# Mission to Mars

# Death of a watery world

### With its next lander, NASA plans to discover what turned Mars from a warm, wet place to the cold, arid planet we see today.

### Long ago, the Red Planet was very different from the frozen, barren desert we have seen on our TV screens courtesy of Pathfinder.

# How it was

### The winding river valleys, shorelines and flood plains formed in those early times are clearly visible from space: proof that liquid water once flowed on Mars.

### It must have been warmer, too. And the planet's atmosphere must have been thicker to trap heat from the Sun and create enough pressure to prevent water from boiling away.

# So what went wrong?

### Why did the Martian atmosphere vanish and what happened to the water that once flowed across its surface?

### Did the planet die from natural causes, or was it a case of suicide, or even murder?

### Scientists hope to get some answers from the Mars Global Surveyor spacecraft, which entered orbit around Mars recently.

# Mars Survey

### The Mars Volatiles and Climate Surveyor (MVACS)--will be launched in January. It will land at the edge of the southern polar cap of Mars and study the climate, the soil and atmosphere.

### There are three main theories and together they read like the plot of a detective novel.

# Murder on Mars

### The first possibility is that Mars was murdered. The surface of Mars is scarred with craters from collisions with comets and asteroids.

### The blast from such impacts can blow away the atmosphere above the crater. And with enough large impacts, a substantial fraction of the atmosphere could be eroded. It would have been a slow, drawn-out death by suffocation.

# Sucked away

### Another possibility is suicide.

### Mars would have needed a thick atmosphere of a greenhouse gas like carbon dioxide to keep it warm enough for liquid water to flow over its surface

### Much of its CO2 may have reacted with Martian silicate rocks to form chemicals called carbonates. So the atmosphere would gradually have been sucked into the surface of the planet.

# Natural Causes

### The final possibility is that the Red Planet died of natural causes. Mars has an orbit that is more eccentric than the Earth's, and the axis of the planet may also have tilted sharply in the past so that winters were very severe.

### Mars may be in the middle of an ice age in which much of its CO2 atmosphere has condensed to form permafrost at the poles or beneath the entire surface. This would be hidden from orbiting spacecraft.

# What happened to the air?

### Martian ice ages may be self-perpetuating.

### A thinner atmosphere would be less effective at transporting heat from the equator to the poles.

### Because of this, the poles would stay cold, keeping the CO2 locked up even when a change in the planet's eccentricity and tilt made the winters less severe.

### This may have locked Mars into a permanent ice age.

# Evidence on Mars

### The only way to decide which of these scenarios is most likely is to land a craft at the poles.

### This is just what the next mission will do. Images from Mariner 9, which orbited Mars in 1971, and the Viking orbiters from the mid-1970s show strange layered terrain at the edge of the south polar cap.

### These formations can be traced for hundreds of kilometres and scientists believe they are made of dust and ice, laid down in layers as periods of cold alternated with warmer conditions.

# What may be found

### A record of the Martian climate may be written in the geology of the area in the same way that the climate record on Earth is reflected in ocean sediments, ice cores and tree rings.

### In May 1999, MVACS will land at a latitude of 72° South, at the edge of the southern polar cap. It will study these strange layers, searching for carbonates and ice in the soil. In addition, it will monitor the seasonal CO2 and water content of the atmosphere

# Another explanation

### Perhaps the Martian soil contains a highly reactive oxidising agent--something you might expect if it had reacted with atmospheric oxygen in the past.

### An oxidising soil would decompose nutrients and would destroy any other organic compounds.

### However, the story may be different beneath the surface. Out of reach of an oxygen-rich atmosphere life may survive

### If TEGA finds no oxidising agents beneath the surface, says Boynton, this might suggest that organic molecules or even microbial life could survive there.

# Survey

### Any gases given off by the sample will be flushed through a laser spectrometer.

### This contains two tunable laser diodes, which emit infrared light over a small range of wavelengths according to the amount of current passed through them.

### Since gases such as water vapour and CO2 absorb infrared light at specific frequencies it will be possible to measure how much of each is present.

# Seasons Table

### Seasons Earth Mars

### (Northern Hemisphere) ( in days) (in earth days)

### Spring 93 171

### Summer 94 199

### Fall 89 171

### Winter 89 146