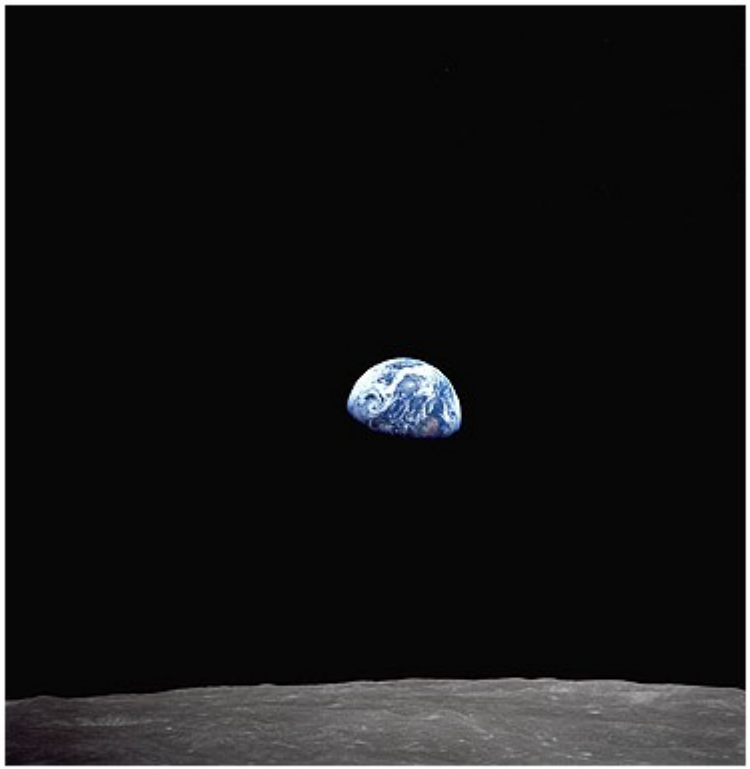
Luna

edini Zemljin satelit,
faze si sledijo s (sinodsko) periodo 29.5 dni (709 ur),
orbitalna (siderska) perioda je 27.32 dni (656 ur),
razdalja Luna Zemlja se veča ~3.8 cm/leto,
dan se daljša ~1.5 ms/stoletje,
libracije, sprednja&zadnja, ne pa svetla&temna stran.

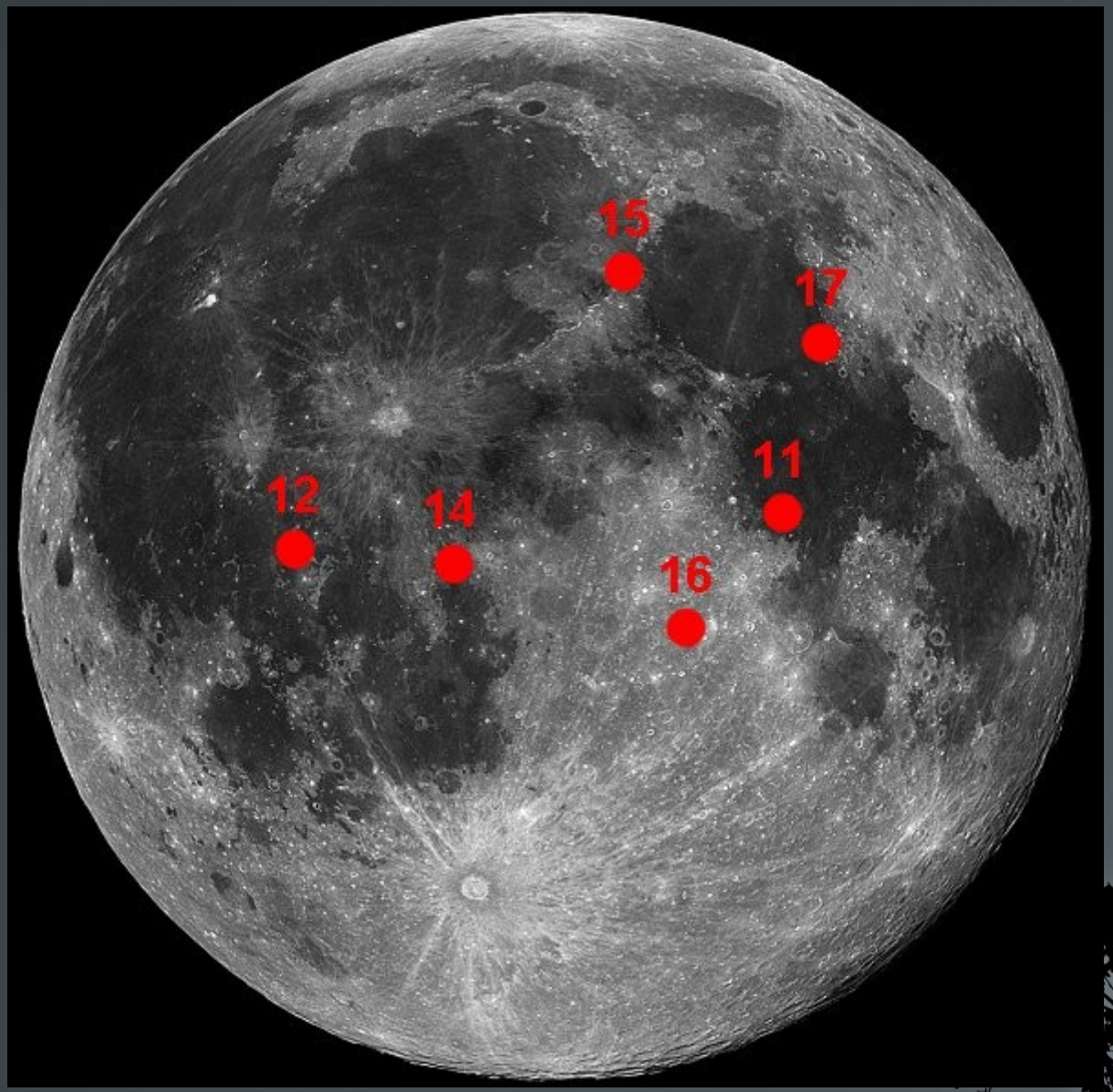
Zemlja z Lune

Earthrise



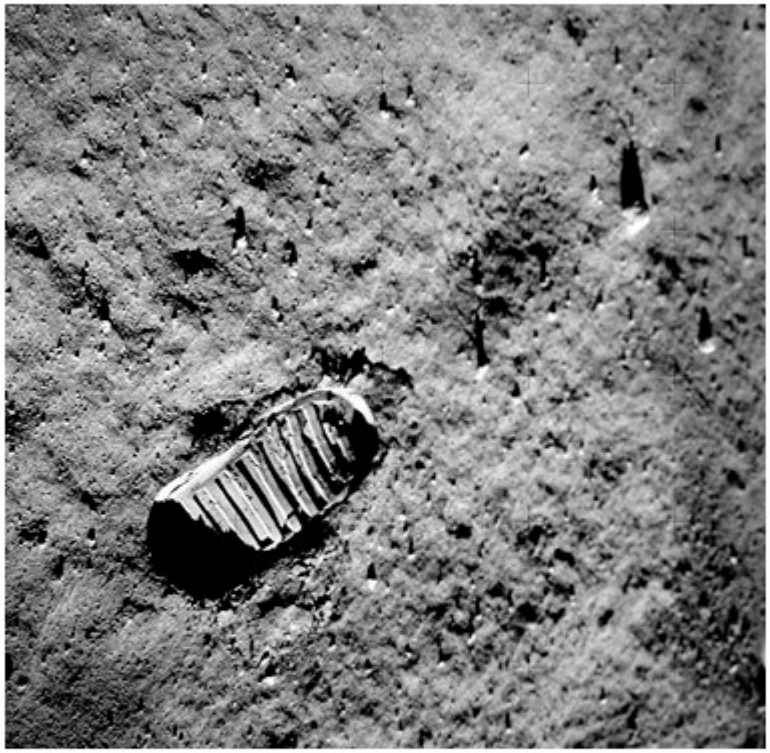
. Expeditions to the Moon created a new image of the Earth as a blue and turquoise ball suspended all alone in the dark chill of outer space, light and round and shimmering like a bubble, flecked with delicate white clouds. This image was taken from the Apollo 8 spacecraft in 1968. (Courtesy of NASA.).

Pristanki Apollovih misij na Luni



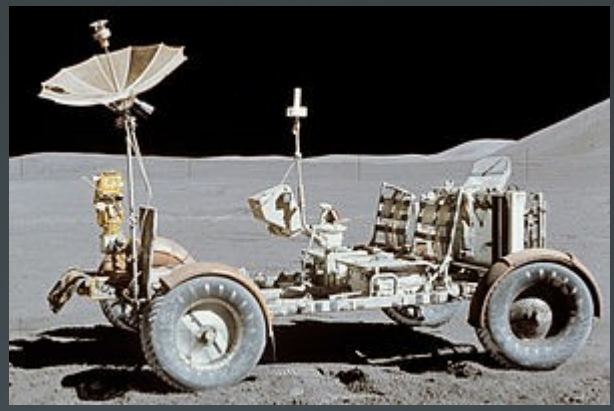
Raziskovanje Lune

Boot prints on the Moon



. On 20 July 1969, Neil Armstrong became the first human to walk on the Moon. His boot print, shown here, reveals a thin layer of Moon dust, about 0.01 meters thick. Because there is no atmosphere, water or weather on the Moon, the footprint will probably remain for 1 or 2 million years. By that time, the constant rain of micrometeorites will have erased it. Altogether, twelve astronauts have left boot prints on the Moon. (Courtesy of NASA.)

Raziskovanje Lune



The Lunar Roving Vehicle had a mass of 463 lb (210 kg), which resulted in a lunar weight of 77.2 lbf (35.0 kgf) - and was designed to hold a payload of an additional 1,080 lb (490 kg) on the lunar surface. The frame was 10 ft (3.0 m) long with a wheelbase of 7.5 ft (2.3 m). The height of the vehicle was 3.6 feet (1.1 m). The frame was made of aluminum alloy 2219

John Young works at the LRV near the LM *Orion* on Apollo 16 in April 1972.

LRVs were used for greater surface mobility during the Apollo J-class missions, *Apollo 15*, *Apollo 16*, and *Apollo 17*. The rover was first used on 31 July 1971, during the Apollo 15 mission. This greatly expanded the range of the lunar explorers. Previous teams of astronauts were restricted to short walking distances around the landing site due to the bulky space suit equipment required to sustain life in the lunar environment. The range, however, was operationally restricted to remain within walking distance of the lunar module, in case the rover broke down at any point.[14] The rovers were designed with a top speed of about 8 mph (13 km/h), although Eugene Cernan recorded a maximum speed of 11.2 mph (18.0 km/h), giving him the (unofficial) lunar land-speed record.[15]

The LRV was developed in only 17 months and yet performed all its functions on the Moon with no major anomalies. Scientist-astronaut Harrison Schmitt of Apollo 17 said, "The Lunar Rover proved to be the reliable, safe and flexible lunar exploration vehicle we expected it to be. Without it, the major scientific discoveries of Apollo 15, 16, and 17 would not have been possible; and our current understanding of lunar evolution would not have been possible."[14]

Raziskovanje Lune

Lunar rover

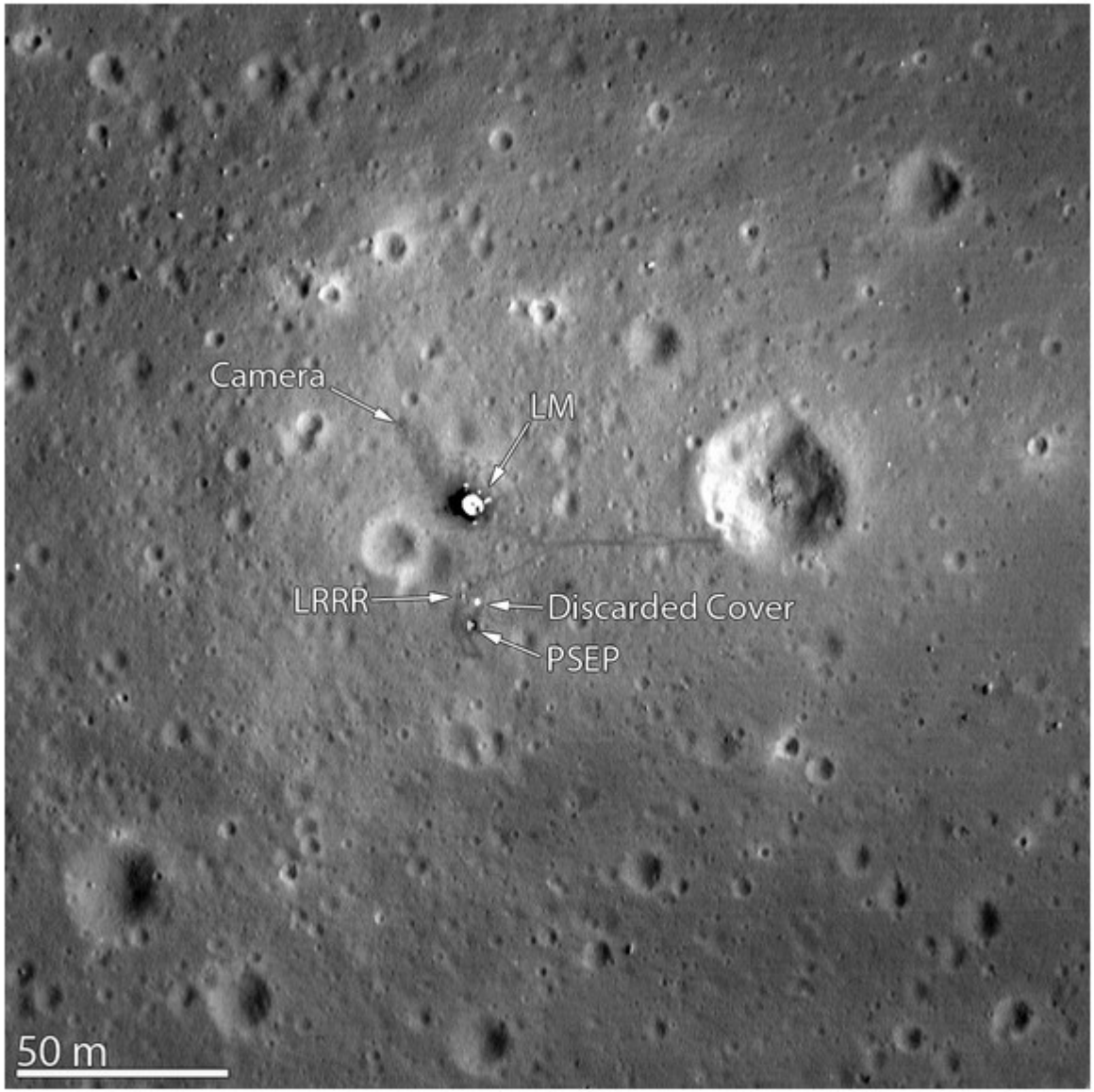
. The battery-powered lunar rovers, used in the last three Apollo missions, could carry two astronauts and all their equipment for thousands of meters across the lunar surface. Because there is no substantial atmosphere, water or weather on the Moon, both the rover and the footprints in the lunar soil may last for millions of years. By that time micrometeorites will have pitted the rover and erased the footprints. (Courtesy of NASA.)

Raziskovanje Lune

Moon ride

. Eugene Cernan walks away from his lunar rover at the edge of the lunar highlands during the Apollo 17 mission in December 1972. Sculptured, rolling hills are present in the background, and the South Massif is at the far right. The mountains of the Moon have smooth, rounded contours, primarily because there has been no water or ice erosion to sculpt them into steep peaks and valleys. The astronauts used roving vehicles like this one to travel across the Moon's rugged terrain, gathering rocks from a wide variety of locations. The rovers were left on the Moon. Free from wind, rain and rust, they will remain intact for millions of years; one might even imaging a returning astronaut using one that was discarded hundreds of years before. (Courtesy of NASA.)

Kraj pristanka Apolla 11 z LRO

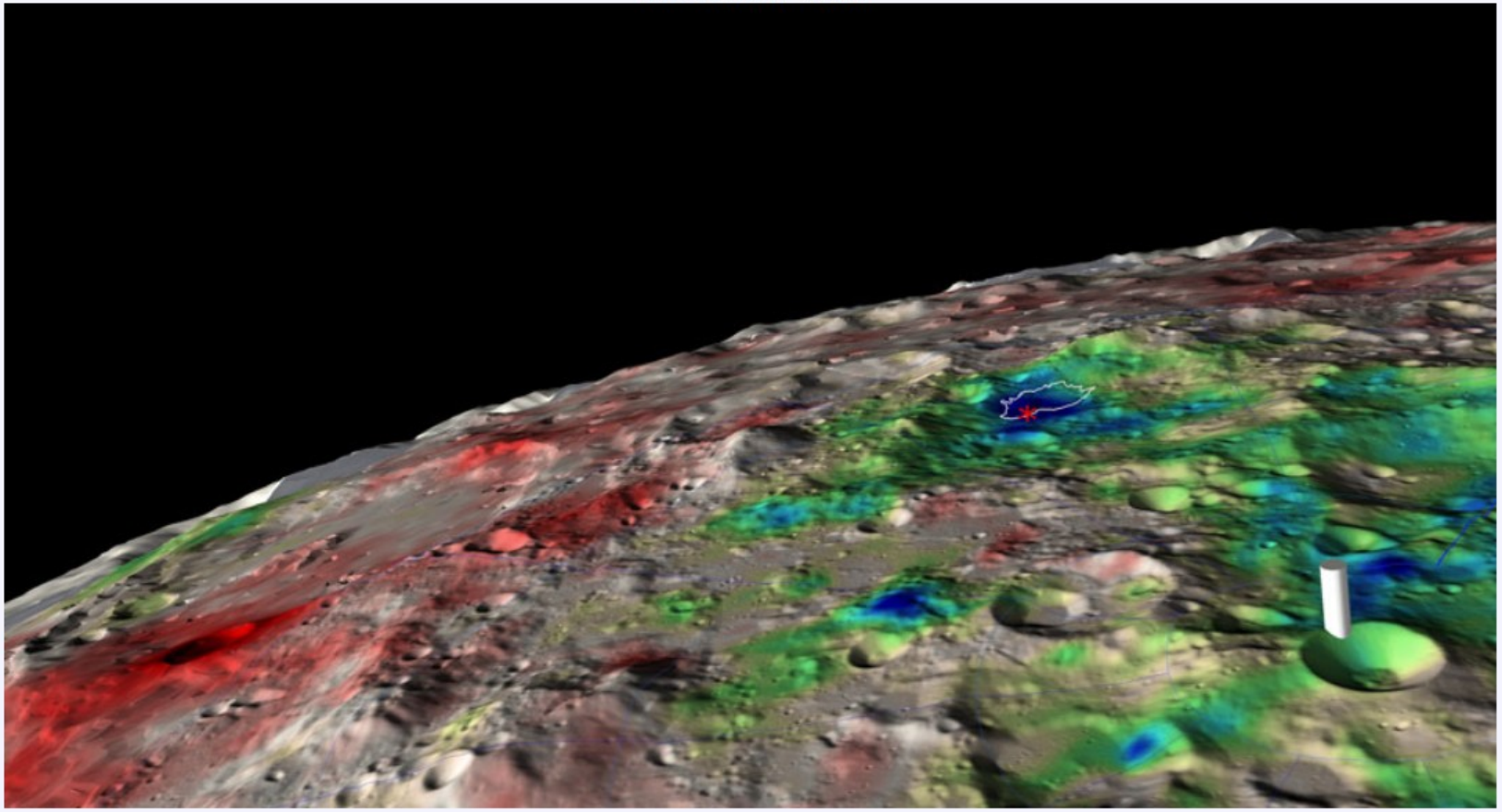


Apollo 11 Moon Landing Site Seen by Lunar Reconnaissance Orbiter

Credit: NASA/GSFC/Arizona State University

The Lunar Reconnaissance Orbiter Camera snapped its best look yet of the Apollo 11 landing site on the moon. The image, which was released on March 7, 2012, even shows the remnants of Neil Armstrong and Buzz Aldrin's historic first steps on the surface around the Lunar Module.

