

# Death by Magnetic Field: the story of Mars Atmosphere

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As we all know, Mars is a cold, desolate planet without any life. But, can you imagine that Mars used to have rivers and lakes, with a lot of life billions of years ago? What happened to Mars that led it to be different from its neighbor planet Earth?

Recently, NASA's Mars Atmospheric and Volatile Evolution (MAVEN) mission identified the smoking gun of what happened to Mars: it used to be much warmer, and had a thicker, more Earth-like atmosphere. NASA pointed out that Mars had a thick atmosphere shortly after it was formed, and most of the composite in its atmosphere was carbon dioxide. However, due to the lack of magnetic field protection, the majority of the Martian atmosphere was destroyed by the strong solar wind, and escaped to space (Carlisle, 2015).

The process of the Martian atmosphere escape happened in 500 million years, around 3.7 billion years to 4.2 billion years ago, and caused this very promising planet to turn into a barren planet.

The MAVEN mission is an orbital spacecraft specially designed by NASA to investigate Mars, which cost 600 million dollars. It was launched on November 2013, and reached the orbit of Mars in 2014. Until now, it has been running for nearly one year, and collected plenty of Martian atmosphere data.

MAVEN's data show that Mars used to have a Martian atmosphere that could maintain a certain atmospheric pressure. The surface temperature of Mars can be maintained at 20-30 Celsius degrees, which is pretty much like what we have on Earth now, a good condition for liquid water to exist. However, Mars experienced a drastic change around 4.2 billion years ago, when the magnetic field of Mars disappeared. Based on spaceborne investigator, NASA found that the solar wind still affects Mars. The destruction of the Martian atmosphere is still continuing, even though the atmosphere on Mars is very thin.

A magnetic field can protect a planet against the lethal effect of the solar wind.

From Figure 1, we can see that without the protection of magnetic field, Martian atmosphere is directly attacked by the solar wind, which is different from Earth. Some studies suggest that the Earth's magnetic field protected early life forms, keeping them from being destroyed by strong solar radiation. Hence, more complex life forms were able to develop. However, tracing the Martian surface magnetic field indicated that Mars lost its magnetic field 4 billion years ago, leaving the atmosphere under severe attack by the solar wind.

NASA scientists also noted that 4.2 billion years ago, when the sun was just being born, it was far more active than the middle-age star we live with now. Mars lost its global magnetic field during the time of this heightened activity. After 500 million years, the Martian atmosphere is substantially destroyed, all due to the

disappearance of Mars global magnetic field.

At present, the reason why Mars' global magnetic field disappeared is still not clear. To find out when and how Mars lost its magnetic field, we need to know a lot of Martian rock ages, as precisely as those we know on Earth. However, we don't have those data now. With continuing space missions like MAVEN, we hope to understand how all this happened someday.

## Sources Cited

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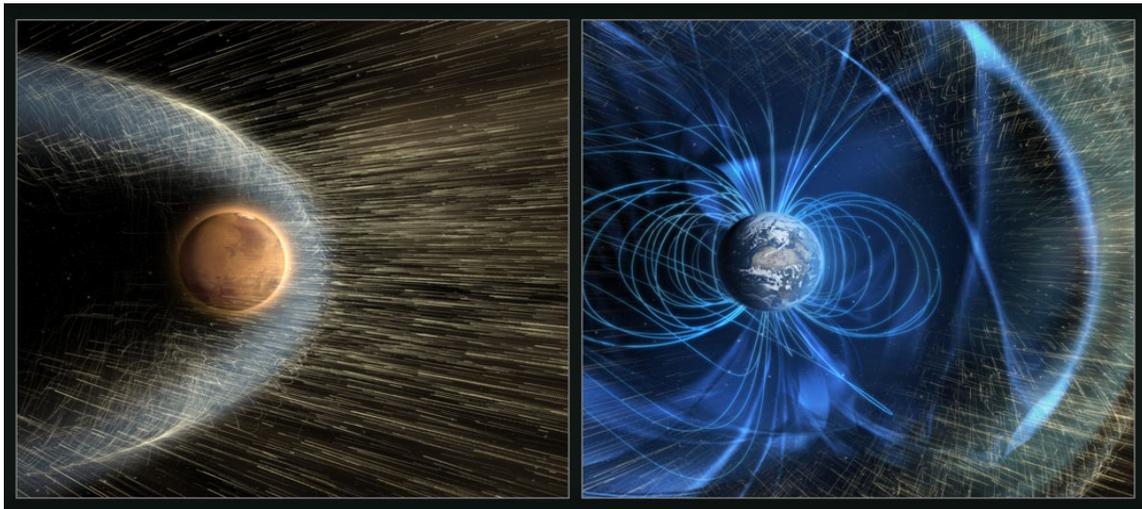


Figure 1. Solar wind attacks Mars and Earth atmosphere.