# AEM 1905: Some considerations for EDL (entry, descent, landing)

• high/low gravity; thick/thin/no atmosphere; altitude of landing zone

• parachutes or descent (retro-rocket) engines or gliding vehicle (space shuttle)

• lift (e.g. the Curiosity lander threw off tungsten mass to gain some angle of attack)

• landing (target) ellipse

• autonomous (if unmanned landing on a distant target)

• solid surface, liquid surface, gas-only

• heat shield (often ablative)

• **Mars**: thin atmosphere, high mach number drogue, retro-rocket/powered descent, dust/wind issues, air bags vs sky crane, MER http://www.youtube.com/watch?v=-_9BYSDtwRc, MSL https://www.youtube.com/watch?v=_KLxmGLZQSY (narrated by AEM alum Steve Lee, JPL)

• **Moon**: no atmosphere, powered descent, dust, touch sensors, ascent stage

• **Earth**: thick atmosphere, skip re-entry, splash-down vs bump-down (with retro-rockets), multi-stage parachutes (for humans) http://www.youtube.com/watch?v=VvObe2XxJ1s

• **Jupiter**: thick atmosphere (won't reach the bottom of the atmosphere "alive")

• **Venus**: thick atmosphere, exceptionally hot surface

• **Comet 67P**: no atmosphere, exceptionally low gravity, 2-hour bounce!

Rosetta mission – the Philae lander
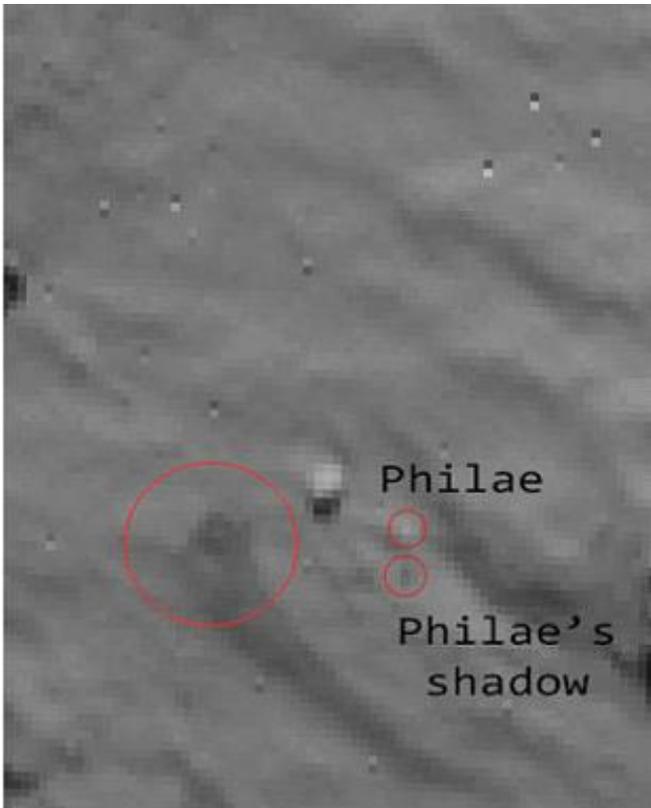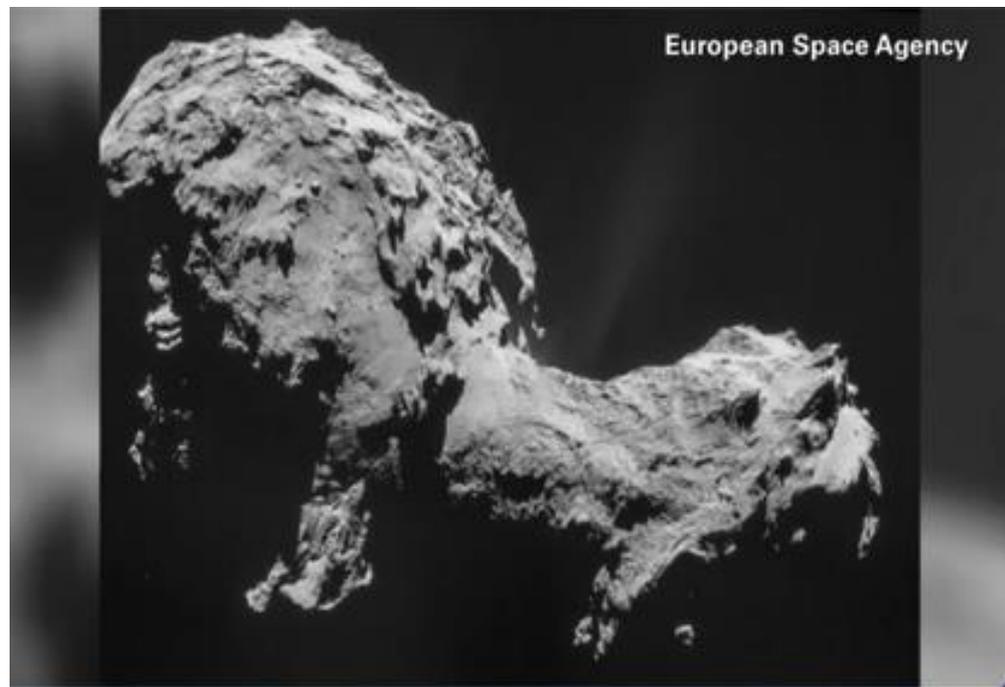
Rosetta mission – the Philae lander