25. oktober 2010

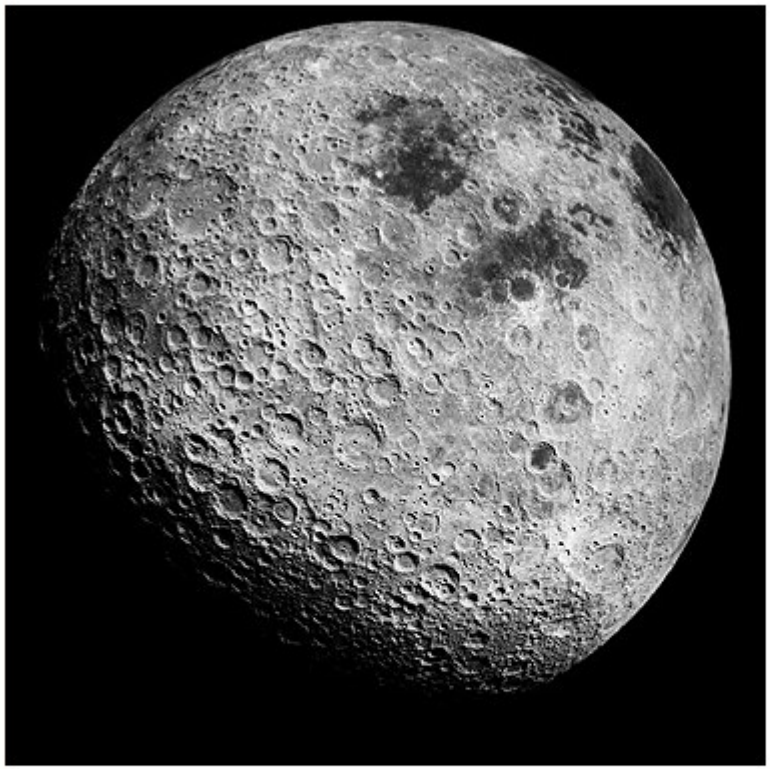


Pod Luninim površjem so odkrili vodo v obliki ledu
Credit: I. Mitrofanov et al., LCROSS, LRO, NASA

Pojasnilo: Je na Luni dovolj vode za bodoče astronavte? Vprašanaje ima globlji pomen v kolikor namerava človeštvo uporabljati Luno kot bodoče oporišče. Da bi to ugotovili so prejšnje leto znanstveniki v kraterju blizu Luninega južnega tečaja raztreščili vesoljsko plovilo LCROSS, ki je bilo v orbiti okoli Lune. Nove analize ostankov eksplozije v kraterju Cabeus dokazujejo, da je vode več kot so sprva domnevali, verjetno okoli 6%. Poleg tega je instrument na ločenem LRO plovilu, ki je meril nevtrone dokazal, da se znatne količine vode v obliki ledu v Luninih tleh verjetno nahajajo na širših področjih, ki so trajno v senci. Na gornji sliki, ki jo je posnel LRO so z modro barvo pobarvana področja, ki so razmeroma bogata z vodikom, katerega prisotnost je verjetno povezana z vodnim ledom pod površino. Nasprotno pa so rdeče obarvana področja najverjetneje suha. Lokacija Luninega južnega tečaja je na posnetku tudi digitalno označena. Še vedno ni znano kako globoko pod površino se nahajajo kristali ledu, kot tudi kako težavno bi bilo izkopavati kristale in jih predelati v pitno vodo.

Zadnja stran Lune

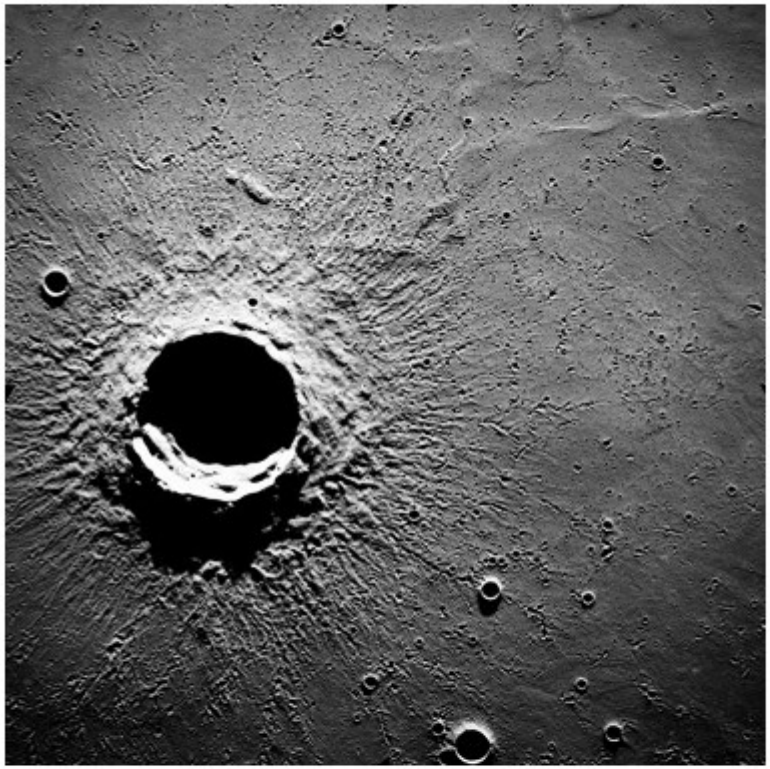
The far side of the Moon



. A view of the Moon never seen before the Space Age, and not visible from the Earth. This picture of the backside of the Moon was recorded by cameras aboard *Apollo 16* in April 1972. The image is centered on the boundary between the lunar near side (*upper left*) and the Moon's hidden face (*lower right*). Three lunar maria are visible as dark patches on the near side. Clockwise from upper left: the Sea of Crises, the Border Sea and Smyth's sea. At lower right are the light-colored and heavily cratered highlands of the far side of the Moon. They contain almost none of the dark maria that characterize the side of the Moon that faces the Earth. (Courtesy of NASA.)

Kraterji na Luni

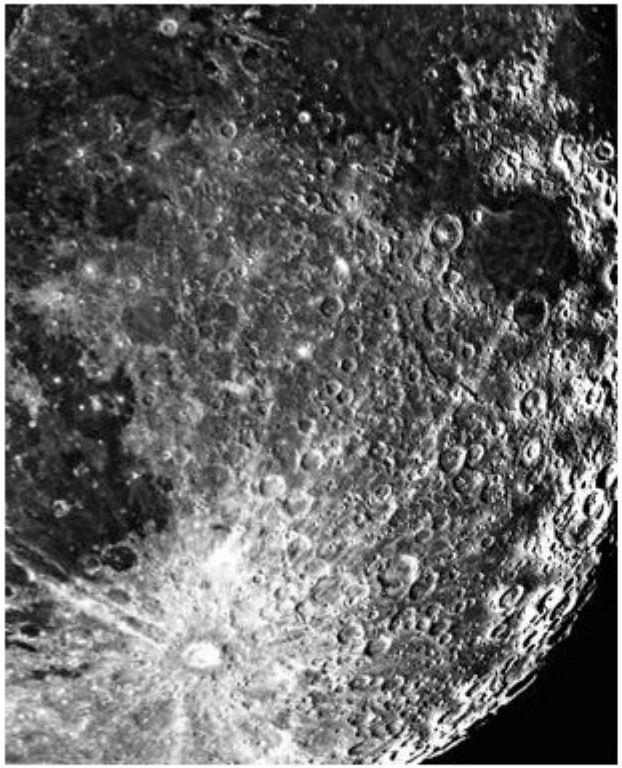
Lunar crater Timocharis



. Astronauts on board the *Apollo 15* mission took this image of the medium-sized crater Timocharis, about 34 thousand meters across, in August 1971. The deposits and ejecta have been thrown radially outward by the meteorite impact that created the primary crater with its circular rim. Smaller secondary craters are located beyond the radial ejecta. (Courtesy of NASA.)

Beli žarki iz mladih kraterjev na Luni

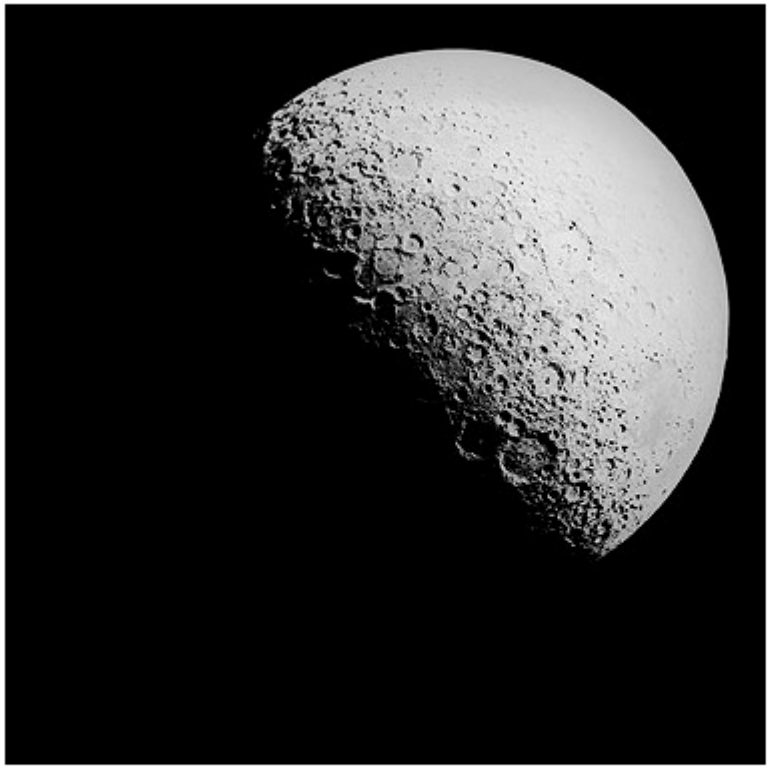
Lunar rays



. White rays splash out across the Moon from crater Tycho at the upper right. Tycho is a large, young crater with a diameter of 85 thousand meters and an age of 107 million years. Only relatively recent craters retain their white rays, for those of older craters are darkened and worn away by continued meteorite impact. The dark, flat circular feature in the lower left is Mare Nectaris (Sea of Nectar). This clear image was produced using the unsharp masking technique that permits high contrast and fine resolution. (Anglo-Australian Telescope © 1976. Photo prepared by David F. Malin.)

S kraterji posuta Luna

Lunar highlands



. The heavily cratered lunar highlands are shown in this picture of the southern hemisphere of the Moon’s near side. Humboldt crater is near the center of the image and Smyth’s Sea is to the right. Impact craters of all sizes, including giant impact basins measuring hundreds of kilometers across, were formed during an intense bombardment of the Moon about 3.9 billion years ago. This image was obtained during the Apollo 15 mission in August 1971. (Courtesy of NASA.)

”Morja” na Luni

Lava flows in a maria

. Lunar volcanism is seen frozen into place on the Sea of Serenity in this Apollo 17 image taken in December 1972. Crater Condorcet (top) and Crater Bessel (bottom) are superposed on the lava, but the lunar maria contain relatively few craters when compared with the lunar highlands. The maria formed a secondary crust on the Moon, when lava filled the giant impact basins over a period of several hundred million years ending around 3.15 billion years ago. The fluid spread rapidly, creating thin extensive sheets rather than piling up to form volcanoes. (Courtesy of NASA.)

”Morja” na Luni

The Moon's Apennine mountains

Imbrium Basin:
Large impact basin
Diameter 1500 km

. The radial structure and steep inner slopes of these mountains (*lower right*) mark a section of the outer rim of the Imbrium Basin. The huge excavation was subsequently filled with lava to form the smooth Mare Imbrium and partially submerge the inner ring of mountains (*upper left*). The smaller circular craters include Timocharis (Fig. 2.16), about 34 thousand meters in diameter (*center left*) and the largest round structure Archimedes (*upper center*) with a diameter of 83 thousand meters. (Courtesy of the Lick Observatory.)

Kraterji na Luni

Craters Copernicus and Reinhold

. Bright ejecta radiates outward from the crater Copernicus near the lunar horizon. It is one of the youngest lunar craters on the near side of the Moon, with an estimated age of 900 million years and a diameter of 93 thousand meters. The craters in the foreground are Reinhold A and B. (Courtesy of NASA.)

Varying crater rate on the Earth's Moon

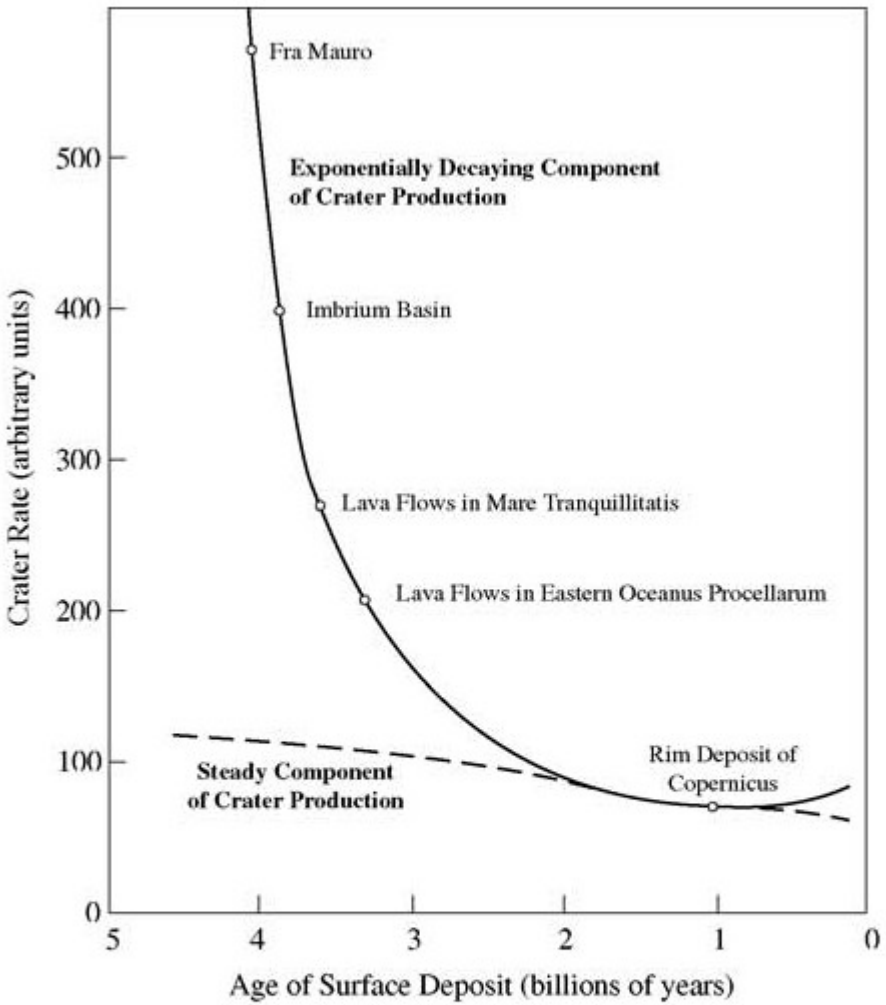


Fig. 2.18 . The rate of forming craters on the lunar surface is plotted against time. The circles denote the crater rate and rock ages at various *Apollo* landing sites. The crater rate was very high during an intense bombardment that occurred 3.9 billion years ago. The rate dropped rapidly during the subsequent billion years, giving way to the lower steady rate of crater production that has persisted for the last 3 billion years. With such a curve, we can obtain approximate surface ages just by counting the number of craters in different parts of the Moon. Estimates of the ages of planetary surfaces can similarly be obtained from the density of craters on them.

Oblike in velikosti kraterjev na Luni

Cross-sectional anatomy of a crater

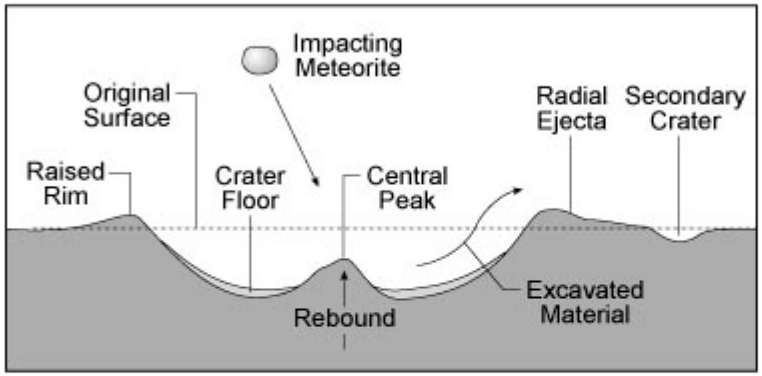


Fig. 2.20 . An impacting meteorite excavates a circular crater that is almost 40 times the diameter of the meteorite. The depth of the crater is roughly one-tenth its diameter, and the crater floor is depressed below the surrounding terrain. The explosion gauges out a circular hole, depositing material around its rim and ejecting debris outward in the radial direction. The surface rebounds from the impacting force of a large meteorite, creating a central peak in the floor of the biggest craters.

Merkur

First visit to Mercury

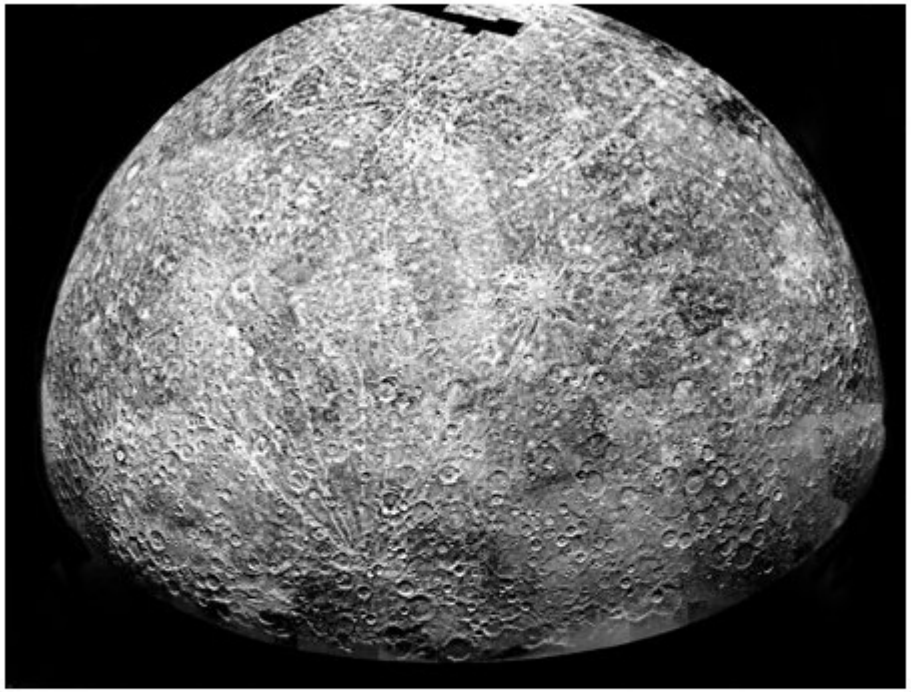


Fig. 2.2 . A photomosaic of Mercury's southern hemisphere produced from images acquired by *Mariner 10* during its first encounter with the planet in March 1974. Mercury has a heavily cratered surface that resembles the lunar highlands. Bright rayed craters are also present on Mercury, as they are on the Moon. (Courtesy of NASA/JPL.)

Merkurjeva udarna kotlina Caloris

Mercury's Caloris impact basin

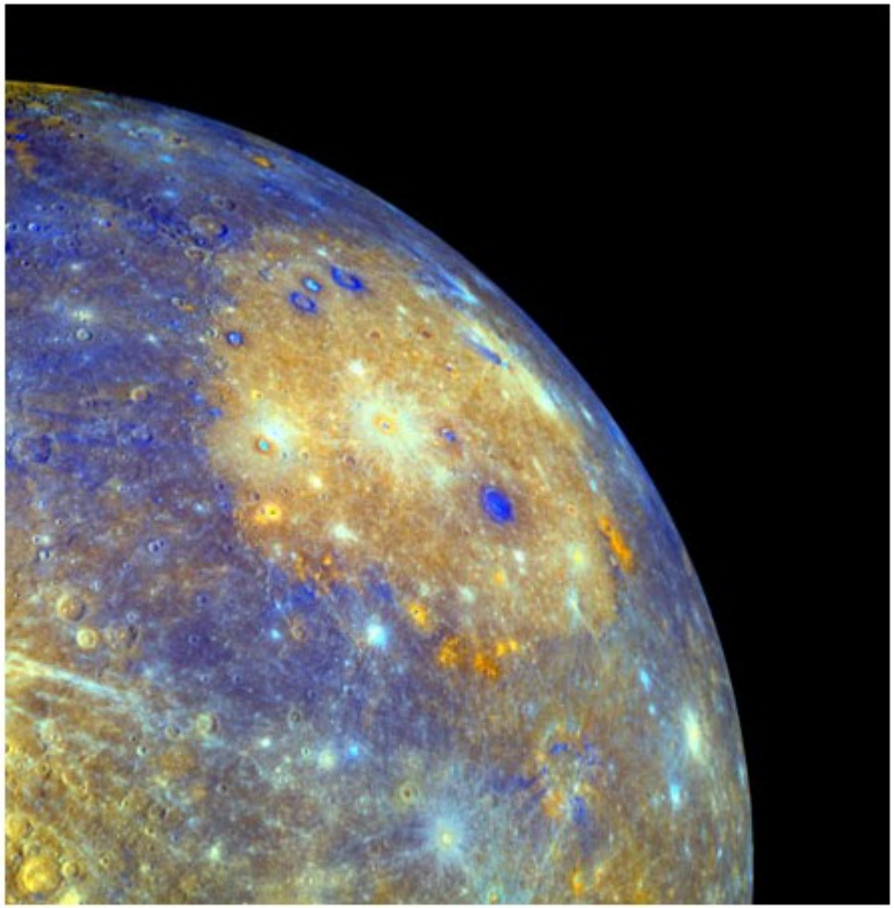


Fig. 2.22 . This false-color image shows Mercury's great Caloris impact basin as a large, circular orange feature in the center of the image. It was acquired on 14 January 2008 from the *MESSENGER* spacecraft. The smaller, bright orange spots just inside the rim of Caloris basin are thought to mark the location of volcanic features. The color variations in the surrounding plains indicate Mercury's variable surface composition. (Courtesy of NASA/JHUAPL/ASU/CIW/Science/AAAS.)

