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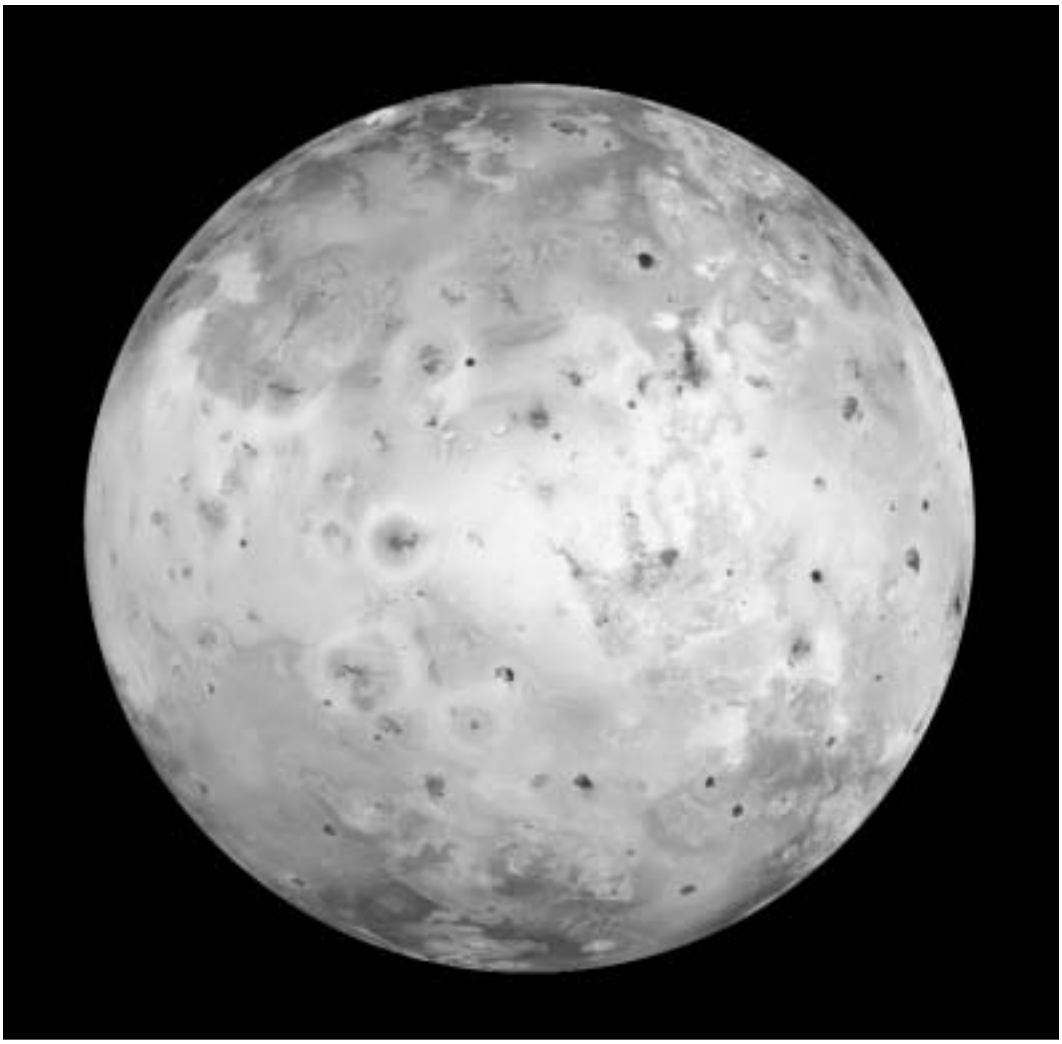
Clementine

Nation: U.S. (66)
Objective(s): lunar orbit
Spacecraft: Clementine
Spacecraft Mass: 424 kg
Mission Design and Management: BMDO and NASA
Launch Vehicle: Titan IIG (no. 23G-11)
Launch Date and Time: 25 January 1994 / 16:34 UT
Launch Site: WSMC / SLC-4W
Scientific Instruments:

1) ultraviolet/visible camera
2) near-infrared camera
3) long-wave infrared camera
4) high-resolution camera
5) two star tracker cameras
6) laser altimeter
7) bistatic radar experiment
8) gravity experiment
9) charged-particle telescope