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Comet lander: Camera sees Philae's hairy landing

By Jonathan Amos
Science correspondent, BBC News

touchdown point

before

taken at 15:43   taken at 15:18

15:43

15:23

15:19

15:14

ESA/ROSETTA/MPS FOR OSIRIS TEAM
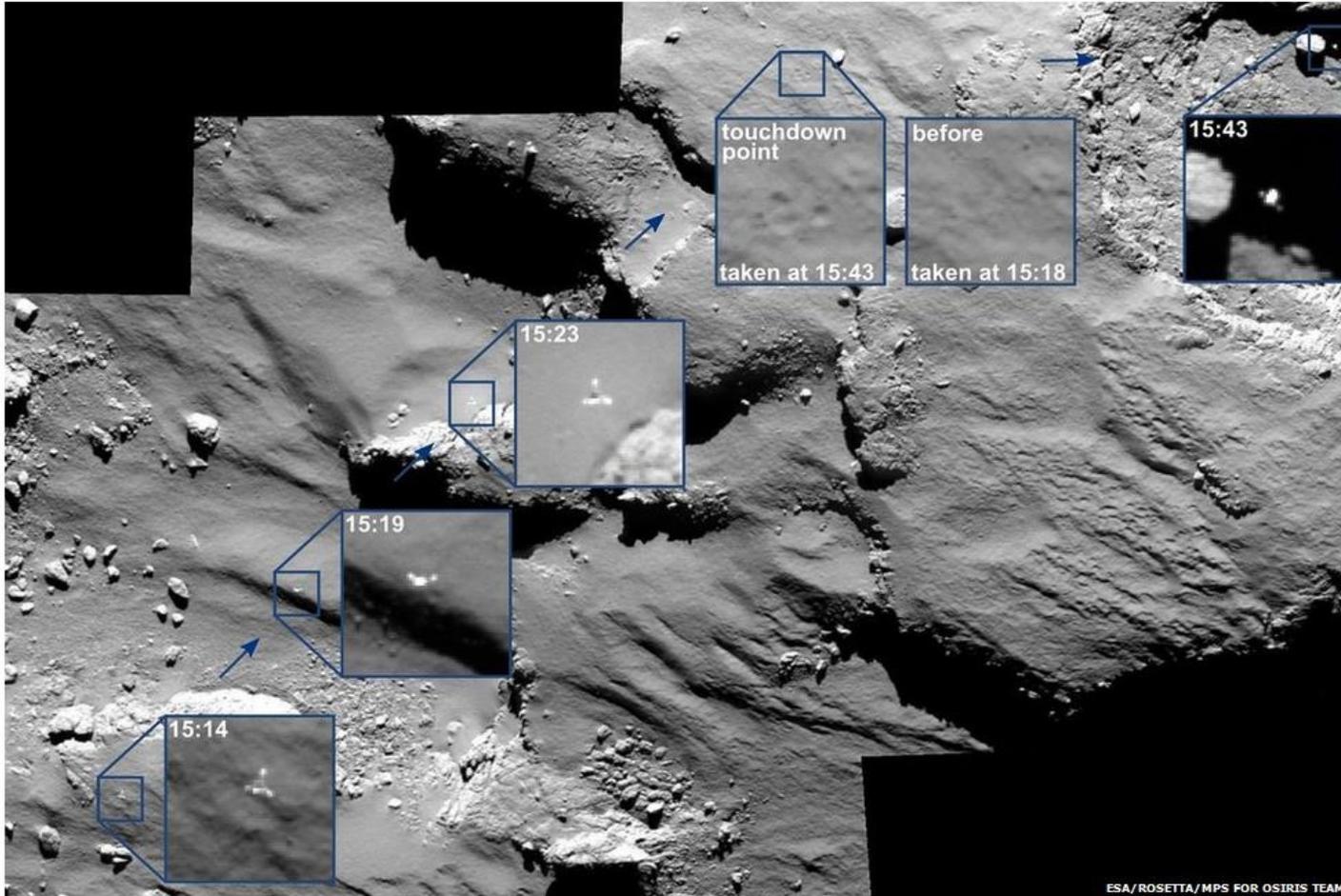
This collection of images was acquired when Rosetta was about 15km above the surface of 67P