Merkurjeva udarna kotlina Caloris

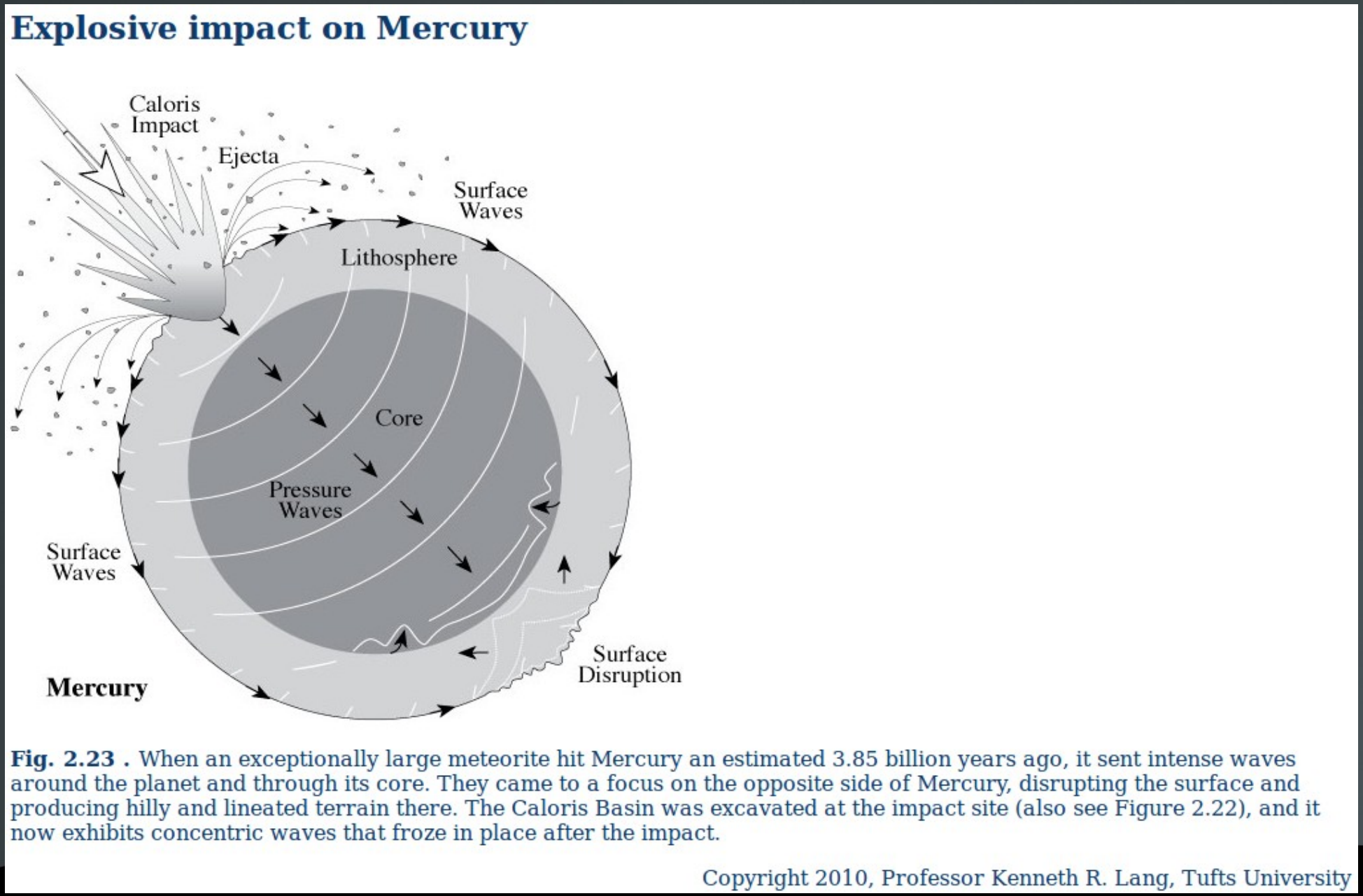


Fig. 2.23 . When an exceptionally large meteorite hit Mercury an estimated 3.85 billion years ago, it sent intense waves around the planet and through its core. They came to a focus on the opposite side of Mercury, disrupting the surface and producing hilly and lineated terrain there. The Caloris Basin was excavated at the impact site (also see Figure 2.22), and it now exhibits concentric waves that froze in place after the impact.

Pretekli vulkanizem na Merkurju

Volcanic activity on Mercury

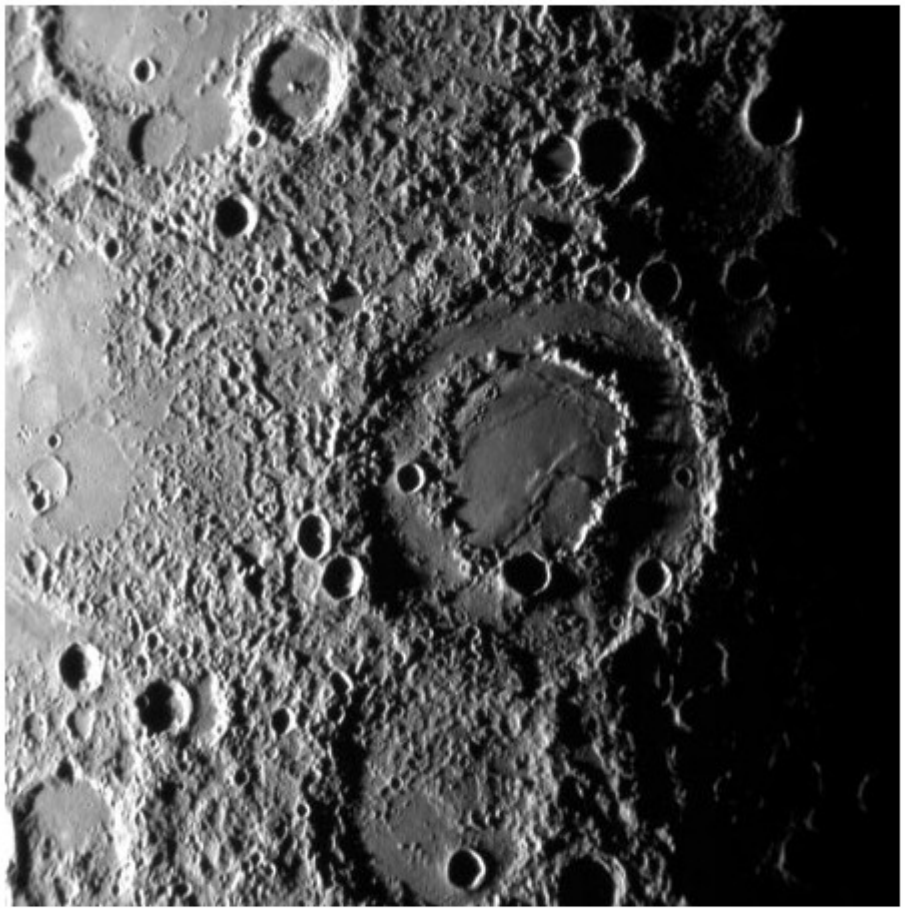
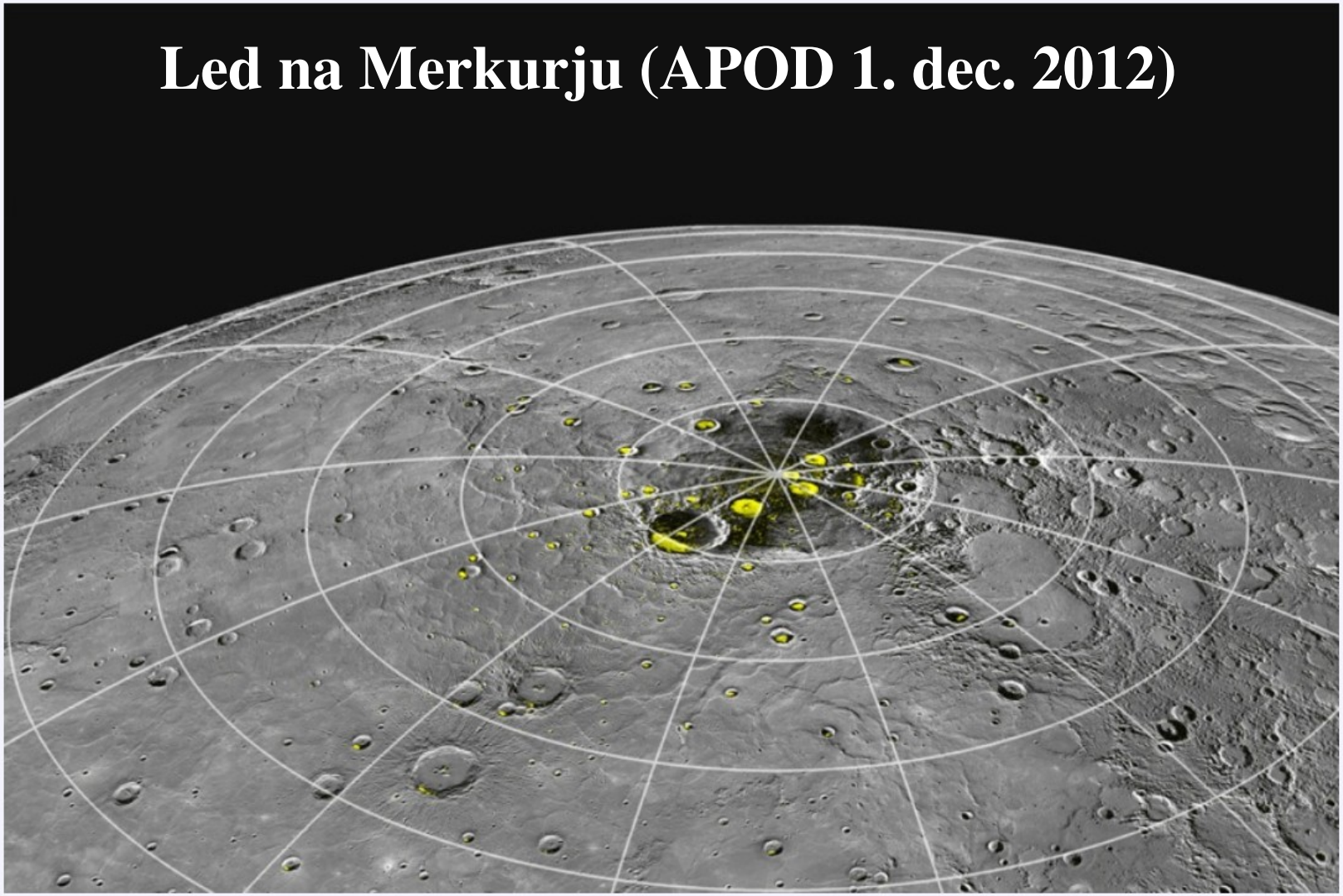


Fig. 2.29 . This double-ringed impact basin on Mercury has a smooth inner floor attributed to lava flows that partially flooded the basin some time after impact. The basin is approximately 60 kilometers in diameter. This image was acquired from the MESSENGER spacecraft on 29 September 2009. (Courtesy of NASA/JHUAPL/CIW.)

Led na Merkurju (APOD 1. dec. 2012)



Sever Merkurja
Avtorstvo: NASA / JHU Applied Physics Lab / Carnegie Inst. Washington

Pojasnilo: Soncu najbližji planet Merkur verjetno ne bi bil dober kraj za medplanetarne zimske olimpijske igre. Vendar nova dognanja iz podatkov okoli Merkurja krožečega plovila MESSENGER kažejo na znatne količine vodnega ledu v stalno senčnih območjih v kraterjih ob planetovem severnem tečaju. O možnosti obstoja ledu na Merkurju se je govorilo že leta, vzrok pa je bilo odkritje radarsko svetlih, torej zelo odbojnih območij ob severnem tečaju. Z rumeno so poudarjena radarsko svetla območja, ki na tej karti narejeni iz projeciranih MESSENGER-jevih slik, ustrezajo dnu ali stenam udarnih kraterjev na severnem tečaju. Dlje od tečaja so svetla območja predvsem na k severu obrnjenih kraterskih stenah. MESSENGER-jevi nevtronsko spektroskopski in termični modeli kraterjev kažejo, da ima snov v teh območjih delež vodika, ki se sklada s skoraj čistim vodnim ledom in je ujeta na območju, ki ostaja hladnejše od 100 Kelvinov (to je -173 stopinj Celzija). V pogojih, ki spominjajo na stalno senčna področja v Luninih kraterjih, verjamemo, da so vir ledu na Merkurju ostanki udarcev kometov.

Name	#	Orbits	Distance (000 km)	O_Period (days)	Incl	Eccen	Discoverer	Date
Sun	-	-	-	-	-	-	-	-
Mercury	I	Sun	57910	87.97	7.00	0.21	-	-
Venus	II	Sun	108200	224.70	3.39	0.01	-	-
Earth	III	Sun	149600	365.26	0.00	0.02	-	-
Mars	IV	Sun	227940	686.98	1.85	0.09	-	-
Jupiter	V	Sun	778330	4332.71	1.31	0.05	-	-
Saturn	VI	Sun	1429400	10759.50	2.49	0.06	-	-
Uranus	VII	Sun	2870990	30685.00	0.77	0.05	Herschel	1781
Neptune	VIII	Sun	4504300	60190.00	1.77	0.01	Adams(9)	1846
Pluto	IX	Sun	5913520	90550	17.15	0.25	Tombaugh	1930

Name	Radius (km)	Mass (kg)	Dens	Abo	Vo	Rotate (days)	Dimensions (km)
Sun	695000	1.99e30	1.41	?	-26.	24.6	
Mercury	2440	3.30e23	5.43	.11	-1.9	58.6	
Venus	6052	4.87e24	5.24	.65	-4.4	-243	
Earth	6378	5.97e24	5.52	.30	-	0.99	
Mars	3397	6.42e23	3.93	.15	-2.0	1.03	
Jupiter	71492	1.90e27	1.33	.52	-2.7	0.41	
Saturn	60268	5.68e26	0.69	.47	0.7	0.45	
Uranus	25559	8.68e25	1.32	.51	5.5	-0.72	
Neptune	24766	1.02e26	1.64	.41	7.8	0.67	
Pluto	1150	1.27e22	2.06	.55	13.6	-6.39	(z)

Name	Gravity (g)	Esc vel (km/s)	M.O.V (km/s)	Axial incl	Oblate	Ascend node	Peri-helion	Equilib (K)	Surface (K)	Press (atm)	Atmospheric Composition
Mercury	0.378	4.44	47.87	0		48.35	77.44	449	440	0	--
Venus	0.907	10.36	35.02	177.36		76.72	131.56	328	730	93	CO2, N2
Earth	1.000	11.19	29.79	23.45	.00335	354.90	102.83	279	287	1	N2, O2, Ar
Mars	0.377	5.03	24.13	25.19	.00519	49.60	335.99	226	218	0.007	CO2, N2, Ar
Jupiter	2.364	59.5	13.06	3.13	.06481	100.47	15.63	122	120	(x)	H2, He
Saturn	0.916	35.5	9.66	26.73	.1076	113.71	92.80	90	88		H2, He
Uranus	0.889	21.3	6.80	97.86	.030	74.06	176.29	64	59		H2, He, CH4
Neptune	1.125	23.5	5.44	29.60	.026	131.81	1.95	51	48		H2, He, CH4
Pluto	0.067	1.3	4.74	122.52		110.42	224.59	44	37	1e-5	N2, CH4, CO

Key:

Gravity	Equatorial surface gravity in g's (see also "Your Weight On Other Worlds")
Esc vel	Escape velocity in kilometers per second
M.O.V.	Mean Orbital Velocity in kilometers per second
Axial incl	Inclination of the rotation axis in degrees (obliquity)
Oblate	Oblateness
Ascend	Longitude of the ascending node
Perihelion	Longitude of perihelion
Equilib	Equilibrium temperature in Kelvins
Surface	Surface temperature in Kelvins
Press	Surface pressure in atmospheres

Notes:

(x) for the jovian planets "surface" refers to the cloud tops or 1 bar level

Much more accurate and detailed data is available from JPL's Horizons **telnet** interface

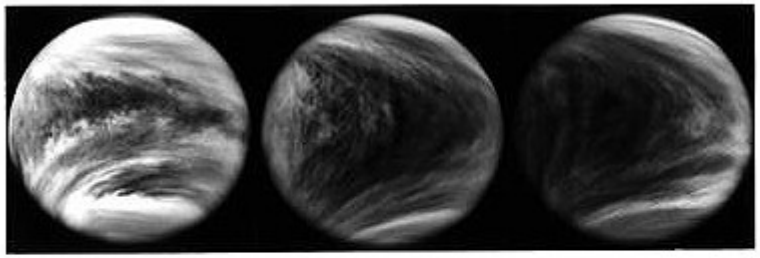
Oblačna Venera

Veiled Venus

. Bright opaque clouds of sulfuric acid wrap around Venus. The creamy yellow veil of clouds circulates once around the planet in only four Earth days, moving at speeds of up to 100 meters per second. Strong zonal winds combine with weaker poleward winds to carry the clouds in a slow spiral toward the poles. The thick cloudy atmosphere of Venus always blocks our view of the surface, and warms that surface to a torrid 730 degrees kelvin. (Courtesy of NASA.)

Oblačna Venera

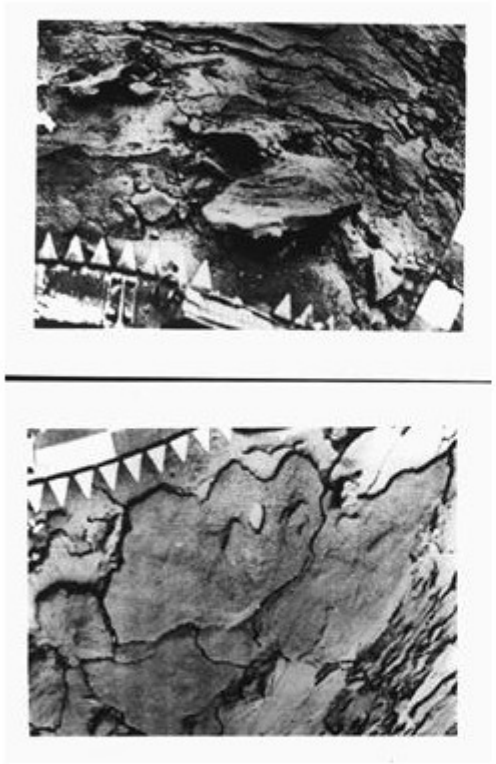
Raging winds



. A high-velocity wind whips the upper layer of Venus's cloud deck around the planet's equator once every four Earth days, moving at speeds of up to 100 meters per second. This is illustrated by these photographs taken at ultraviolet wavelengths on consecutive days by the *Pioneer Venus* spacecraft in 1979. The Y-shaped clouds move towards the west (*left*). The winds of Venus are dominated by a zonal (east-to-west) circulation. The low atmosphere and the planet's surface also rotate westward, but with the much slower period of 243 days. (Courtesy of Larry Travis and NASA.)

Venerino površje

Surface rocks on Venus



. On 5 March 1982 the *Venera 14* lander touched down on Venus at 13 degrees south latitude and 310 degrees east longitude, where it survived for just one hour before succumbing to the planet's heat. That was long enough to radio back these photographs of the surface of Venus, which include part of the lander and a mechanical arm at the bottom. The thin, plate-like slabs of rock could be due to molten lava that cooled and cracked. The composition and texture of these rocks is similar to terrestrial basaltic lava. (Courtesy of Iosif Shklovskii.)

Venus unveiled with radar

Izhodiščni poldnevnik
na Veneri gre po dogovoru
preko osrednjega vrha
kraterja Ariadne.

Fig. 2.9 . A cloud-penetrating radar system on board the *Magellan* spacecraft has mapped the global landforms and features on Venus with a resolution of 120 meters, more completely than any planet including Earth. This hemisphere, centered at 180 degrees east longitude, shows the bright, planet-wide, equatorial highlands that contain towering volcanoes, long lava flows and deep faults and fractures. They run from lower left to upper right through Aphrodite Terra (*left of center*), a continent sized highland, and the bright highland Atla Regio (*just right of center*) to Beta Regio (*far right and north*). Dark areas correspond to terrain that is smooth on the scale of the radar wavelength (0.13 meters); bright areas are rough. The orange tint, based on color images taken by the *Venera 13* and *14* landers, simulates the color of sunlight at ground level after being filtered through the planet's thick atmosphere and clouds. (Courtesy of NASA/JPL.)

Radarska slika zgubanega Venerinega površja

Chaotic tessera terrain

. Many episodes of surface deformation apparently created this complicated version of the more ordered tessera shown in Fig. 7.22. The complex pattern of ridges and valleys has was probably formed by several episodes of faulting, folding, shearing, compression and extension. The chaotic tessera terrain is often found at relatively high elevations up to 3 thousand meters above the surrounding plains; the Magellan image shown here is located at about 25 degrees south latitude and 1 degrees east longitude within Alpha Regio. The largest ridges and troughs are about 10 thousand meters wide and less than 70 thousand meters long. Alpha is the first letter of the Greek alphabet. (Courtesy of NASA.)

