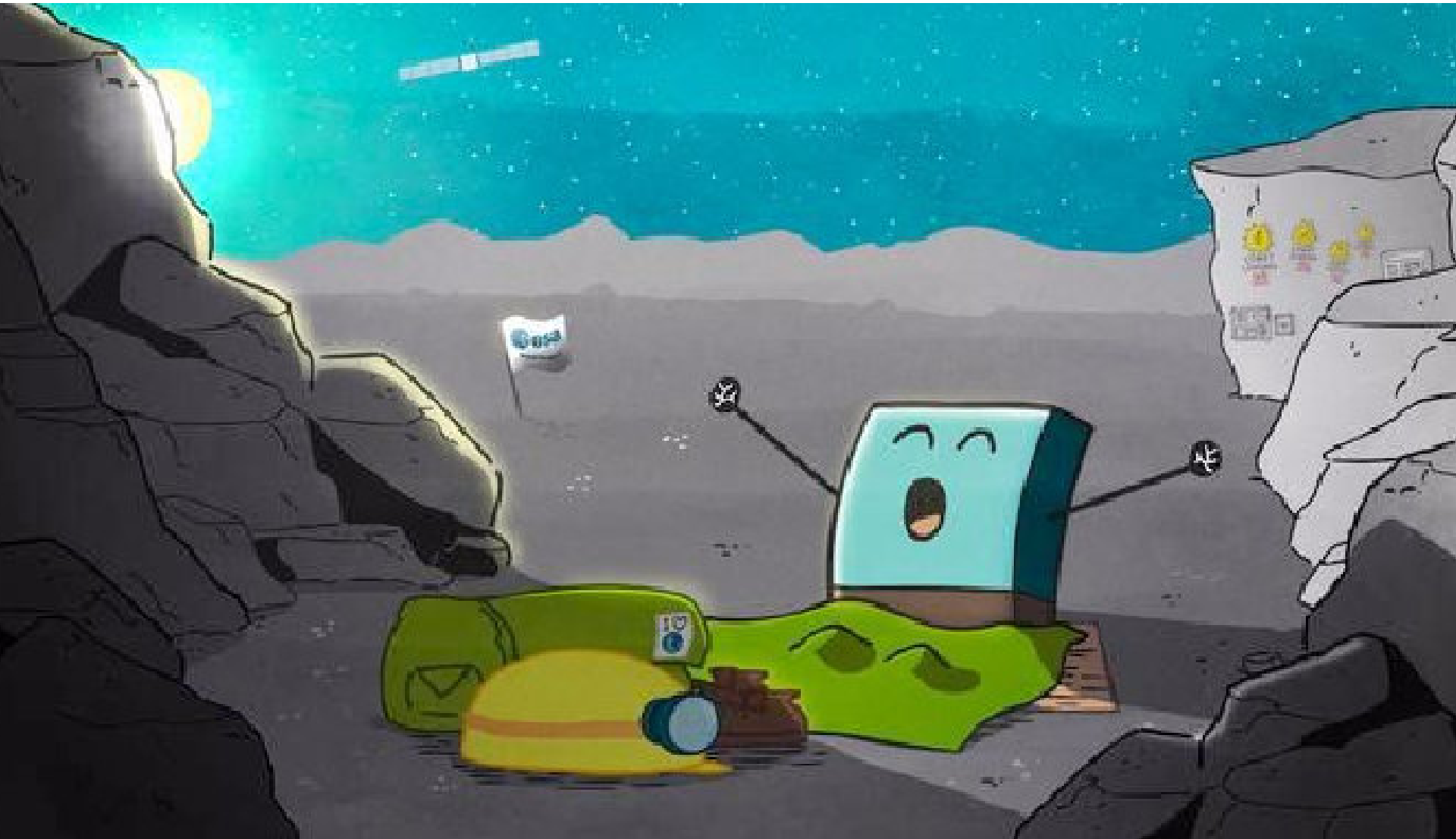
3,6 Tsd 1,8 Tsd

Mehr Fotos und Videos anzeigen

Mission over ?

What about the sleeping Lander?

We are back !!!

