

# What should we know about mars global surveyor

[Science](#), [Astronomy](#)



## **Report 1: Scientific Instrument (TES)**

### **Introduction**

Mars Global Surveyor was developed by the National Aeronautics and Space Administration (NASA) and was launched on November 7th, 1996. A total of five scientific instruments flew onboard the Surveyor spacecraft, among them the Thermal Emission Spectrometer (TES), which will be further explored in this report.

Fig. 1. A drawing of Mars Global Surveyor; “ Mars Global Surveyor,” WPclipart, n. d., [www. wpclipart. com/space/solar\\_system/Mars/Mars\\_Global\\_Surveyor. png. html](http://www.wpclipart.com/space/solar_system/Mars/Mars_Global_Surveyor.png.html).

### **Purpose**

The purpose of the Thermal Emission Spectrometer (TES) is to measure the thermal infrared energy, more commonly known as heat, emitted from Mars, in order to accomplish the ultimate goal of mapping the surface geology of Mars (Hamilton, et al, 14733). Along with this primary objective, questions about “ the composition of surface minerals, rocks, and ice, the temperature and dynamics of the atmosphere, the properties of the atmospheric aerosols and clouds, the nature of the polar regions, and the thermophysical properties of the surface materials” on Mars that were unclear before the mission were to be answered with the aid of TES (Christensen, et al, 23823).

### **Functions**

TES is built with an “ infrared interferometric spectrometer, a bolometer or radiance channel, and a reflectance or albedo channel.” By utilizing an interferometer to create a full spectrum of infrared light from the surface of <https://assignbuster.com/what-should-we-know-about-mars-global-surveyor/>

Mars, TES then uses detectors to measure the heat. As a result, TES is able to collect data on “atmospheric and surface temperature, dust and water ice aerosol optical depth, and water vapor column abundance” (Smith, 148). The data gathered by TES are “calibrated to a 1- $\sigma$  precision of  $2.5-6 \times 10^{-8} \text{ W cm}^{-2} \text{ sr}^{-1}/\text{cm}^{-1}$ ,  $1.6 \times 10^{-6} \text{ W cm}^{-2} \text{ sr}^{-1}$ , and about 0.5 K in the spectrometer, visible/near-infrared bolometer, and infrared bolometer, respectively. These instrument subsections are calibrated to an accuracy of about  $4 \times 10^{-8} \text{ W cm}^{-2} \text{ sr}^{-1}/\text{cm}^{-1}$  (0.5 K at 280 K), 1-2%, and about 1-2 K, respectively” (Christensen, et al, 23823). The spectrometer measures at “spectral resolutions of 5 and 10cm, the bolometer channel measures with a spatial resolution of 3km, and the albedo channel also measures at 3km resolution.” Sources of error in the measurements of TES include a “time-variable systematic radiometric error, which arises because of a periodic sampling error of TES interferograms” (Pankine, 112). TES originally was on board the Mars Observer, and will be used again in the Lucy mission, which plans to be launched in 2021. No announced improvements were made to TES.

Fig. 2. A detailed look at the major components of TES; “Mars Global Surveyor Thermal Emission Spectrometer experiment: Investigation description and surface science results,” *Journal of Geophysical Research*, 2001, p. 23827.

### **Data**

TES collected data in the form of spectra, with different resolutions: Full Spectral/Spatial Resolution, Full Spectral Resolution/Spatially Masked, Spectrally Masked/Full Spatial Resolution, and Spectrally Masked/Spatially

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Masked. The following table (Table 1) shows the total number of TES spectra collected during the “ aerobraking, mapping, and extended phases of the mission.” Data were sent back to Earth through a device called Mars Relay, another instrument attached to the Mars Global Surveyor, which collects data sent by spacecraft on the surface of Mars and transmit it back to Earth.

Table 1. “ How many TES spectra were collected?” Arizona State University, n. d.

## **Results**

The primary mission of the Surveyor spacecraft was completed in January 2001. On November 2nd, 2006, during its third extended mission phase, the spacecraft failed to respond. After failing to reconnect the spacecraft, NASA officially ended the mission in January 2007. Nevertheless, the data collected by TES during the 10 years of its voyage were able to provide crucial information about the geology of Mars.

## **Surface Mineralogy**

The data collected by TES with regard to surface mineralogy had been thoroughly studied by scientists, who made the following conclusions: “ aqueous mineralization has produced gray, crystalline hematite in limited regions under ambient or hydrothermal conditions; these deposits are interpreted to be in-place sedimentary rock formations and indicate that liquid water was stable near the surface for a long period of time,” “ unweathered volcanic minerals dominate the spectral properties of dark regions, and weathering products, such as clays, have not been observed anywhere above a detection limit of 10%; this lack of evidence for chemical

weathering indicates a geologic history dominated by a cold, dry climate in which mechanical, rather than chemical, weathering was the significant form of erosion and sediment production,” and “ there is no conclusive evidence for sulfate minerals at a detection limit of 15%” (Christensen, et al, 23823).

### **Polar Regions**

The polar region also has been studied and was found that “ condensed CO<sub>2</sub> has three distinct end-members, from fine-grained crystals to slab ice,” “ the growth and retreat of the polar caps observed by MGS is virtually the same as observed by Viking 12 Martian years ago,” “ unique regions have been identified that appear to differ primarily in the grain size of CO<sub>2</sub>; one south polar region appears to remain as black slab CO<sub>2</sub> ice throughout its sublimation,” and “ regional atmospheric dust is common in localized and regional dust storms around the margin and interior of the southern cap” (Christensen, et al, 23823).

Fig. 3. South polar cap regression; “ Mars Global Surveyor Thermal Emission Spectrometer experiment: Investigation description and surface science results,” Journal of Geophysical Research, 2001, p. 23853.

### **Thermophysical Properties of Mars’ Surface**

Analysis of the thermal and physical properties of the surface of Mars shows that “ the spatial pattern of albedo has changed since Viking observations,” “ a unique cluster of surface materials with intermediate inertia and albedo occurs that is distinct from the previously identified low inertia/bright and high-inertia/dark surfaces,” and “ localized patches of high-inertia material have been found in topographic lows and may have been formed by a

unique set of aeolian, fluvial, or erosional processes or may be exposed bedrock" (Christensen, et al, 23823).