Vpadni krater Aurelia na Veneri

Aurelia impact crater on Venus

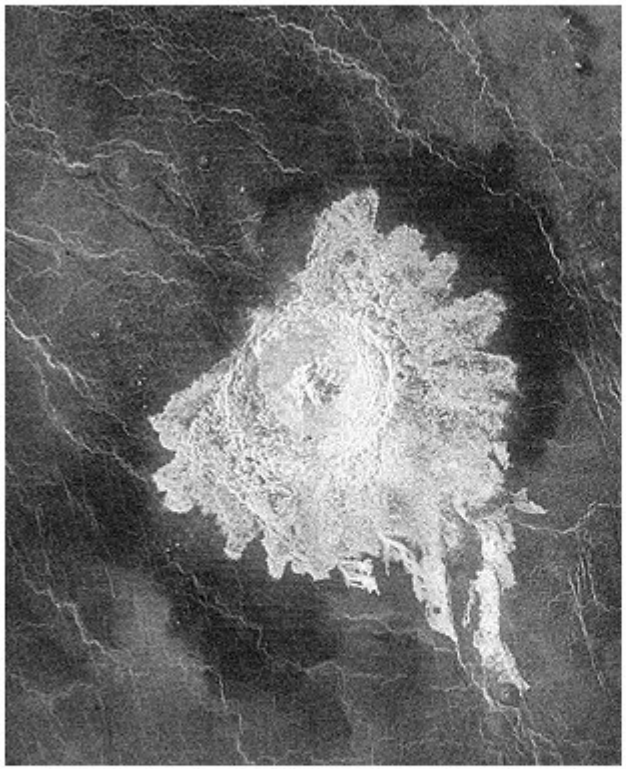


Fig. 2.25 . The unusual crater shapes on Venus are illustrated in this *Magellan* radar image of the Aurelia crater. Like the large impact craters on the Moon, it contains a circular rim, terraced walls and a central peak. But unlike lunar craters, flows emanate from the crater, and a sector of the flow is missing, apparently due to an oblique impact from the upper-left. Interaction with the dense, thick atmosphere on Venus caused the ejected debris to act like a fluid, producing the lacy, rounded lobes. Crater Aurelia, which is 32 kilometers in diameter, has been named in honor of the mother of Julius Caesar; apparently, Aurelia is also the name of Arnold Schwarzenegger's mother. (Courtesy of NASA/JPL.)

(Pretekli) vulkanizem na Veneri

Maat Mons a volcano on Venus

Fig. 2.30 . This three-dimensional perspective of Maat Mons on Venus was obtained from radar data taken from the *Magellan* spacecraft in October 1991. The volcano is 8 kilometers high, the second highest peak on the planet. Fresh, dark lava extends for hundreds of kilometers in the foreground, perhaps flowing from a relatively recent eruption. Maat Mons is a giant shield volcano similar in size and shape to the big island of Hawaii. Maat is the name of the ancient Egyptian goddess of truth and justice, and Mons is the Latin term for "mountain". The orange tint simulates the color of sunlight at ground level after filtering by the dense, thick atmosphere of Venus. (Courtesy of NASA/JPL.)

Vulkanske ”palačinke” na Veneri

Pancake domes on Venus

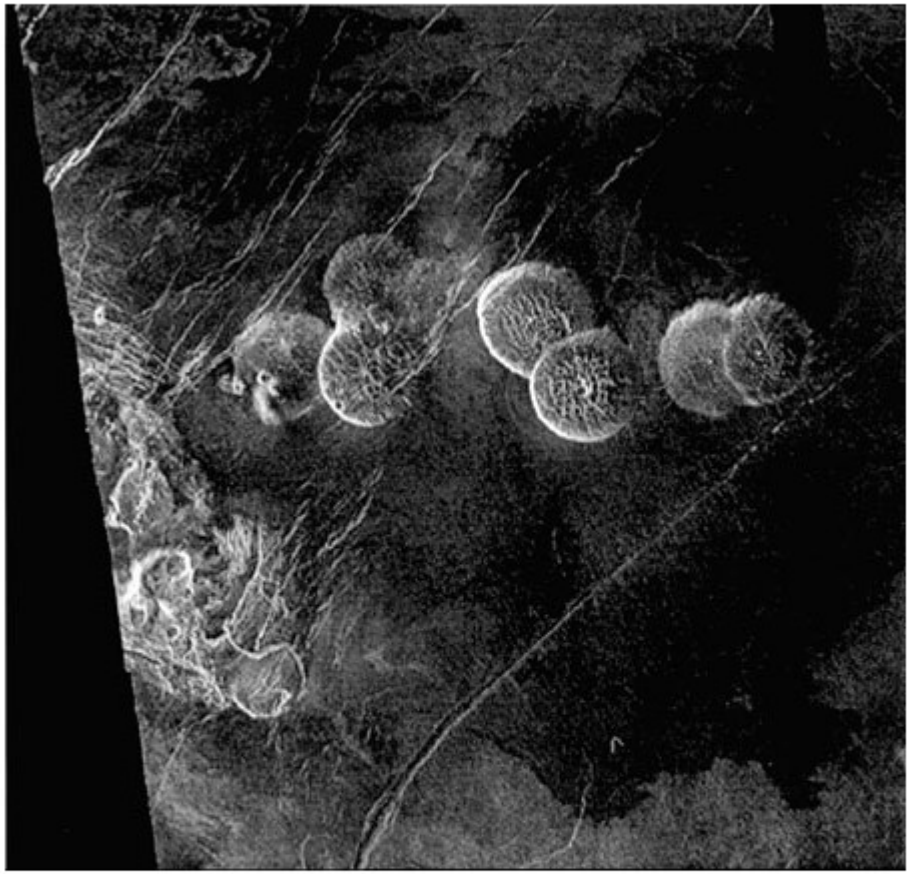


Fig. 2.31 . These seven volcanic domes were discovered in radar images of Venus taken from the *Magellan* orbiter. They all have round shapes that are about 25 kilometers across, and steep sides that are less than 750 meters high. Their central vents may be lined up along a crack in the surface. These domes are attributed to very thick, stiff and sluggish lava flows, rather than the fluid and runny type. Eruptions of the pasty, viscous lava, coming from a central vent on a relatively level surface, would form the circular, flattened shapes that resemble giant pancakes. Since there is little or no erosion by wind or water on Venus, newer pancakes look much the same as the ones on which they are superimposed. (Courtesy of NASA/JPL.)

Tektonika plošč na Zemlji

Nyiragongo

. The continent of Africa is being split apart by the pent-up pressure of hot, rising magma in numerous underlying hot spots along the Great Rift Valley. Volcanic outpourings like Nyiragongo fill the valley with lava as the rift slowly widens. (Courtesy of Bruce Coleman.)

Tektonika plošč na Zemlji

An infant ocean

. An ocean is being born where the Arabian peninsula and the African continent are moving apart, a process that began about 20 million years ago. In a few hundred million years, the Red Sea could be as wide as the Atlantic Ocean is now. (Satellite photograph courtesy of NASA.)

Tektonika plošč na Zemlji

An infant ocean

. An ocean is being born where the Arabian peninsula and the African continent are moving apart, a process that began about 20 million years ago. In a few hundred million years, the Red Sea could be as wide as the Atlantic Ocean is now. (Satellite photograph courtesy of NASA.)

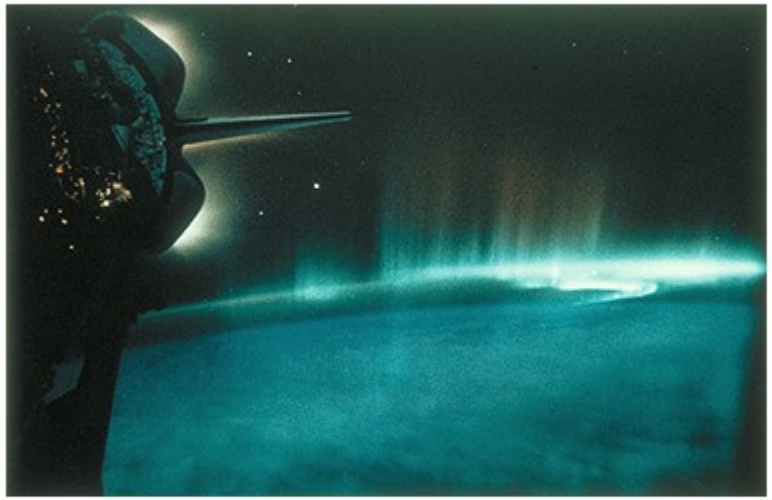
Zemlja kot vodni planet

Earth, the water planet

. Almost three quarters of the Earth's surface is covered by water, as suggested by this view of the North Pacific Ocean. Earth is the only planet in the solar system where substantial amounts of water exist in all three possible forms - gas (water vapor), liquid and solid (ice). Here white clouds of water ice swirl near Alaska; the predominantly white ground area, consisting of snow and ice, is the Kamchatka Peninsula of Siberia. Japan appears near the horizon. From this orientation in space, we also see both the day and night sides of our home planet. (Courtesy of NASA.)

Zemljin polarni sij

Aurora Austalis



. The eerie, beautiful glow of auroras can be detected from space, as shown in this image of the Aurora Australis, or Southern Lights, taken from the *Space Shuttle Discovery*. The colored emission of atomic oxygen extends upward to between 200 thousand and 300 thousand meters above the Earth's surface. (Courtesy of NASA.)

Mars

a=1.52 a.u., 1.88 leta, R=3400 km, M=6.4E23 kg, povpr.gostota=3900 kg/m3, g=0.377*Zemlja

- Atmosferski tlak: na 31 km: 10 mbar, na 48 km: 1 mbar. Na Marsu: 5-8 mbar

  95% CO2, 2% N, 0.1-0.4% O2, zelo suho (skupna vodna plast < 0.1 mm). Velina vode v km globokem permafrostu pod površjem (detekcija z Mars Odysey leta 2002) in v polarnih kapah (zlasti južna, bolj sezonska bolj iz vodnega in ne CO2 ledu). Spirit in Opportunity odkrila hematit – mineral, ki nastane le z vodo.

- Večino prvotnega CO2 v skalah. Ker ni tektonike plošč, se CO2 ni recikliral nazaj v atmosfero. Torej skoraj ni efekta tople grede (na Zemlji hvala bogu je). Rdeča barva je rja.

  Temperatura navadno pod -50 stopinj C, na ekvatorju poleti lahko doseže 0 st C.

  Šibko neglobalno magnetno polje (Mars Global Surveyor 1997). Jedro najbrž skoraj popolnoma trdno.

  Giovanni Schiaparelli, Percival Lowell; Mariner 4 1965 images,

Mars

naklon osi: 25 stopinj, dan=24,5 ure,

- znatno sploščen tir (do 30 stopinj razlike): v perheliju viharji nad 100 m/s
- Olympus Mons: 20 km visok, 600 km premer, največji v Osončju. Neaktiven < 100 Myr, večina vulkanov in vulkanskih ravnic na severu iz prve milijarde let. Jug več (prvotnih) kraterjev. Kanjon Valles Marineris: 5000 km dolg, 200 km širok, 6 km globok!
- Fobos, Deimos: približni premer 20 km. Fobos vzhaja na zahodu. Ujeta asteroida?
- Mars 4: 1965, Viking: 1976, Mars Stezosledec: 1997, Spirit&Opportunity(še deluje) 2004, Phoenix: 2008 water in north, current orbiters: Mars Reconnaissance Orbiter, Mars Odyssey, Mars Express (ESA).
- 1996: ALH84001

Mars

Curiosity: 900 kg, od tega 80kg instrumentov, 2.9x2.7x2.2 m

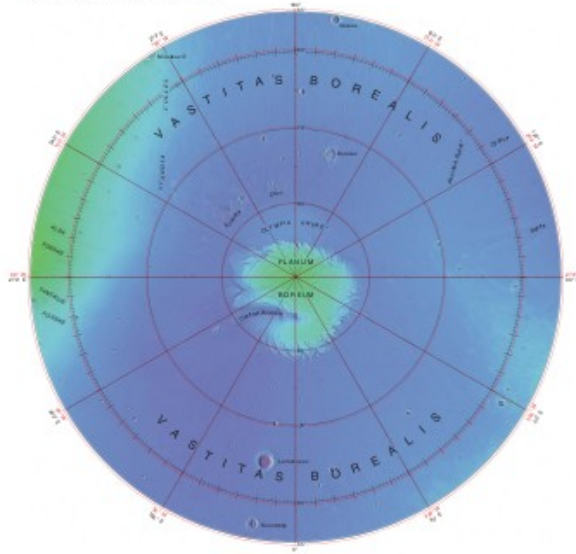
- termoelektrični generator (kot Vikinga), 4.8kg plutonij 238 dioksida, 125W električne (po 14 letih 100W) in 2kW toplotne moči.
- 2 računalnika s po 256MB RAMa, 2GB flasha, RAD7500 procesor s 400 MIPS (kot Pentium leta 1996, današnji približno 200-krat hitrejši).
- Komunikacije: 14 minut do Zemlje, X band z Zemljo (32 kbit/s), UHF radio z orbiterji (do 2Mbit/s,
- vendar vsak orbiter le do 8 minut na dan = skupaj do ~350 Mbytov na dan po Xu in isto po UHFih) = 1 CD/dan.
- Hitrost: do največ 90m/uro, tipično 200m/dan, 30 stopinjski naklon, 60cm podvozje, 50cm kolesa JPL.
- Gale crater, klimatologija, geologija, vloga vode v preteklosti, naseljivost Marsa, je bilo v preteklosti kdaj lahko življenje.
- Instrumenti: HI-RES kamere, vidni spekter po uplinjenju z IR laserjem, rentgenski spektrometer (alfa delci), mikroskop, vrtanje in analiza kristalne strukture oz. kemična analiza v roverju. Skupaj 17 kamer. Analiza vode v globini.

Mozaik Marsa

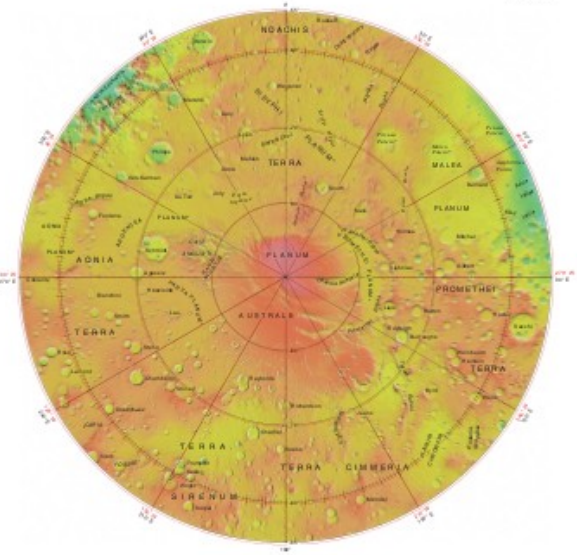
Mozaic of Mars

. This computer-generated mosaic of Viking orbiter images of Mars shows three volcanoes as dark spots to the west (*left*), while the bottom center of the scene shows the entire Valles Marineris canyon system, from Noctis Labyrinthus (*left*) to the chaotic terrain (*right*). Outflow channels are found in the north (*top*), and a variety of clouds and hazes are also visible, especially near the edge. (Courtesy of Alfred S. McEwen, U.S. Geological Survey.)

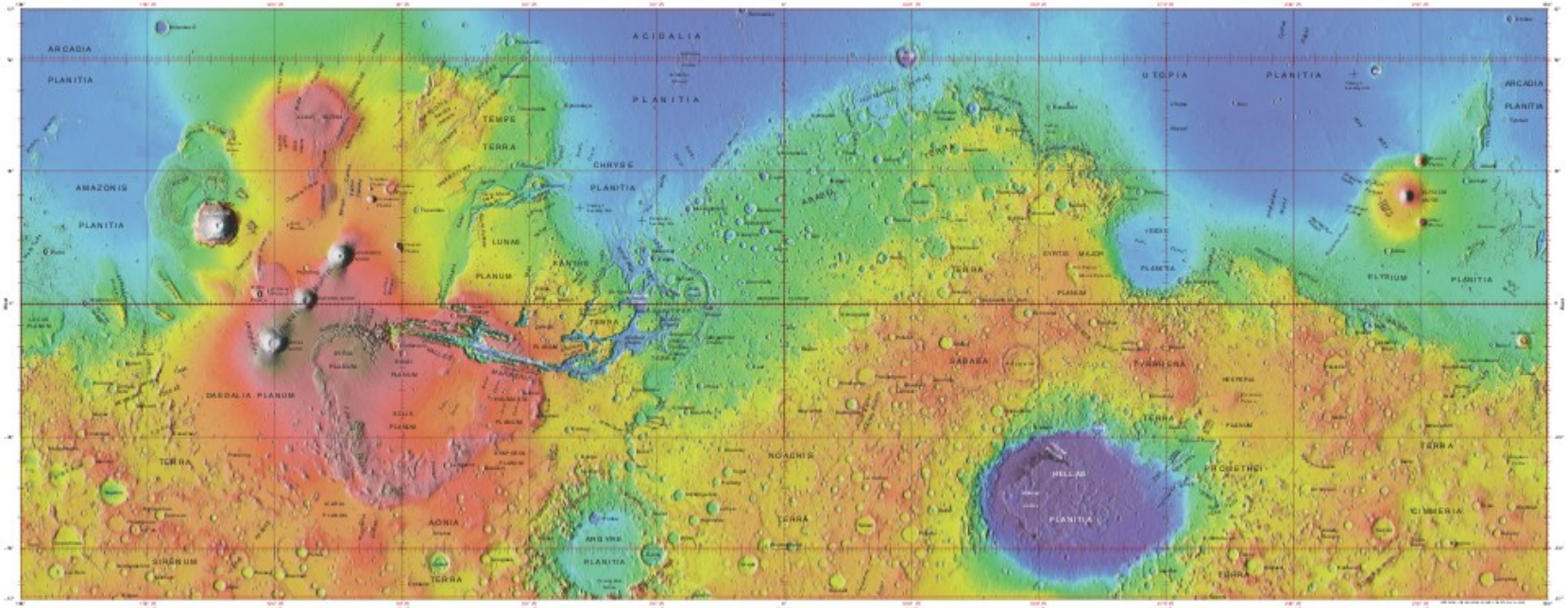
mars_topography_map.pdf



NORTH POLAR REGION



SOUTH POLAR REGION



Topographic Map of Mars

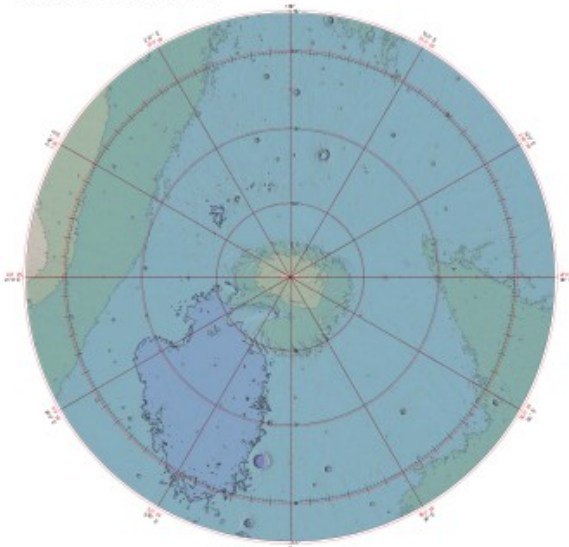
M 25M RKN

By

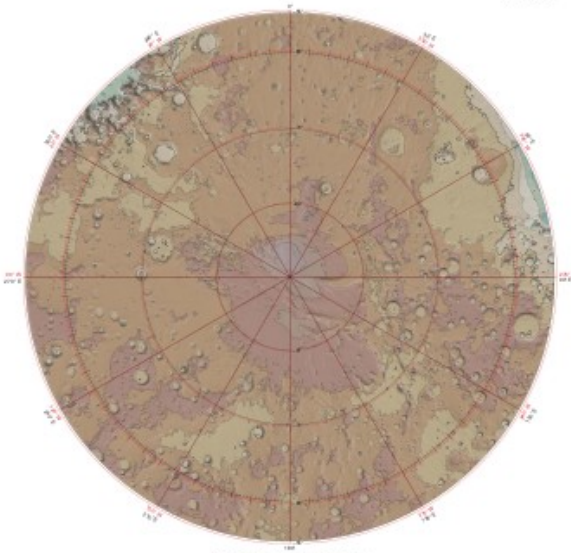
U.S. Geological Survey

2003

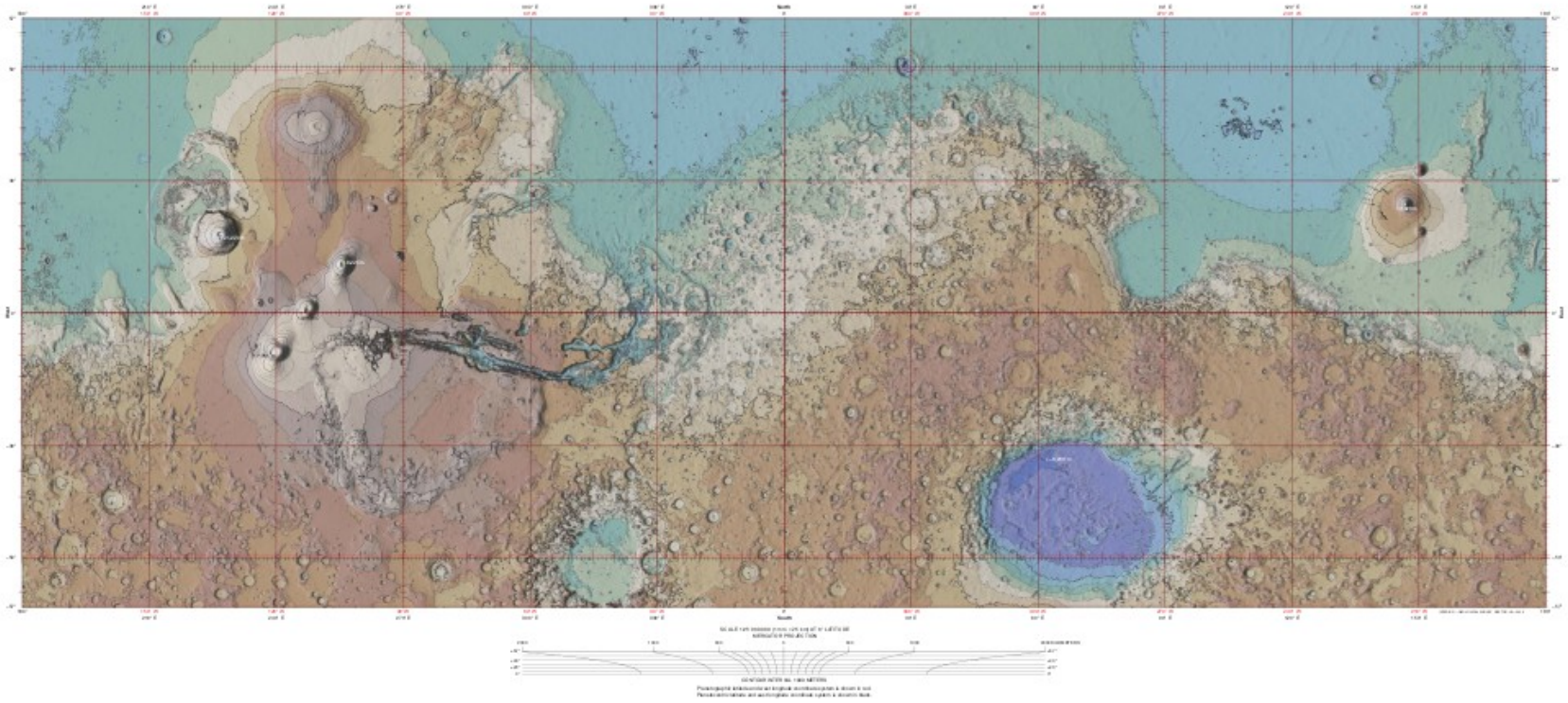
mars_elevation_map.pdf



NORTH POLAR REGION



SOUTH POLAR REGION



Color-Coded Contour Map of Mars

M 25M RKT

By

U.S. Geological Survey

2003

Marsovo površje

Surface of Mars

. The Martian surface viewed from the *Viking 1* lander on 3 August 1976. The Martian landscape resembles the rock-strewn deserts of the Earth. The wind-blown dunes create a gently rolling landscape. Drifting dust clings against the wind-eroded rocks and fills the sky. Mars is a cold and desolate world in which the silence is broken by the roar of winds, the hiss of dust, the rumble of mammoth landslides, and perhaps by outbursts of active volcanoes. (Courtesy of JPL and NASA.)