High-resolution pictures have now been released of the Philae probe in the act of landing on Comet 67P last Wednesday.

Rosetta mission – an update

On September 2, 2016, the Philea lander was finally spotted on the surface!
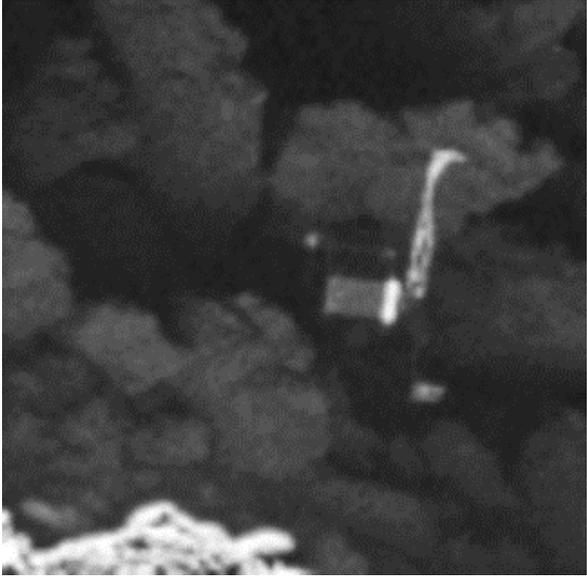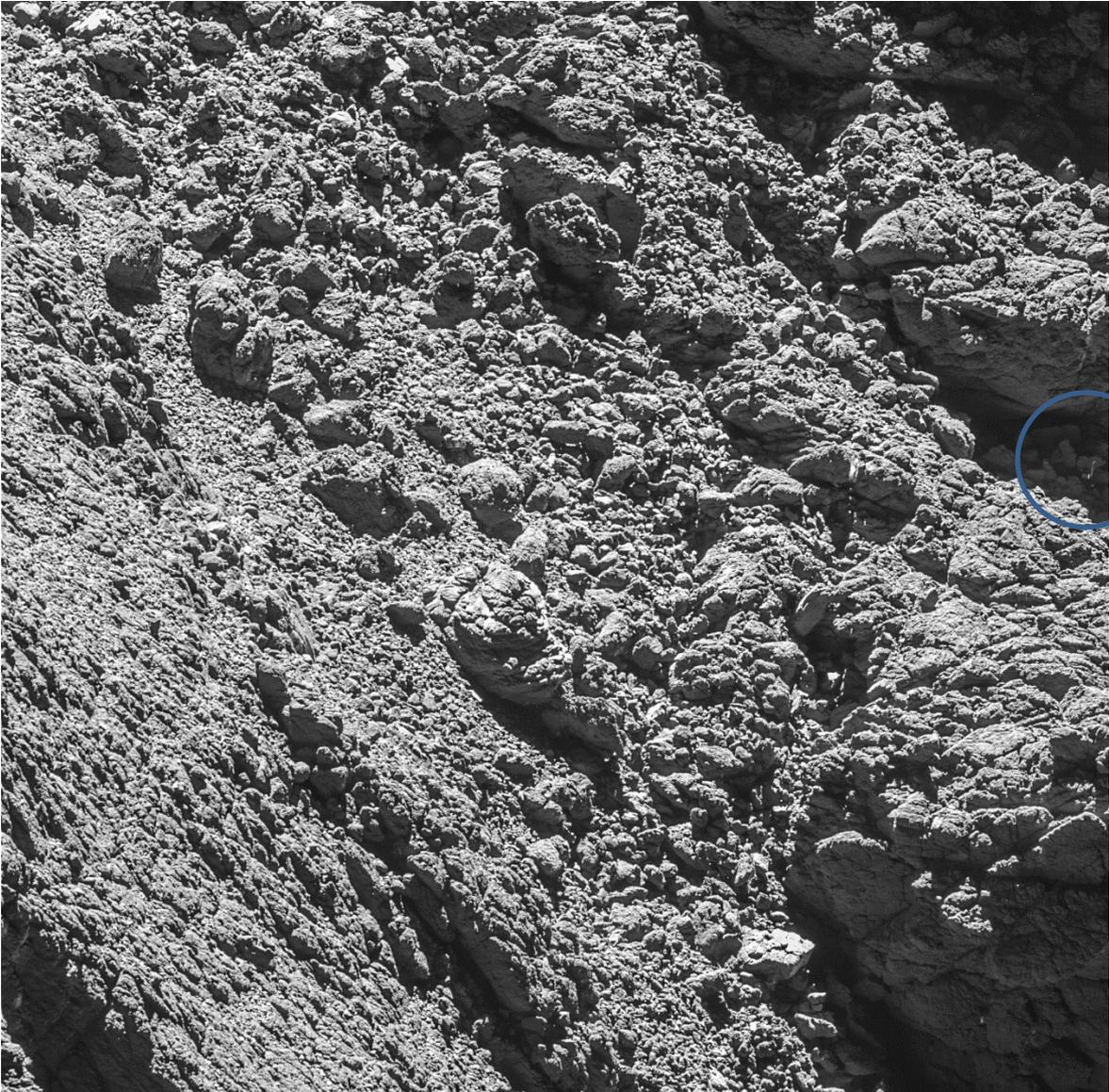
Rosetta mission – an update