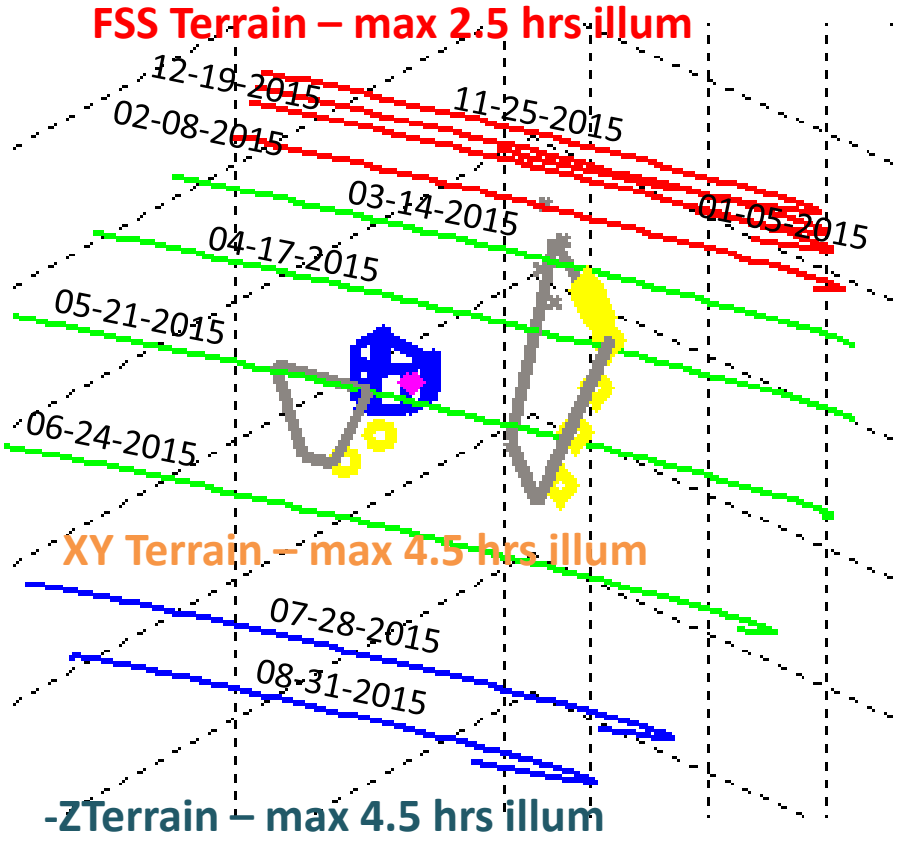


Situation for Long Term Science

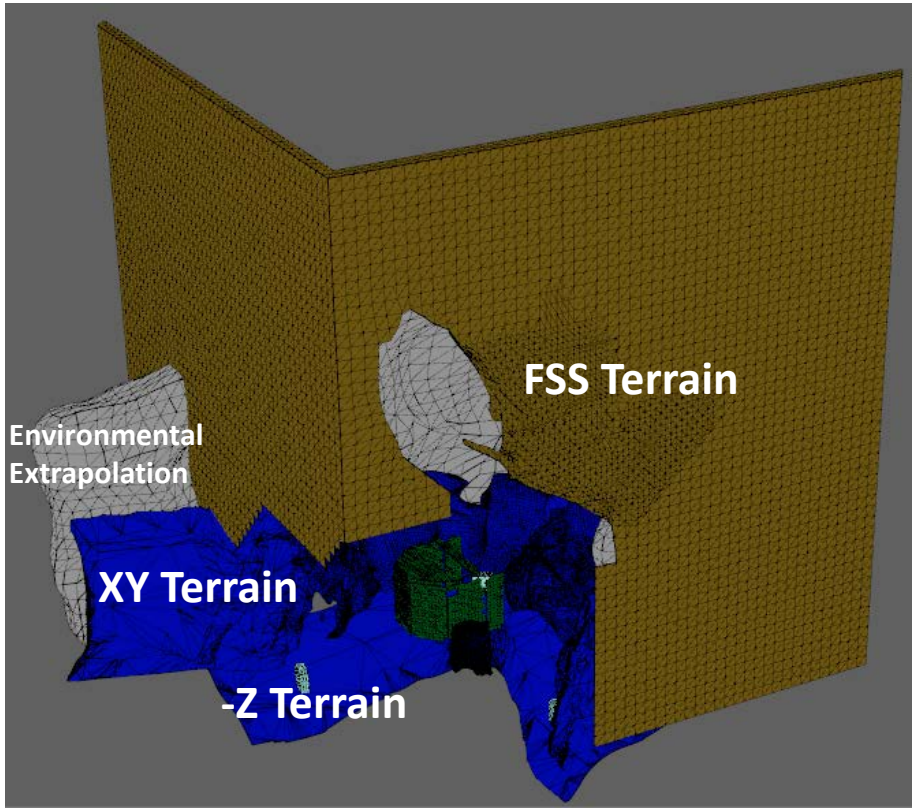
- Lander at a location with limited illumination and “some” antenna obscuration
- Situation is still improving „every day“
- Wake up after increased illumination was expected for the May – June timeframe
- First contact: June 13 (20:28 UTC) for about 85 sec
  - About 340 HK packets transmitted
  - Mass memory full (Lander awake since several days)
  - Second RF coms on June 14 (5 packets only)
- Lander healthy and in good (i.e. warm) temperature range
- Communications possibilities currently unclear and need refinement of Rosetta Orbits

Power Prediction Solar Illumination

Solar track evolution



Near-Field Terrain CAD model



We have always been optimistic
Philae would wake up !

And wildly enough: We were right !!

Lets hope for more and better
Communications possibilities!