Poplave v Marsovi preteklosti

Streamlined islands on Mars

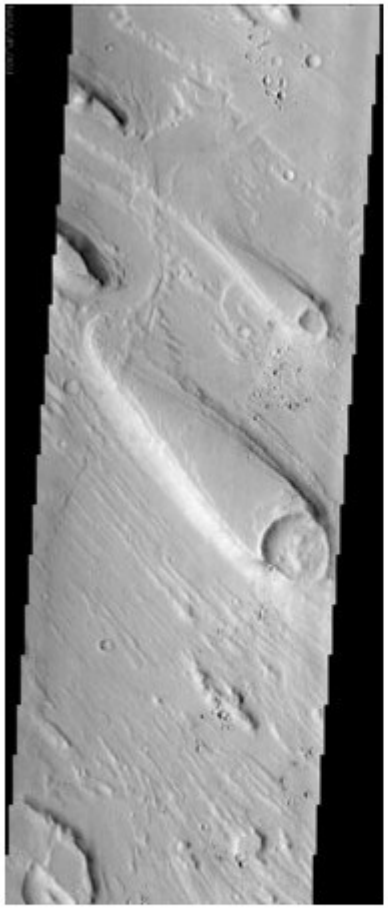


Fig. 2.41 . An image of the Mangala Vallis region on Mars, taken with an instrument aboard the *2001 Mars Odyssey* orbiter. The scoured floors and teardrop-shaped islands were probably created by powerful, ancient flows of liquid water. The flowing water ran from the heavily cratered, southern highlands to the northern lowland plains. The name Mangala is the word for Mars in Sanskrit. (Courtesy of NASA/JPL/ASU.)

Poplave v Marsovi preteklosti

Ancient water flow in Mars' Ares Vallis

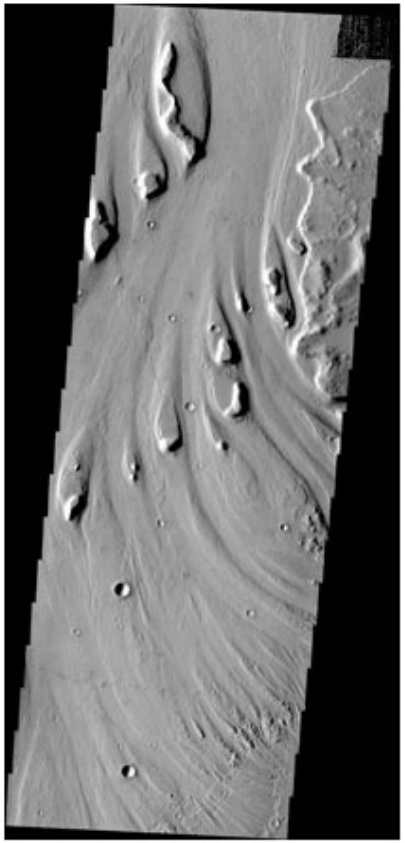
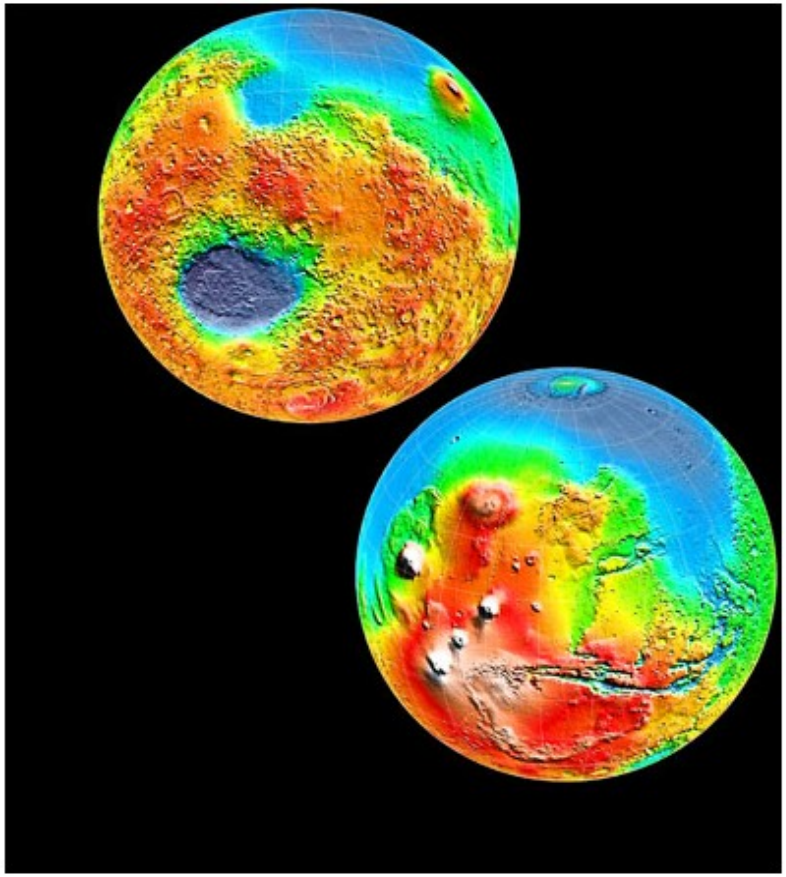


Fig. 2.42 . As shown in this image, obtained from an instrument aboard the *2001 Mars Odyssey* orbiter, large quantities of water were diverted around preexisting craters in Ares Vallis. As the water made its way downstream, the interference with the flow was reduced, and the water flow reformed at the narrow ends of the islands. The orientation of the islands therefore indicates the direction of flow, with the narrow end of the island pointing downstream. In this case, the flow is from the lower right to upper left. Ares Vallis is an outflow channel opening onto the Chryse Planitia, landing site of *Mars Pathfinder* (see Figures 2.14 and 2.15). Ares is the Greek god of war, and possibly connected with the Roman god Mars. (Courtesy of NASA/JPL/ASU.)

Marsova topografija: kam je tekla voda?

Highs and lows of Mars' topography



Izhodiščni poldnevnik na Marsu gre po dogovoru skozi sredino kraterja Airy-0.

Fig. 2.43 . Global topographic maps of two sides of the planet Mars, based on detailed laser altimeter measurements from the *Mars Global Surveyor* spacecraft. In these images, color represents height above (or below) the mean planetary radius, ranging from dark blue (-8 kilometers) through green, yellow and red (+4 kilometers) to white (over 8 kilometers in altitude). Flowing water would run downhill, collecting in the low lying blue regions including the Hellas impact basin (*upper image*), about 2.8 thousand kilometers across, the Valles Marineris (*lower image*), shown as a horizontal gash beside the Tharsis volcanoes (*pink*), and the extensive lowland plains in the north (*top of both images*). (Courtesy of NASA/JPL/ GSFC.)

Marsova topografija: kam je tekla voda?

Nirgal Vallis on Mars

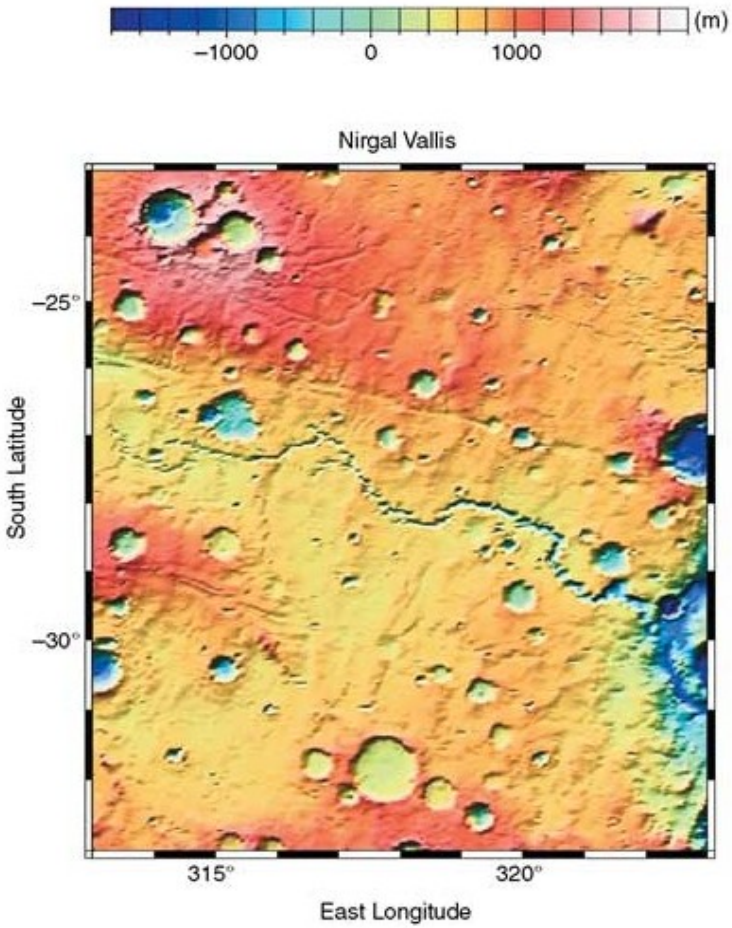


Fig. 2.44 . This valley meanders over 500 kilometers across the heavily cratered southern highlands on Mars, with few tributaries. The valley network is shown in topographic relief with a vertical accuracy of approximately 1 meter provided by a laser altimeter on the *Mars Global Surveyor*. The direction of water flow would be downhill, to the lower right. Nirgal Vallis is located at 28.4 degrees south and 42.0 degrees west longitude (east longitude shown here). Nirgal is the word for "Mars" in Babylonian. (Courtesy of NASA/JPL/GSFC.)

Drugačnost nekaterih Marsovih kraterjev

Material ejected from impacts on Mars

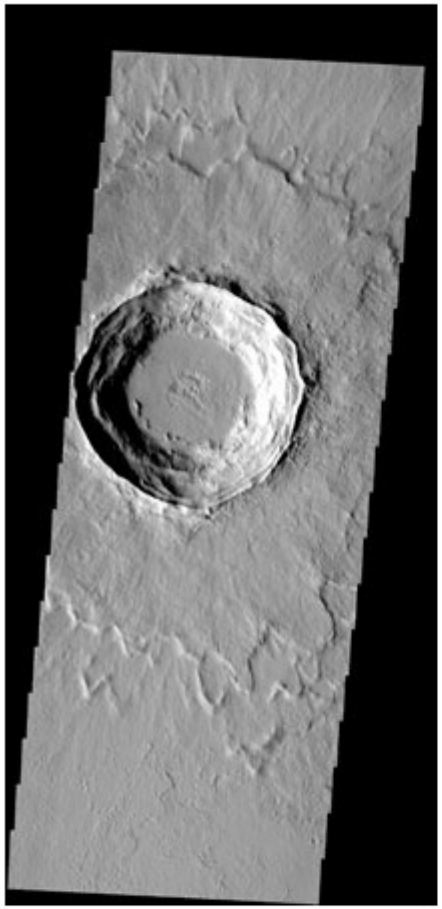


Fig. 2.24 . Some Martian craters are surrounded by discrete lobes of fresh-appearing flows, each surrounded by a low ridge or rampart and sometimes layered. The unique pattern of ejected material can be attributed to melting of water ice by the heat of impact. An instrument aboard the *2001 Mars Odyssey* orbiter took this image. (Courtesy NASA/JPL/ASU.)

Vulkan Olympus Mons na Marsu

Olympus Mons a volcano on Mars

Fig. 2.32 . A mosaic of the towering Martian volcano Olympus Mons, using data obtained from the *Viking 1* orbiter in the late 1970s. It is the largest known volcano in the solar system, rising about 25 kilometers and spreading over 600 kilometers at its base. Counts of impact craters suggest that the lava flows on the gentle slopes of this volcano are relatively young, averaging only about 30 million years old. The summit caldera, or central depression, is a composite of as many as seven roughly circular depressions that formed by recurrent collapse when magma was withdrawn from within the volcano. The caldera is almost 3 kilometers deep and up to 70 kilometers across. The volcano is surrounded by a well-defined scarp, or cliff, that is up to 6 kilometers high. Many of the plains surrounding the volcano are covered by terrain containing ridges and grooves; it is called an aureole, the Latin term for "circle of light". Mons is the Latin term for "mountain". Mount Olympus, the highest mountain in Greece, is the home of the gods in Greek mythology. (Courtesy of NASA/JPL/USGS.)

Mesto pristanka Stezosledca na Marsu

Flood debris on Mars

Fig. 2.15 . A panorama of the surface of Mars taken from the *Mars Pathfinder* spacecraft soon after its' landing on 4 July 1997. The scene is littered with boulders and rocks, the debris of catastrophic floods early in the planet's history. The flood residue is found between a few meters away from the lander to the two modest hills, the Twin Peaks, which are about 30 meters tall and located at a distance of about one kilometer. Between and partially covering the rocks is rust-red, iron-oxide dust, the result of chemical weathering of exposed rock surfaces here and elsewhere. (Courtesy of NASA/JPL.)

Mesto pristanka Stezosledca na Marsu

Mars Pathfinder lands on an ancient flood plain

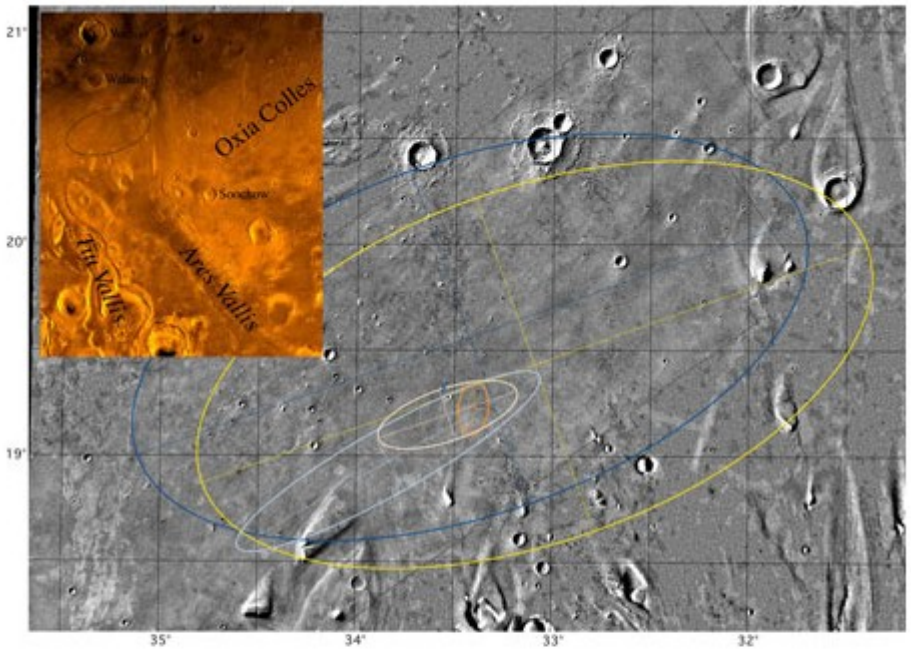
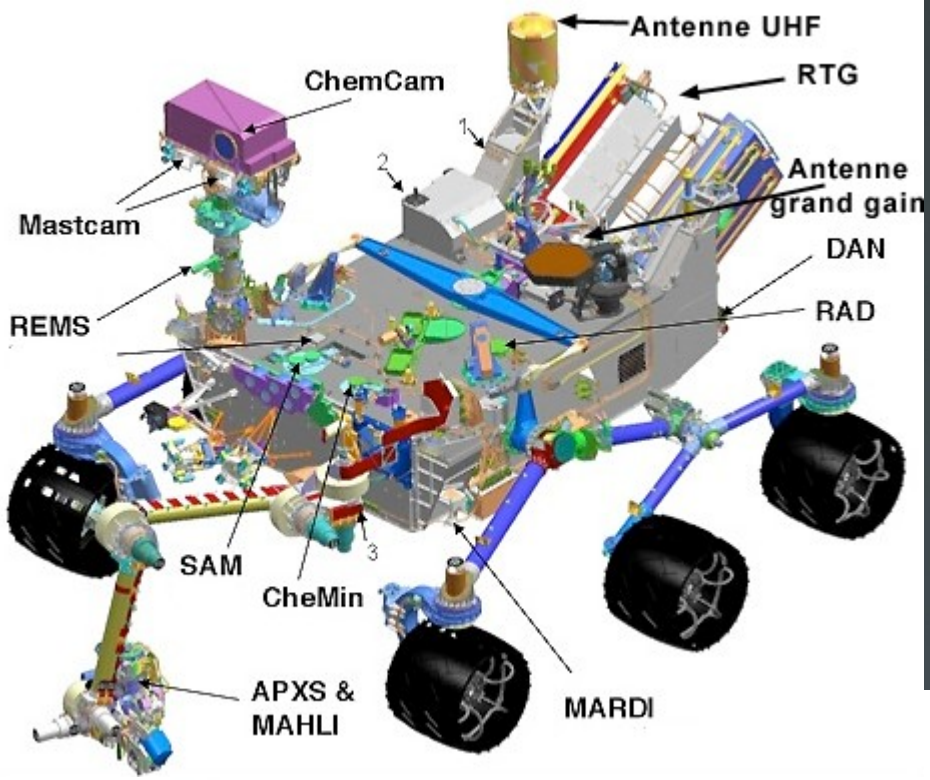


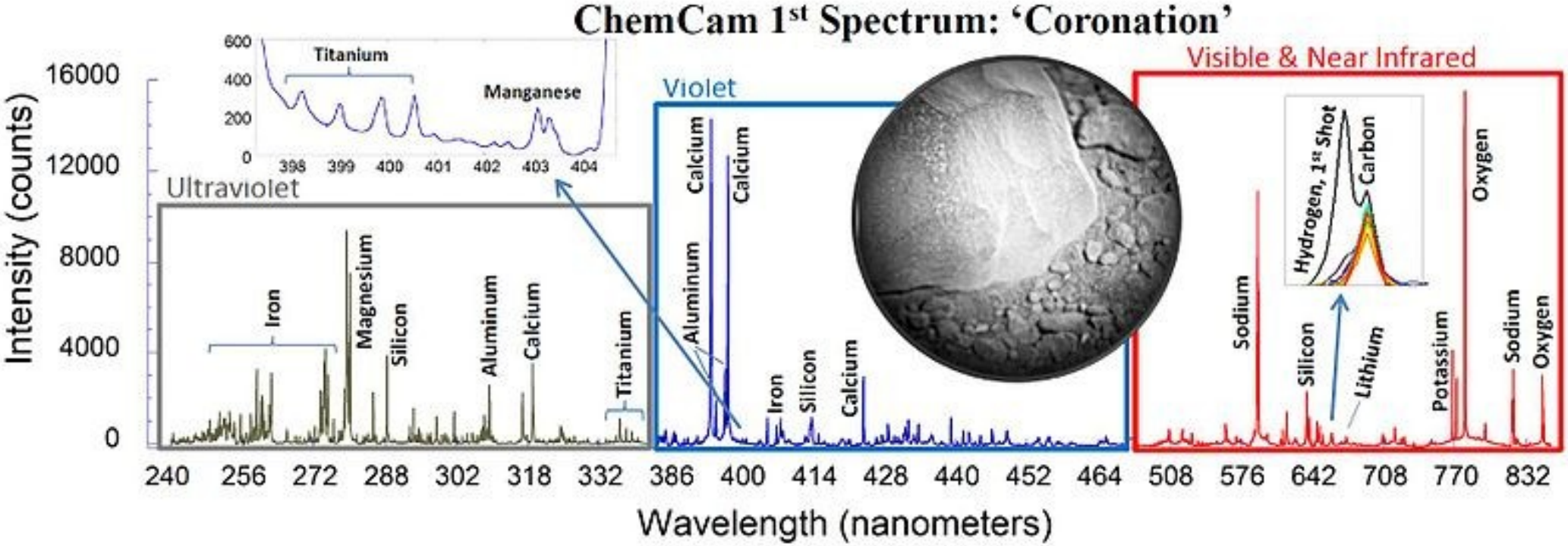
Fig. 2.14 . About 3.7 billion years ago, great floods rushed out of the outflow channel, Ares Vallis, and emptied into the Chryse Planitia, or Plains of Gold, region of Mars (*color inset*). The flowing water carved out streamlined islands around craters (*top right*). This area was chosen as the *Mars Pathfinder* landing site for three reasons: it seemed safe, with no steep slopes or rough surfaces; it had a low elevation, which provided enough air density above the surface for a parachute to work, and it appeared to offer a variety of rock types deposited by the floods. The ellipses mark the area targeted for landing of *Mars Pathfinder*, as refined several times during the final approach to Mars. An X within the smallest ellipse marks the location of the lander at 19.33 degrees north and 33.55 degrees west. The site is about 850 kilometers southeast of the location of *Viking 1* lander. (Courtesy of NASA/JPL.)