On September 30, 2016, the Rosetta spacecraft was intentionally crashed.
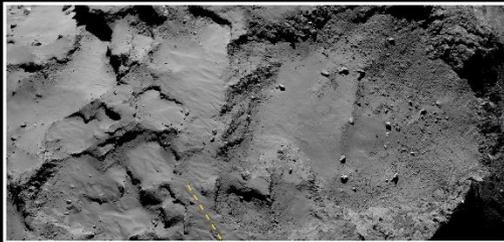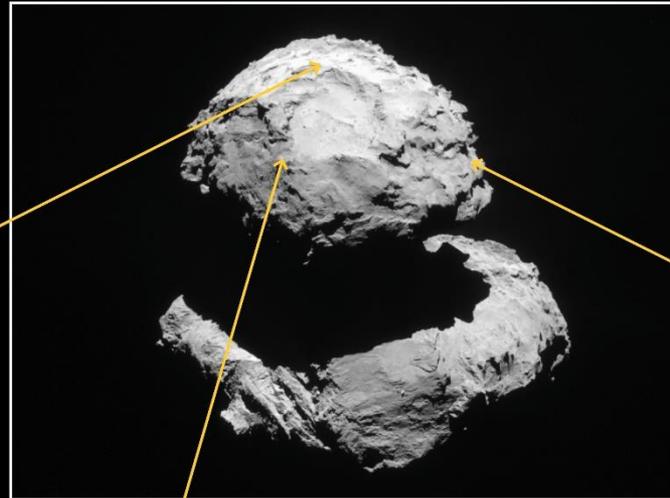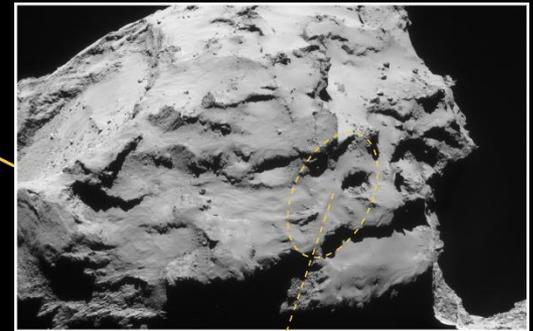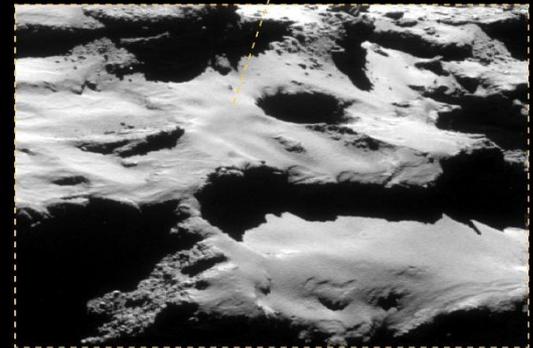
Rosetta mission – an update

