

Satellite Image Map of Grand Canyon National Park

The Image Map

This composite satellite image map was produced from data acquired by the Landsat 7 satellite on the mornings of October 10 and October 17, 1999. The map scale is 1:250,000, which means that one inch on the map represents an actual distance of approximately 4 miles (250,000 inches) on the earth's surface.

The Landsat 7 satellite has a circular, near-polar orbit with a nominal altitude of approximately 440 miles. Each orbit takes about 99 minutes. (The time required to collect the data for this Grand Canyon image was approximately 30 seconds.) The orbit is sun-synchronous and is timed so that the satellite passes over the Grand Canyon area at about 9:30 AM mean local sun time. The Thematic Mapper scanner on the Landsat 7 satellite collects data in a continuous stream along a 115-mile-wide path as the satellite moves from north to south along the daylight portion of its orbit. Pixel size (smallest area for which data are collected) is 30m by 30m (about 100 by 100 feet), an area about the size of a typical residential lot. Measurements are collected from seven broad bands of the electromagnetic (light) spectrum, three nearly contiguous bands spanning most of the visible part of the spectrum and four more widely-spaced bands covering critical portions of the infrared spectrum.

Interpretation of the Image Map

This satellite image of the Grand Canyon is a digital color composite of infrared and visible light. Because infrared light is beyond the range of human eyesight, such images commonly emphasize features that are invisible to the human eye. In fact, one could say that they enable us to see portions of the earth's surface as if we were wearing infrared glasses. However, this particular image has been specially enhanced to appear rather like what we might see as astronauts looking down from hundreds of miles in space (through a perfectly clear atmosphere). Vegetation appears in various shades of green and yellow green; water appears as dark blue; and many man-made features appear as shades of dark purple, gray and black.

Only rocks and soils are noticeably different in this infrared view. In arid and semi-arid areas where vegetation is sparse, these basic earth materials appear in a variety of colors that reflect subtle differences in their mineralogical (chemical) content. For example, the oldest rocks of the region (Precambrian schist and other metasedimentary rocks overlain by Cambrian seafloor deposits) appear in hues of light reddish purple. Exposures of these rocks are largely confined to the deepest parts of the Grand Canyon at both its eastern and western ends. Permian-age Kaibab Limestone, which forms the relatively smooth and gently undulating surface of the western part of the Colorado Plateau, is by far the most extensively exposed rock unit in the region. These rocks are exposed almost continuously across the width of the image from the Grand Wash Cliffs on the west to the Echo Cliffs on the east, a distance of almost 130 miles (200 km). Where vegetation is sparse, these rocks appear on the image in various shades of mottled greenish-blue. In many areas however, this distinctive coloration is obscured by the greens, yellows and browns of forest, desert scrub and grassland. Overlying the Kaibab Limestone (near the eastern edge of the image) the sandstones of the Moenkopi Formation show up as a narrow convoluted band of olive green. These rocks are overlain in turn by the riverine siltstones, sandstones and conglomerates of the Chinle Formation (appearing as bright blue) and the wind-deposited sandstones of the Glen Canyon group (appearing in shades of yellow, orange and brown). These resistant sandstones cap the Paria and Aibito Plateaus in the northeast corner of the image. The youngest rocks in this area of the Colorado Plateau occur in several Quaternary to late Tertiary (historic to 10 million year old) basaltic volcanic fields. These basaltic lava flows form an arcuate trend of large, irregular, light- to dark-gray blotches across the southern and western parts of the image. Locally, these flows are surmounted by bright orange cinder cones. On the eastern edge of the image, Shadow Mountain, the most conspicuous of these volcanoes, stands out in high contrast as a bright reddish-orange spot within the bright blue Chinle Formation.

The Natural Landscape

To many, the Grand Canyon of the Colorado River is the most spectacular natural feature in the United States. Approximately one mile deep at its deepest, more than 10 miles wide at its widest, and 178 river miles long (from Lee's Ferry, just downstream of Glen Canyon Dam, to Pearce's Ferry, now submerged beneath the uppermost reaches of Lake Mead), it is truly a Grand Canyon.

The Grand Canyon was formed less than 5 million years ago in response to extension of the Basin and Range province and concomitant uplift of the Colorado Plateau (largely between 13 and 5 million years ago). The Canyon cuts across the southwestern margin of the Plateau, a transitional region separating the Plateau's relatively stable and unbroken core (to the east) from the highly extended and fragmented region of the Basin and Range (to the west). Across this transitional zone, the plateau surface has been broken by young, north-south trending faults into a series of lesser plateaus separated by bold, west-facing scarps and cliffs. From west to east these faults and plateaus are: Grand Wash Fault - Shivwits Plateau, Hurricane Fault - Uinkaret Plateau, Aubrey and Toroweap faults - Kanab Plateau, and West Kaibab Fault - Kaibab Plateau.) This transitional zone of fault-bounded plateaus has been locally intruded and partly covered by the cinder cones and lava flows of several large basaltic volcanic fields. Although much of the general geologic history of the region is well known, the exact timing and development of the Grand Canyon remains obscure.

The Human Landscape

Compared to many areas of the new west, human impact in the Grand Canyon area has been relatively limited. The chasm of the Grand Canyon poses a formidable barrier that has significantly limited human use and development within the region. Aside from the easternmost reaches of Lake Mead (which can be seen on the western edge of the image), the most conspicuous indications of human activity are several areas of cleared land that are located just outside the boundaries of Grand Canyon National Park. The most conspicuous of these is a patchwork of cleared sections located north of the canyon near the southern rim of the Shivwits Plateau. Other larger but somewhat less conspicuous areas are located 10 to 15 miles WSW of Grand Canyon Village and approximately 10 miles south of Desert View. Other indications of human activity include (1) an extensive area of closely spaced clear cuts that covers most of the crest of the Kaibab Uplift (in the northeast part of the image); (2) Glen Canyon Dam (just visible in the extreme northeast corner of the image); (3) the towns of Page, Arizona (east of Glen Canyon Dam) and Mesquite, Nevada (located in the extreme northwest corner of the image); and (4) the dark gray paths of the several paved highways that encircle the region (specific locations provided on the accompanying index map).

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25 KILOMETERS
15 MILES
SCALE - 1:250,000



GRAND CANYON NATIONAL PARK

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