Barvna panorama z vozila radovednost (curiosity)

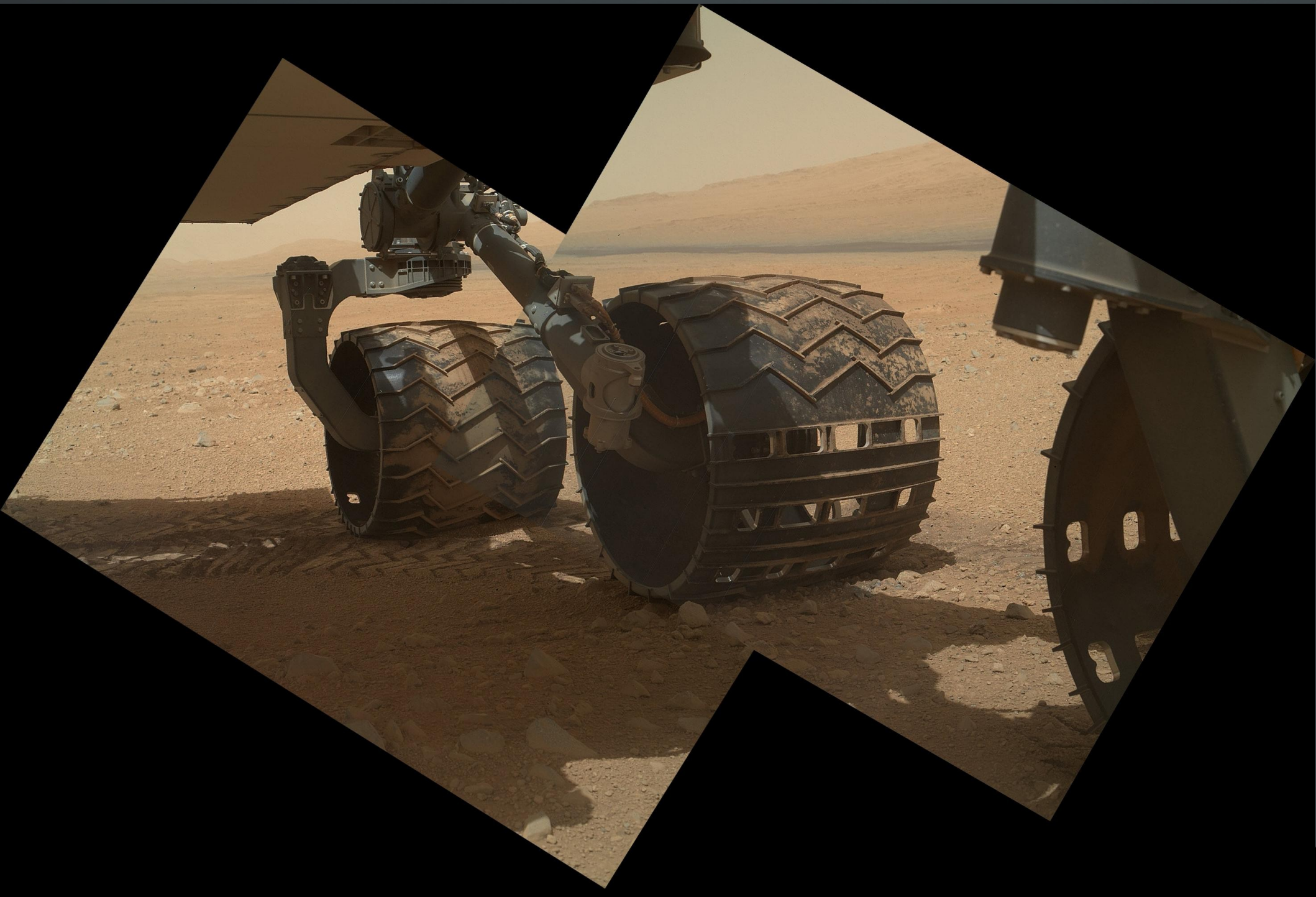
Mars science laboratory (curiosity)

Spekter po laserskem uplinjenju.

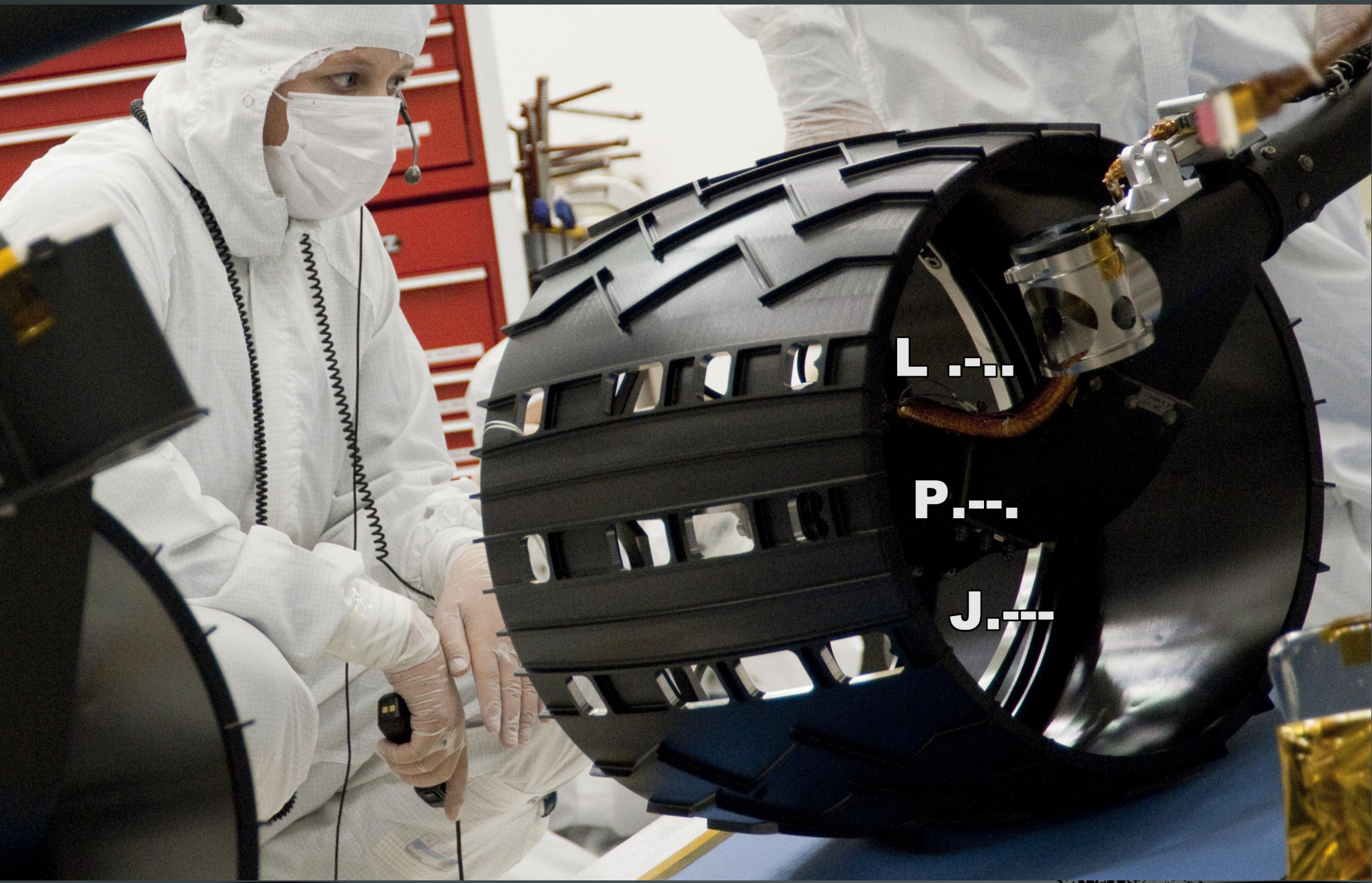




Mars science laboratory (curiosity)

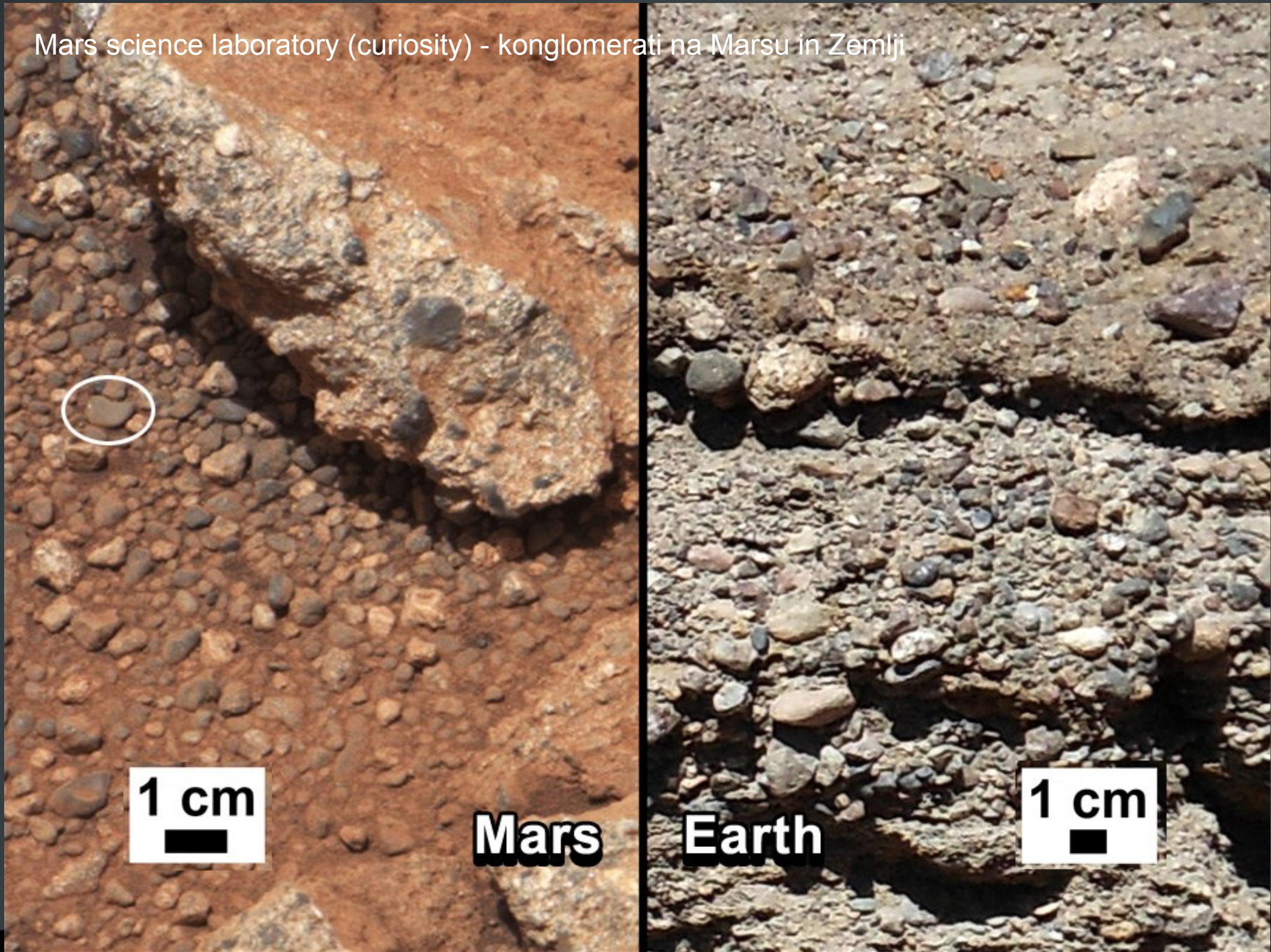


Mars science laboratory (curiosity) - (morse code)



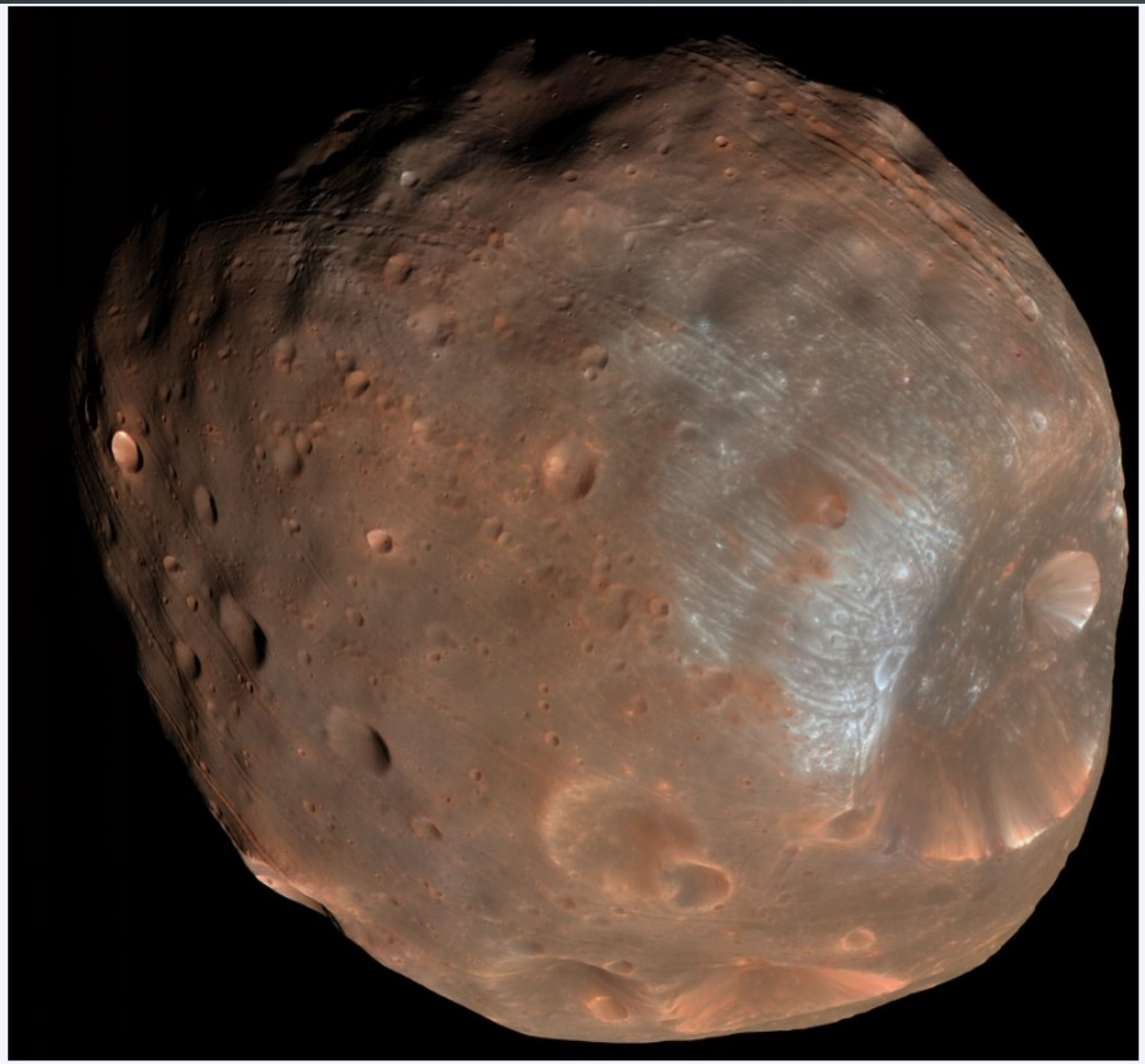
Mars science laboratory (curiosity) - stara rečna struga

Mars science laboratory (curiosity) - konglomerati na Marsu in Zemlji



Mars science laboratory (curiosity) v primerjavi s prejšnjimi vozil(c)i na Marsu

Marsova luna Fobos



Fobos: Obsojena Marsova luna
Avtorstvo slike: HiRISE, MRO, LPL (U. Arizona), NASA

Pojasnilo: Mars, rdeči planet, poimenovan po rimskem bogu vojne, ima dve majhni luni, Fobos in Deimos, katerih imeni sta grški izpeljanki za strah in paniko. Ti Marsovi luni sta čisto mogoče ujeta asteroida in izvirata iz glavnega pasu asteroidov med Marsom in Jupitrom ali mogoče celo iz bolj oddaljenih predelov osončja. Na zgornji neverjetni barvni sliki, ki jo je posnelo vesoljsko plovilo Mars Reconnaissance Orbiter pri ločljivosti okol sedem metrov na točkovni element kamere, je večja luna, Fobos, ki je zares videti kot s kraterji prekrito, asteroidu podobno telo. A tirnica lune Fobos je zelo blizu Marsa - okoli 5800 kilometrov nad površjem - glede na Zemljino Luno, ki je od površja Zemlje oddaljena skoraj 400000 kilometrov. Ker je ta razdalja tako majhna, gravitacijska plimska sila razteguje površino lune Fobos. V približno 100 miljonih let se bo Fobos razletel zaradi napetosti, ki jo povzroča neizprosna plimska sila. Ostanki bodo počasi tvorili obroč okoli Marsa.

Obisk Gaspre in Ide na poti k Jupitru

Galileo's long flight to Jupiter

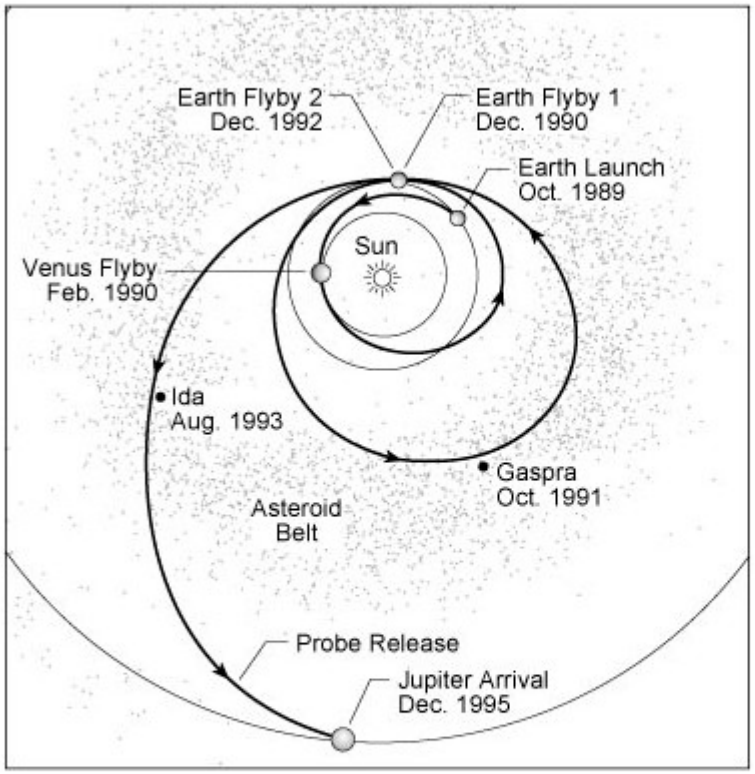


Fig. 2.10 . After launch in October 1989, the *Galileo* spacecraft used the gravity of the Earth and Venus to accelerate it on to its encounter with Jupiter, six years after launch. In its long, indirect flight path, *Galileo* was able to fly past two asteroids at close range, 951 Gaspra in October 1991 and 243 Ida in August 1993 (see Figure 2.11). The spacecraft entered into orbit around Jupiter in December 1995, when its descent probe, which had been released five months earlier, dove into the giant planet's atmosphere. The main spacecraft continued to orbit the planet and examine its satellites until 21 September 2003.