Overlapping images taken on descent. About 1 km across.
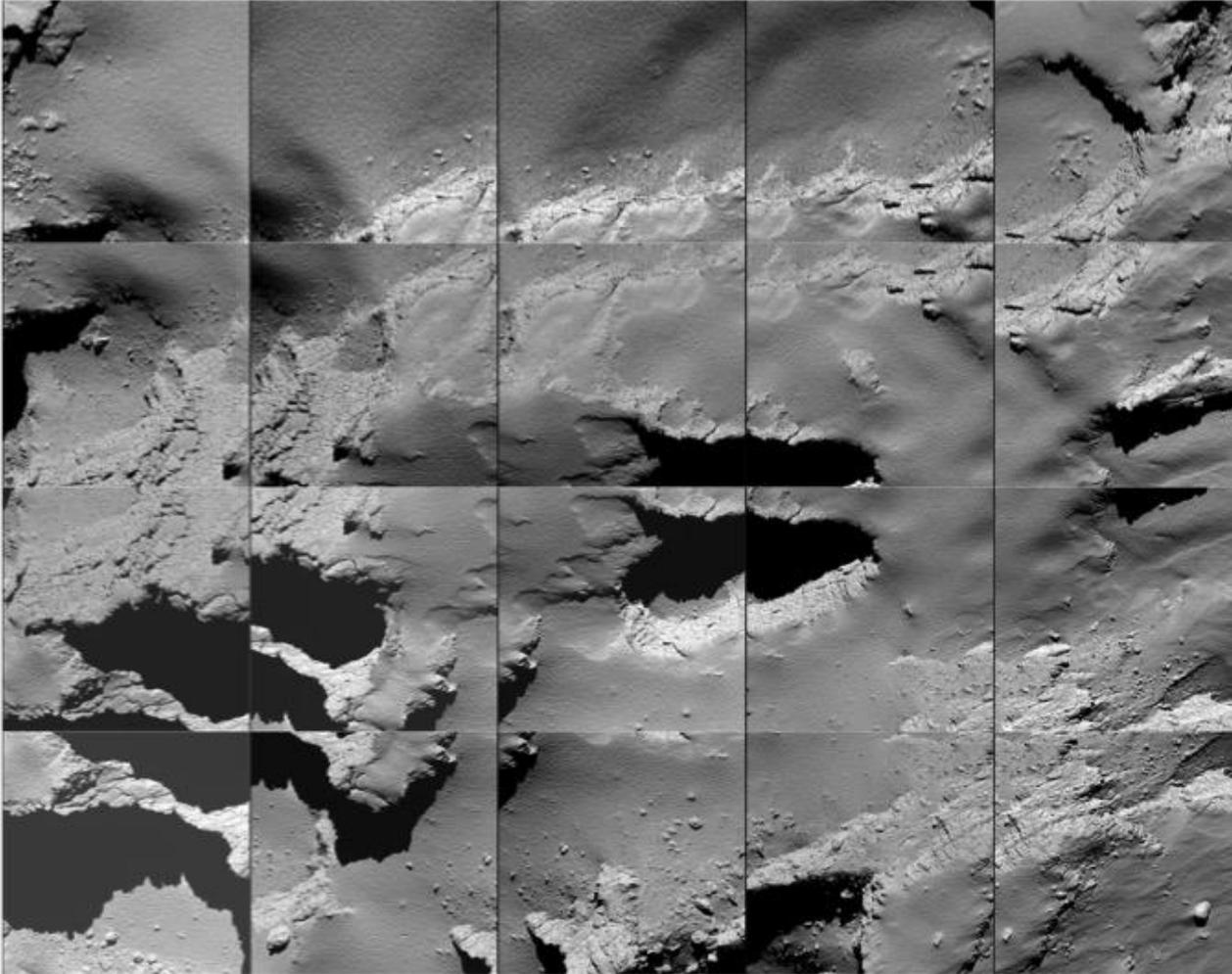
Final image from 20 m.
About 1 m across.