Results: Clementine was the first U.S. spacecraft launched to the Moon in over twenty years (since Explorer 49 in June 1973). The spacecraft, also known as the Deep Space Program Science Experiment (DSPSE), was designed and built to demonstrate a set of lightweight technologies such as small-imaging sensors for future low-cost missions flown by the Department of Defense. Clementine carried fifteen advanced flight-test components and ten science instruments. After launch, the spacecraft remained in a temporary orbit until 3 February 1994, at which time a solid-propellant rocket ignited to send the vehicle to the Moon. After two subsequent Earth flybys on 5 February and 15 February, Clementine successfully entered an elliptical polar orbit on 19 February with a period of 5 days and a perilune of 400 kilometers. In the following two months, it transmitted about 1.6 million digital images of the lunar surface; in the process, it provided scientists with their first look at the total lunar landscape, including polar regions. After completing its mission goals over 297 orbits around lunar orbit, controllers fired Clementine's thrusters on 3 May to inject it on a rendezvous trajectory in August 1994 with the asteroid 1620 Geographos. Due to a computer problem at 14:39 UT on 7 May that caused a thruster to fire and use up all propellant, the spacecraft was put into an uncontrollable tumble at about 80 rpm with no spin control. Controllers were forced to cancel the asteroid flyby and return the vehicle to the vicinity of Earth. A power supply problem on 20 July further diminished the operating capacity of the vehicle. Eventually, lunar gravity took control of Clementine and propelled it into heliocentric orbit. The mission was terminated in June 1994 when falling power supply levels no longer allowed clear telemetry exchange. On



NASA's Galileo spacecraft acquired its highest resolution images of Jupiter's moon Io on 3 July 1999, during its closest pass to Io since orbit insertion in late 1995. This color mosaic uses the near-infrared, green, and violet filters (slightly more than the visible range) of the spacecraft's camera and approximates what the human eye would see. Most of Io's surface has pastel colors, punctuated by black, brown, green, orange, and red units near the active volcanic centers. A false-color version of the mosaic has been created to enhance the contrast of the color variations. The improved resolution reveals small-scale color units that had not been recognized previously and that suggest that the lavas and sulfurous deposits are composed of complex mixtures. Some of the bright (whitish), high-latitude (near the top and bottom) deposits have an ethereal quality like a transparent covering of frost. Bright red areas were seen previously only as diffuse deposits. However, they are now seen to exist as both diffuse deposits and sharp linear features like fissures. Some volcanic centers have bright and colorful flows, perhaps due to flows of sulfur rather than silicate lava. In this region, bright, white material can also be seen to emanate from linear rifts and cliffs. Comparison of this image to previous Galileo images reveals many changes due to the ongoing volcanic activity. North is toward the top of the picture, and the Sun illuminates the surface from almost directly behind the spacecraft. This illumination geometry is good for imaging color variations but poor for imaging topographic shading. However, some topographic shading can be seen here due to the combination of relatively high resolution (1.3 kilometers per picture element) and the rugged topography over parts of Io. The image is centered at 0.3° north latitude and 137.5° west longitude. The resolution is 1.3 kilometers per picture element. The images were taken on 3 July 1999 at a range of about 130,000 kilometers by the Solid State Imaging (SSI) system on NASA's Galileo spacecraft during its twenty-first orbit.

3 December 1996, DoD announced that Clementine data indicated that there was ice in the bottom of a permanently shadowed crater on the lunar south pole. Scientists estimated the deposit to be approximately 60,000 to 120,000 cubic meters in volume—comparable to a small lake that is 4 football fields in surface area and 5 meters deep. This estimate was very uncertain, however, due to the nature of the data.

179)
Wind
Nation: U.S. (67)
Objective(s): orbit around L1 Libration Point, lunar flybys
Spacecraft: Wind
Spacecraft Mass: 1,250 kg
Mission Design and Management: NASA GSFC
Launch Vehicle: Delta 7925-10 (no. D227)
Launch Date and Time: 1 November 1994 / 09:31:00 UT
Launch Site: ESMC / launch complex 17B
Scientific Instruments:

1) WAVES radio and plasma wave experiment
2) three low-energy matrix telescopes
3) electron isotope telescope
4) suprathermal energetic-particle telescope
5) solar wind experiment
6) solar wind ion composition spectrometer
7) high-mass-resolution spectrometer
8) suprathermal ion composition spectrometer
9) two fluxgate magnetometers
10) 3-D plasma and energetic-particle analyzer
11) transient gamma-ray spectrometer
12) Konus gamma-ray burst studies experiment

Results: Wind is part of the twelve-satellite Inter-Agency Solar-Terrestrial Physics (IASTP) Program, a joint project among the United States, Japan, Russia, the Czech Republic, and ESA to study the behavior of the solar-terrestrial system. The first of two NASA-sponsored Global Geospace Science Program vehicles, the Wind spacecraft carries eight instruments (including one each from France and Russia) to investigate the solar wind's encounters with Earth's magnetosphere and ionosphere in order to determine the origins and three-dimensional characteristics of the solar wind. Wind initially operated in a unique figure-eight-shaped elliptical orbit around Earth at 28,000 x 1.6 million kilometers, partially maintained by regular "double flybys" of the Moon. The closest of nineteen flybys of the Moon between 1 December 1994 and 17 November 1998 was on 27 December 1994, at a range of 11,834 kilometers. By November 1996, Wind was in a "halo orbit" around the Earth-Sun Libration Point, where the solar and terrestrial gravity are approximately equal. On 17 November 1998, it began to move into a series of "petal" orbits designed to take it out of the elliptical plane. Wind's trips above and below the elliptic (up to 60°) allowed the spacecraft to sample regions of interplanetary space and the magnetosphere that had not been previously studied. All of its instruments were operational in July 2001.