Obisk Gaspre in Ide na poti k Jupitru

Asteroids close up

Fig. 2.11a . The Jupiter-bound *Galileo* spacecraft took images of the asteroids 951 Gaspra (*left*) and 243 Ida (*right*) on 29 October 1991 and 28 August 1993, respectively. Both objects have irregular, elongated shapes, suggesting numerous past collisions. Gaspra has dimensions of 19 x 12 x 11 kilometers, and it contains a striking abundance of small craters. Ida is almost three times as long as Gaspra, and a small moon, named Dactyl, accompanies Ida, though the tiny satellite is not visible in this image. Ida is a member of the Koronis family of asteroids, presumed fragments left from the breakup of a larger precursor asteroid in a catastrophic collision. (Courtesy of NASA/JPL.)

Dvojni asteroid 90 Antiope
(dva 100km asteroida na razdalji 200 km in s periodo 16 ur, Keckovo opazovanje)

Družinski portret Jupitrove družine

Giant red spot and Galilean satellites

Fig. 2.12 . The edge of Jupiter with its Great Red Spot and on the same scale the planet's four largest moons, known as the Galilean satellites. From top to bottom the moons are Io, Europa, Ganymede and Callisto. Winds blow counter-clockwise around the Great Red Spot, which has been observed for more than 300 years and is larger than one Earth diameter. Europa is about the size of Earth's Moon, and Ganymede, the largest moon in the solar system, is bigger than the planet Mercury. (Courtesy of NASA/JPL.)

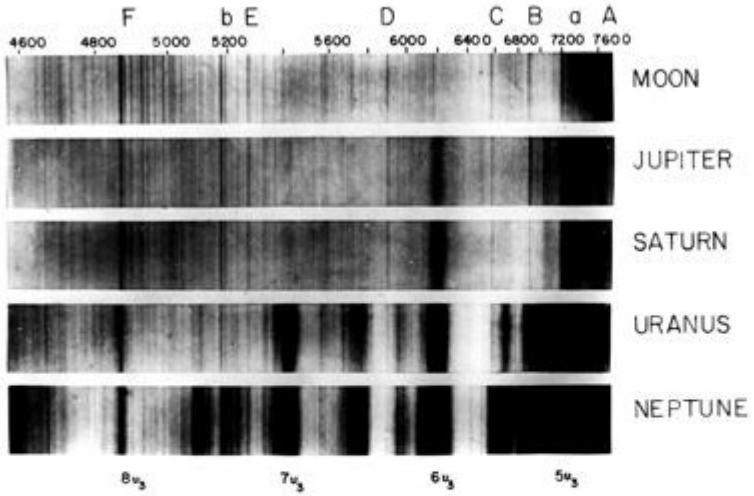
Jupiter

Giant world

. Jupiter's clouded world with its alternating structure of light zones and dark belts. The two innermost Galilean satellites are also visible. Bright orange Io is seen just above the cloud tops, and icy-white Europa lies above it to the right. (Courtesy of JPL and NASA.)

Plinasti planeti: metan in amonijak

Spectra of the giant planets



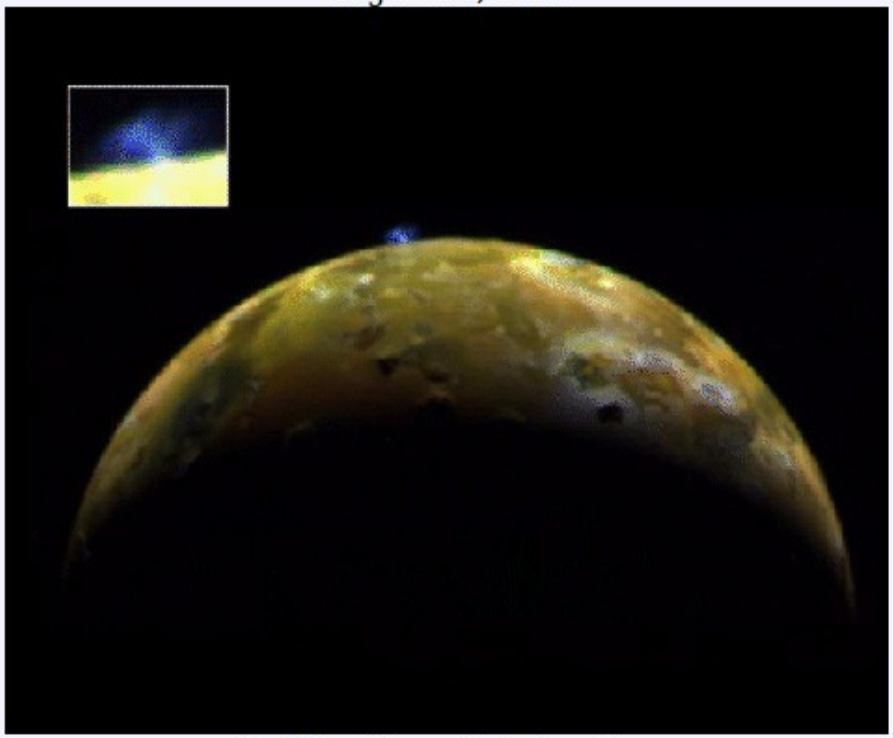
. The radiation spectra of the giant planets at visible wavelengths photographed by Vesto M. Slipher at the Lowell Observatory in 1907. Slipher's work was discussed by Rupert Wildt in 1931, who interpreted some of the bands of Jupiter as absorption by ammonia and methane, the natural gas we use for cooking and heating. Multiples of methane's vibration frequency, n3, are given along the bottom of this figure. The Moon's spectrum is also shown to illustrate the dark Fraunhofer lines found in reflected sunlight and those introduced by the terrestrial atmosphere. The wavelength scale at the top of the figure is in the Angstrom units that were in common use when Slipher took his observations; just divide these numbers by ten to get the wavelength in nanometers.

Trenutna vulkanska aktivnost na Jupitrovi luni Io

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

August 15, 1996



Galileo Views Io Eruption
Credit: The Galileo Project, JPL, NASA

Explanation: Io's surface is active. Geyser-like eruptions from volcanoes on this Jovian moon were seen by both Voyager spacecraft in 1979 and were also spotted this year in late June by Galileo's camera from a distance of about 600,000 miles. The blue plume seen at the moon's edge (magnified in the inset) arises from Ra Patera, a large shield volcano, and extends about 60 miles above the surface. The blue color is attributed to condensing and freezing sulfur dioxide gas. Galileo images have also revealed that the plume glows in the dark - perhaps due to fluorescence of excited sulfur and oxygen ions. Io's surface is cold, its temperature averages about -230 degrees Fahrenheit, *so why is it so active?* The most likely cause is the gravitational tug of war over Io between Jupiter and the other Galilean moons which perturbs Io's orbit. The orbital changes would result in tidal force variations heating Io's interior and and generating the sulfurous volcanic activity.

Trenutna vulkanska aktivnost na Jupitrovi luni Io

Volcanic activity on Io

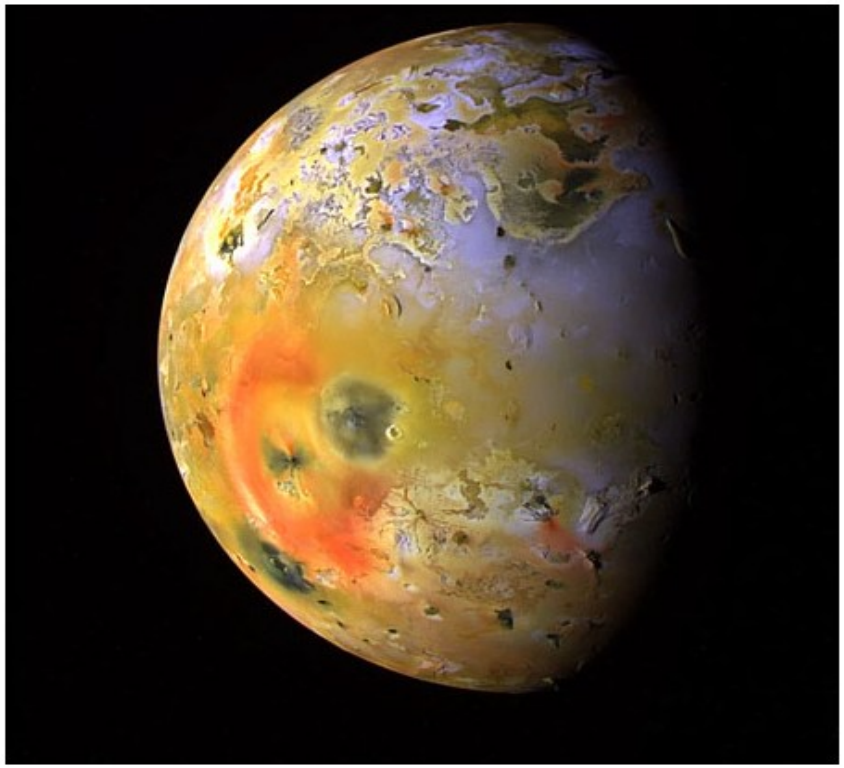


Fig. 2.33 . Massive eruptions continuously disfigure the surface of Jupiter's satellite Io, the most volcanically active body in the solar system. As shown in this color-enhanced image, taken from the *Galileo* spacecraft on 19 September 1997, Io's surface is continuously being covered by lava flowing from its volcanoes, erasing any impact craters. A bright red ring surrounds the volcano Pele, marking the site of sulfur compounds deposited by its volcanic plumes. A dark circular area, about 400 kilometers in diameter, intersects the upper-right part of the red ring and surrounds another volcanic center named Pillan Patera. Deposits of sulfur dioxide frost appear white and gray in this image, while other sulfurous materials probably cause the yellow and brown shades. Pele is the Hawaiian goddess of the volcano, and Pillan Patera is named for the Araucanian thunder, fire and volcano god. (Courtesy of NASA/JPL/U. Arizona.)

Trenutna vulkanska aktivnost na Jupitrovi luni Io

Lava flows on Jupiter's satellite Io

Fig. 2.34 . Numerous volcano calderas and lava flows were discovered on Jupiter's innermost large moon, Io, in 1979 using an instrument aboard the *Voyager 1* spacecraft. This *Voyager 1* image of Ra Patera, a large shield volcano, shows flows up to 300 kilometers long emanating from a dark volcanic vent. The diffuse reddish and orange colorations are probably surface deposits of sulfur compounds. The bright whitish patches probably consist of freshly deposited sulfur dioxide frost. Ra is an Egyptian Sun god. (Courtesy of NASA/JPL.)

Jupitrova luna Evropa

Jupiter's satellite Europa

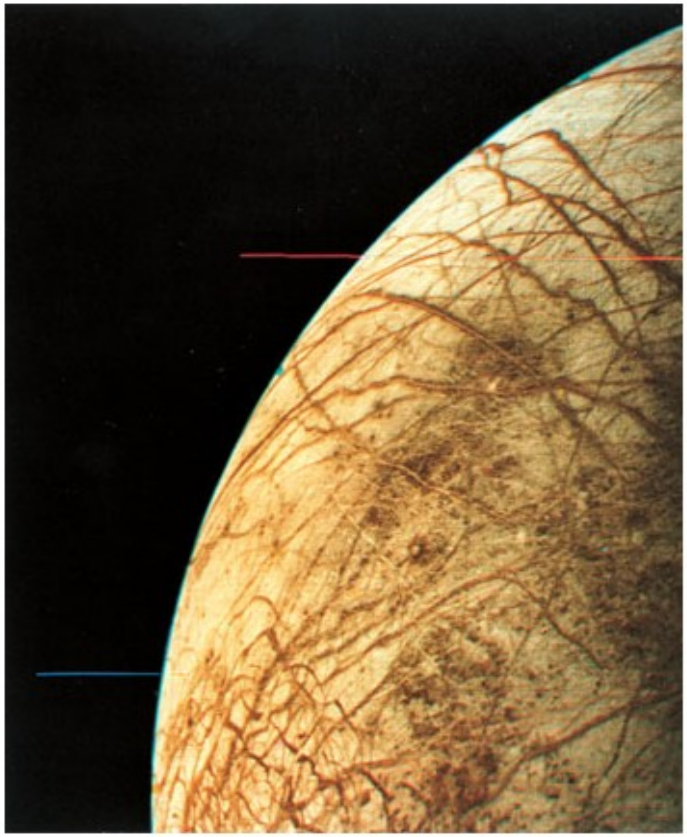


Fig. 2.35 . Dark streaks mark Europa's smooth surface, forming a spidery, veined network in this *Voyager 2* image taken on 9 July 1979. In contrast to Jupiter's satellite Callisto (see Figure 2.17), Europa has very few impact craters; the absence of craters suggests that the ice crust is relatively young. Internal stresses have apparently fractured Europa’s icy mantle, producing intersecting cracks that extend for thousands of kilometers but reach depths of less than 100 meters. The fractures may have been filled by liquid water gushing out from a global ocean in the satellite's interior, warmed by tidal heating. (Courtesy of NASA/JPL.)

Jupitrova luna Evropa

Water oozes out from Jupiter's moon Europa

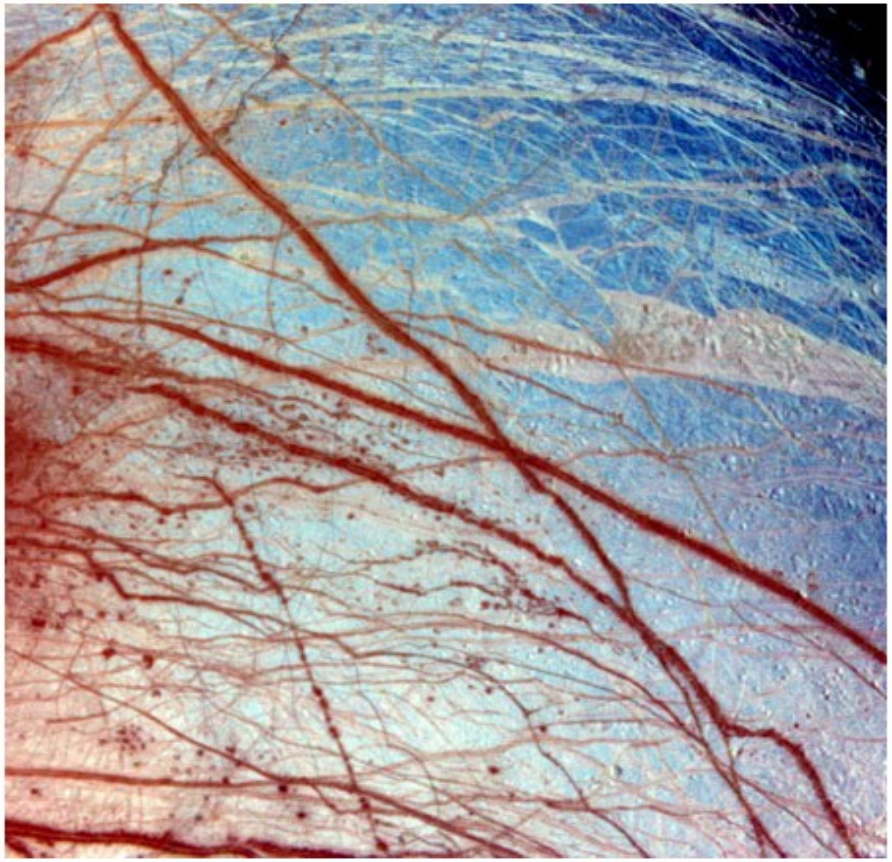


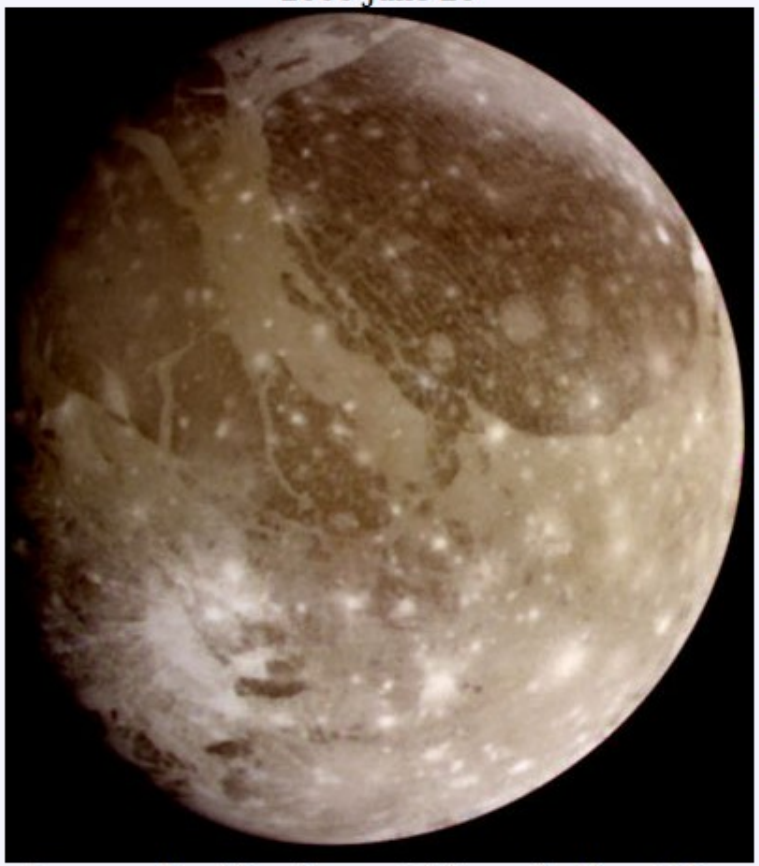
Fig. 2.36 . A composite, color-enhanced image of the Minos Linea region of Jupiter's moon Europa, taken on 28 June 1996 by imaging cameras on *Galileo*. The icy plains, shown here in bluish hues, reflect different amounts of light, probably as the result of differences in the sizes of the ice grains. The long red cracks in the ice could mark the sites of liquid water oozing out from the warm interior of Europa. The area covered in this image is about 1.26 kilometers across. In Greek mythology, Minos is the son of Zeus and the king of Crete, who kept a monster named Minotaur in a labyrinth. Linea is a "dark or bright elongate marking". (Courtesy of NASA/JPL/ U. Arizona.)

Ganimed – največja luna v Osončju

Astronomy Picture of the Day

Discover the cosmos! Each day a different image or photograph of our fascinating universe is featured, along with a brief explanation written by a professional astronomer.

2000 June 20



Ganymede: The Largest Moon in the Solar System
Credit: Galileo Project, JPL, NASA

Explanation: If Ganymede orbited the Sun, it would be considered a planet. The reason is that Jupiter's moon Ganymede is not only the largest moon in the Solar System, it is larger than planets Mercury and Pluto. The robot spacecraft Galileo currently orbiting Jupiter has been able to zoom by Ganymede several times and snap many close-up pictures. Ganymede, shown above in its natural colors, sports a large oval dark region known as Galileo Regio. In general, the dark regions on Ganymede are heavily cratered, implying they are very old, while the light regions are younger and dominated by unusual grooves. The origin of the grooves is still under investigation.

Kraterji na Jupitrovi luni Kalisto

Craters on Jupiter's moon Callisto

Fig. 2.17 . The ancient surface of Callisto shows one of the highest densities of impact craters in the solar system. The satellite's icy surface is as rigid as steel, permitting it to record the bright scars of a heavy bombardment by meteorites roughly 4.0 billion years ago. As shown in this image, taken from the *Galileo* spacecraft in May 2001, Callisto's surface seems uniformly cratered, but it is not uniform in color or brightness. Scientists believe the brighter areas are mainly water ice, while the darker areas are highly eroded, ice-poor material. (Courtesy of NASA/JPL/DLR.)

V Saturnovi senci

In Saturn's shadow

Fig. 2.13 . This marvelous panoramic view of Saturn and its rings was created from 165 images taken by a wide-angle camera aboard the *Cassini* spacecraft on 15 September 2006, as it drifted into the darkness of Saturn's shadow and permitted observations of the planet's tiny ring particles. The narrowly confined G ring resides just outside the bright, inner main rings. The outer, wide E ring encircles the entire system; icy plumes feed the E ring from Saturn's satellite Enceladus. The exaggerated color contrast in this mosaic view can be used to infer processes that are sorting the ring particles according to their size. (Courtesy of NASA/JPL/SSI.)

