

A recipe for making the surface features on Mars

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The martian landscape is significantly different from that observed on the Earth. The principal landscape of interest here is the outflow channel, whose size implies immense discharges of water, exceeding any known flood flows on Earth. The regional collapse known as chasma and/or chaotic terrain are regarded as a source region of the outflow channel, since some outflow channels are emanated from them. A scenario which explains the genesis of the outflow channel is as follows. An igneous magma source contacts the permafrost exists in the martian subsurface, the heat supplied by the magma melts the permafrost. If the melted water discharges on the surface, the flood flow and regional collapse should be formed simultaneously.

However, it is not obvious whether the melting process can produce such a catastrophe. Here, we conducted a series of experiments of the melting of a permafrost layer by a localized heat source to confirm the above scenario.

We succeeded to reproduce the catastrophic collapse of the melting region when the water content of the permafrost exceeds a half. When the water content is less than a half, however, the collapse does not take place.

Some events which correspond to the outflow channel are not observed in our laboratory experiments. However, taking the peculiar martian environment into account, such as lower gravitational acceleration and lower atmospheric pressure, we cannot decline the above scenario from the results of our experiments.