Saturn

Ringed Saturn with icy moons

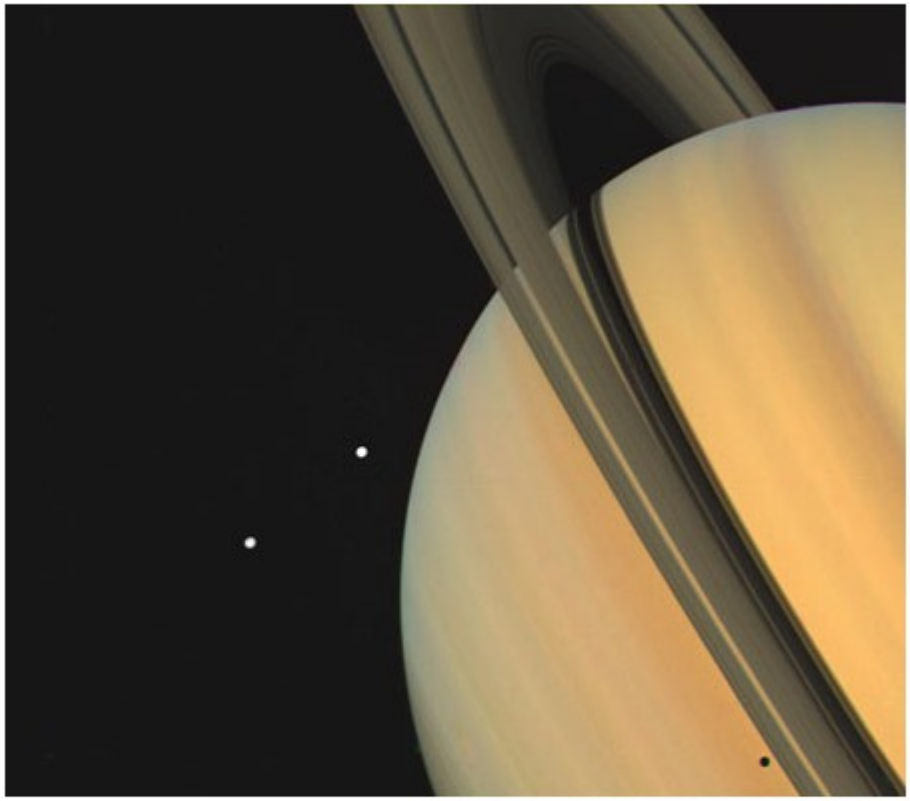
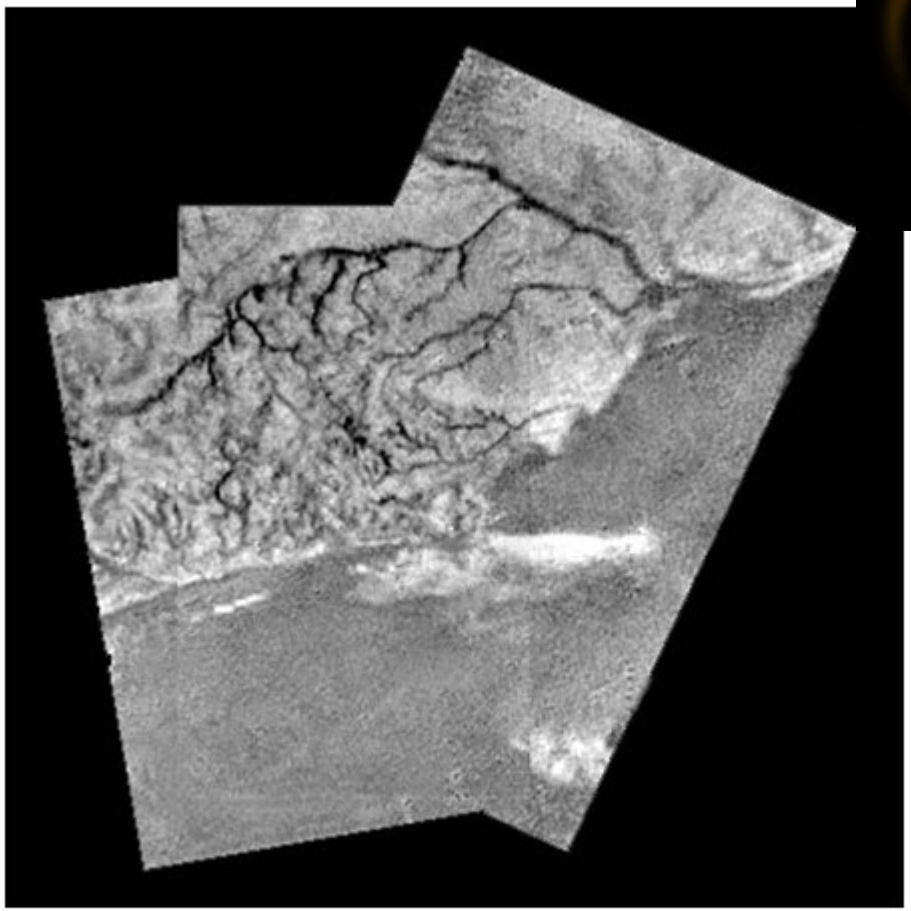
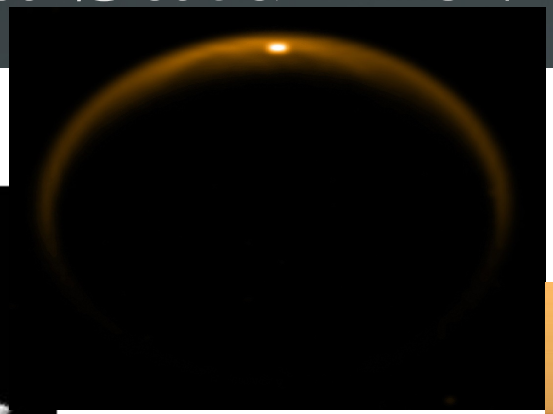


Fig. 2.6 . Saturn's yellow-brown clouds are swept into bands by the planet's rapid rotation. Two of its white moons (*left*), Tethys (*above*) and Dione (*below*), are covered with water ice. The shadows of Saturn's main rings and Tethys are cast onto the cloud tops. The outer A ring is separated from the central B ring by the dark Cassini Division, which is 3,500 kilometers wide. This gap is so tenuous that the edge of Saturn can be seen through it. The faintest of Saturn's main rings, the inner C-ring or crepe ring, is barely visible against the planet. This image was obtained from the *Voyager 1* spacecraft on 3 November 1980. (Courtesy of NASA/JPL.)

Reke metana na Saturnovi luni Titan

Methane flows on Titan





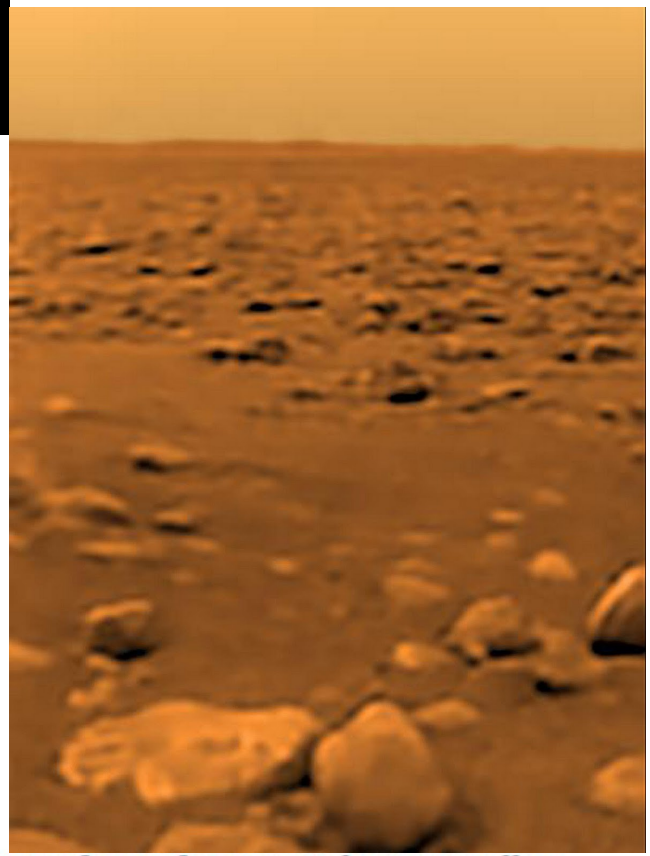


Fig. 2.16 . This image was taken from the *Huygens Probe* just before it landed on the surface of Saturn's large satellite Titan on 14 January 2005. It shows flows down a high ridge into a major river channel from different sources. The feature has been attributed to liquid methane fed by the fall of methane rain. (Courtesy of NASA/JPL/ESA/U. Arizona.)

Saturnova luna Enkelad

Saturn's satellite Enceladus

Fig. 2.37 . The bright, smooth surface of Enceladus, shown in this *Voyager 2* image obtained on 25 August 1981, reflects almost 100 percent of the incident sunlight, making it one of the most reflective objects in the solar system. When viewed up close, part of its surface is scarred with impact craters. Other parts of the surface contain cracks and grooves, suggesting that internal stresses may have discharged water that froze into smooth ice. (Courtesy of NASA/JPL.)

Saturnova luna Enkelad

Ice plumes on Saturn's moon Enceladus

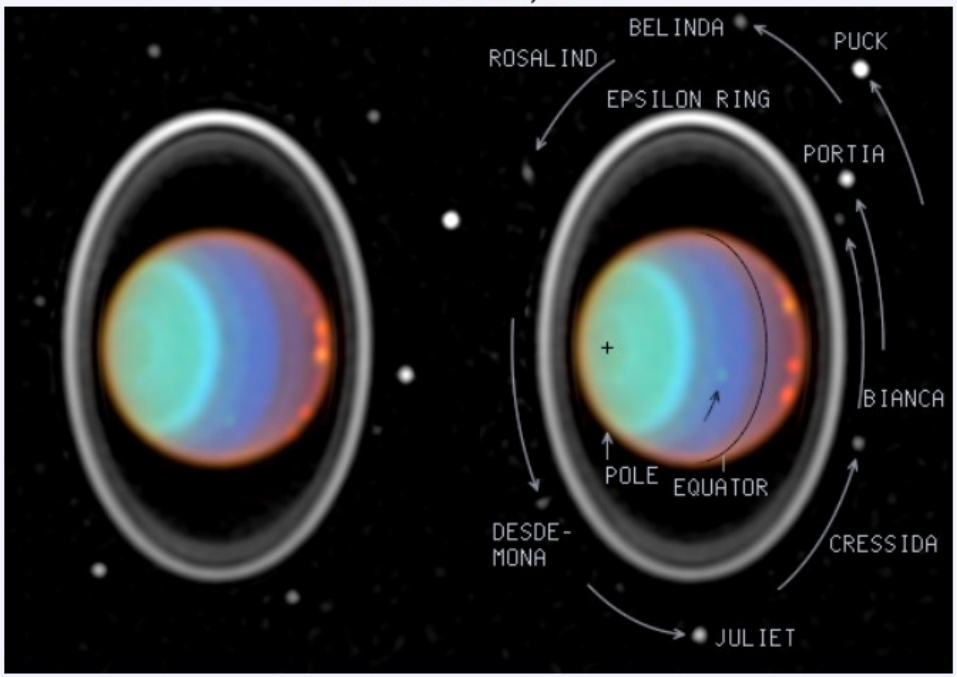
Fig. 2.38 . Enormous jets and fountains of ice are erupting on Saturn's moon Enceladus, feeding the planet's E ring. This image, taken from the *Cassini* spacecraft on 27 November 2005, exhibits several geyser-like jets, which vent and spurt plumes of ice particles, water vapor and trace amounts of organic compounds. Eight source locations were identified in this image, all on the prominent tiger stripe features, or sulci, in the moon's south polar region. These features were under close scrutiny from *Cassini* for years after their discovery in 2005. (Courtesy of NASA/JPL/SSI.)

2001 August 26

Uranus: The Tilted Planet
Credit: Voyager 2 Team, NASA

Explanation: Uranus is the third largest planet in our Solar System after Jupiter and Saturn. Uranus is composed mostly of rock and ices, but with a thick hydrogen and helium atmosphere. The blue hue of Uranus' atmosphere arises from the small amount of methane which preferentially absorbs red light. This picture was snapped by the Voyager 2 spacecraft in 1986 - the only spacecraft ever to visit Uranus. Uranus has many moons and a ring system. Uranus, like Venus, has a rotation axis that is greatly tilted and sometimes points near the Sun. It remains an astronomical mystery why Uranus' axis is so tilted. Uranus and Neptune are quite similar: Uranus is slightly larger but less massive.

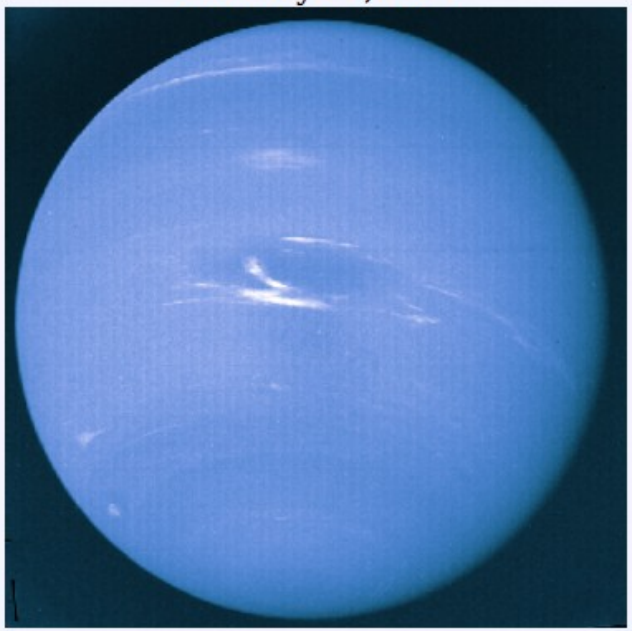
November 26, 1997



Uranian Moons, Rings, And Clouds
Credit: E. Karkoschka (Univ. of Arizona), NASA

Explanation: The giant planet Uranus is faint and featureless when viewed in visible light. But this pair of near-infrared mosaics from the Hubble Space Telescope's NICMOS camera reveals moons, rings, and clouds of this distant gas planet. The color coded images highlight different atmospheric layers - blue represents the deepest layers while the highest cloud features have a reddish tinge. Racing around the planet, high, bright clouds are seen to move substantially between the two pictures taken only ninety minutes apart. Ring systems are a common to the solar system's giant planets. Here the main Uranian ring seems to vary in width and is clearly brightest near the top. The eight specks beyond the ring system are small Uranian moons which also show counter-clockwise motion over ninety minutes as traced by the arrows on the right hand image.

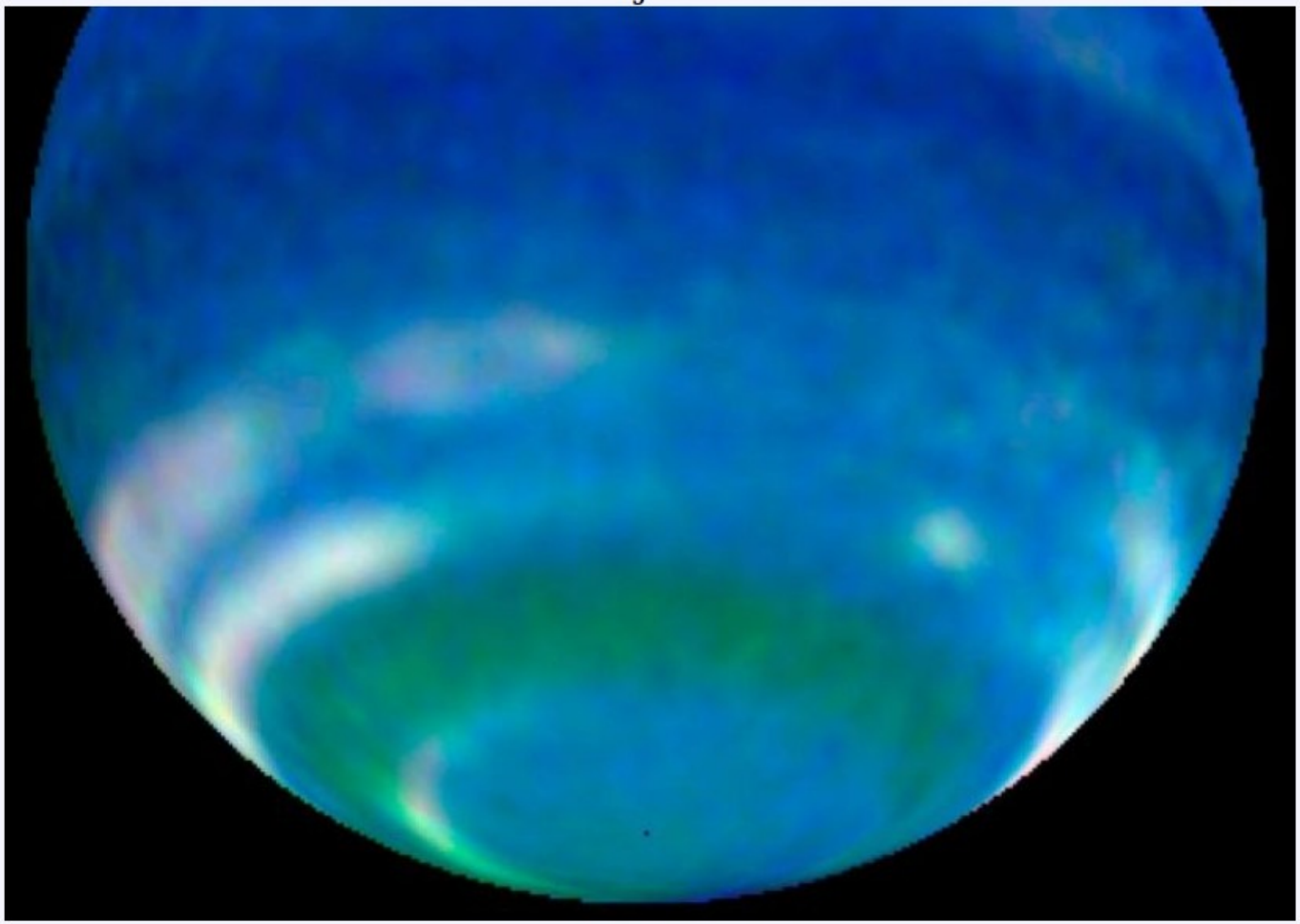
February 21, 1998



Neptune: Big Blue Giant
Credit: Voyager 2, NASA

Explanation: This picture was taken by the Voyager 2 spacecraft in 1989 - the only spacecraft ever to visit Neptune. Neptune will be the farthest planet from the Sun until 1999, when the elliptical orbit of Pluto will cause it to once again resume this status. Neptune, like Uranus, is composed mostly of liquid water, methane and ammonia, is surrounded by a thick gas atmosphere of mostly hydrogen and helium, and has many moons and rings. Neptune's moon Triton is unlike any other and has active volcanoes. The nature of Triton's unusual orbit around Neptune is the focus of much discussion and speculation.

2004 June 26

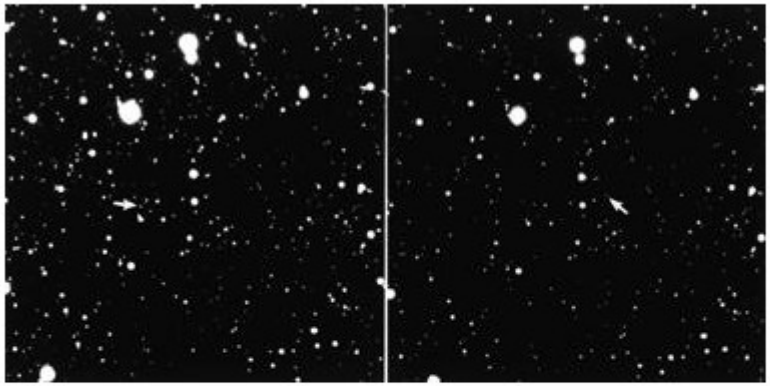


Neptune: Still Springtime After All These Years
Credit: L. Sromovsky and P. Fry (Univ. Wisconsin - Madison) et al., NASA

Explanation: In the 1960s spring came to the southern hemisphere of Neptune, the Solar System's outermost gas giant planet. Of course, since Neptune orbits the Sun once every 165 earth-years, it's still springtime for southern Neptune, where each season lasts over four decades. Astronomers have found that in recent years Neptune has been getting brighter as illustrated in this Hubble Space Telescope image made in 2002. Compared to Hubble pictures taken as early as 1996, the 2002 image shows a dramatic increase in reflective white cloud bands in Neptune's southern hemisphere. Neptune's equator is tilted 29 degrees from the plane of its orbit, about the same as Earth's 23.5 degree tilt, and Neptune's weather seems to be dramatically responding to the similar relative seasonal increase in sunlight -- even though sunlight is 900 times less intense for the distant gas giant than for planet Earth. Meanwhile, summer is really just around the corner, coming to Neptune's southern hemisphere in 2005.

Odkritje Plutona

Discovery of Pluto



. A region of the constellation Gemini, photographed by Clyde W. Tombaugh on 23 January 1930 (*left*), and the same region photographed six days later (*right*). When comparing the two plates on 18 February 1930 with a blink microscope, Tombaugh noticed an object (*arrows*) on the second plate that had changed its location with respect to the background stars since the first plate was taken. This was a previously unknown object that had to belong to the solar system. Because of its slow apparent motion across the sky, the planet images were separated by just 3.5 millimeters on the two photographs. (Courtesy of the Lowell Observatory.).

Mimolet kometa Halley

The black heart of comet Halley

Fig. 2.7 . The coal-black nucleus of comet Halley is a dirty ball of ice, about the size of Paris or Manhattan. It is silhouetted against bright jets of water and dust that stream sunward (*right*) from at least three places that have been warmed by the Sun's radiation. In this projection, the nucleus measures 14.9 kilometers by 8.2 kilometers. This is a composite of images taken by the European Space Agency's *Giotto* spacecraft near its encounter with the nucleus of comet Halley on 14 March 1986. (Courtesy of ESA.)