Martian Groundwater Outflows in Flume Experiments

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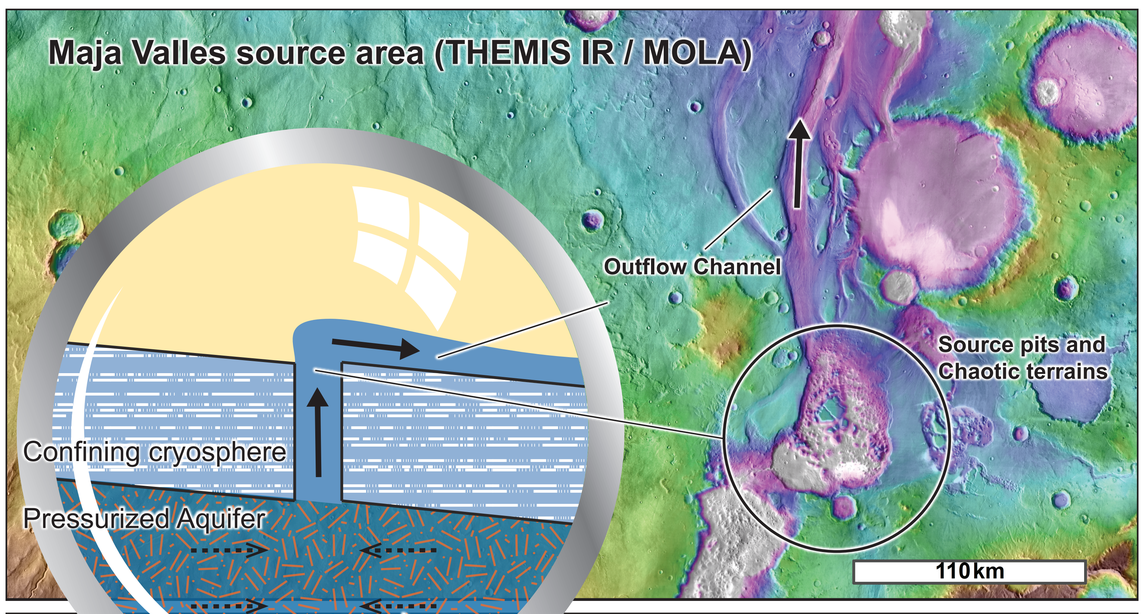
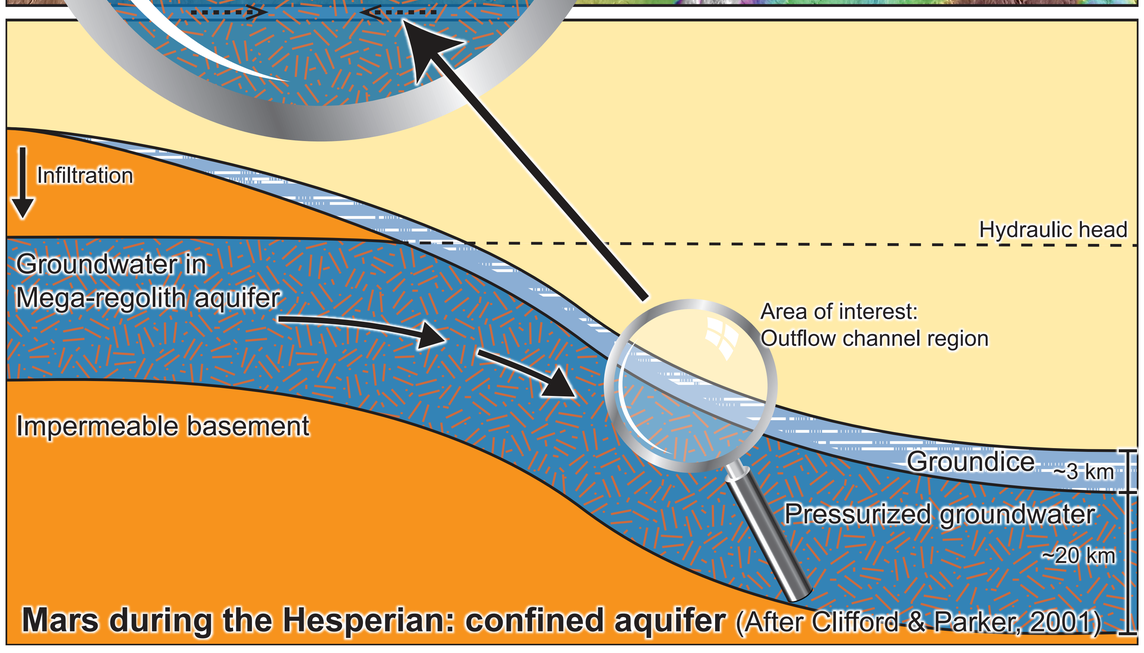




INTRODUCTION

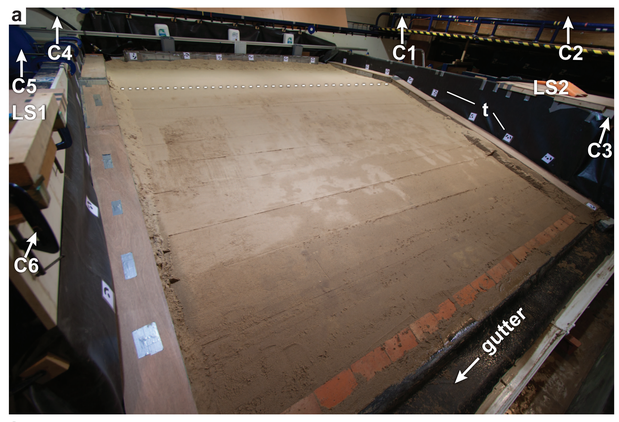
- Outflow channels result from release of pressurized groundwater confined beneath a crosphere.
- A problem with this theory is that groundwater flows slowly and outflow channels are huge and require large amounts of water in short amounts of time.
- Knowledge on such systems in limited as such events never occur on Earth.

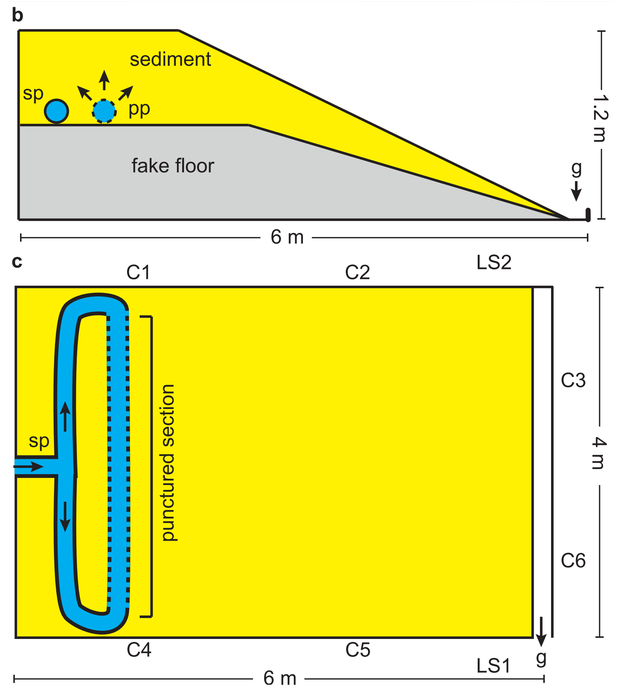
AIMS

- We want to know what groundwater outflow mechanisms there are and if this can form these large valleys.

METHODS

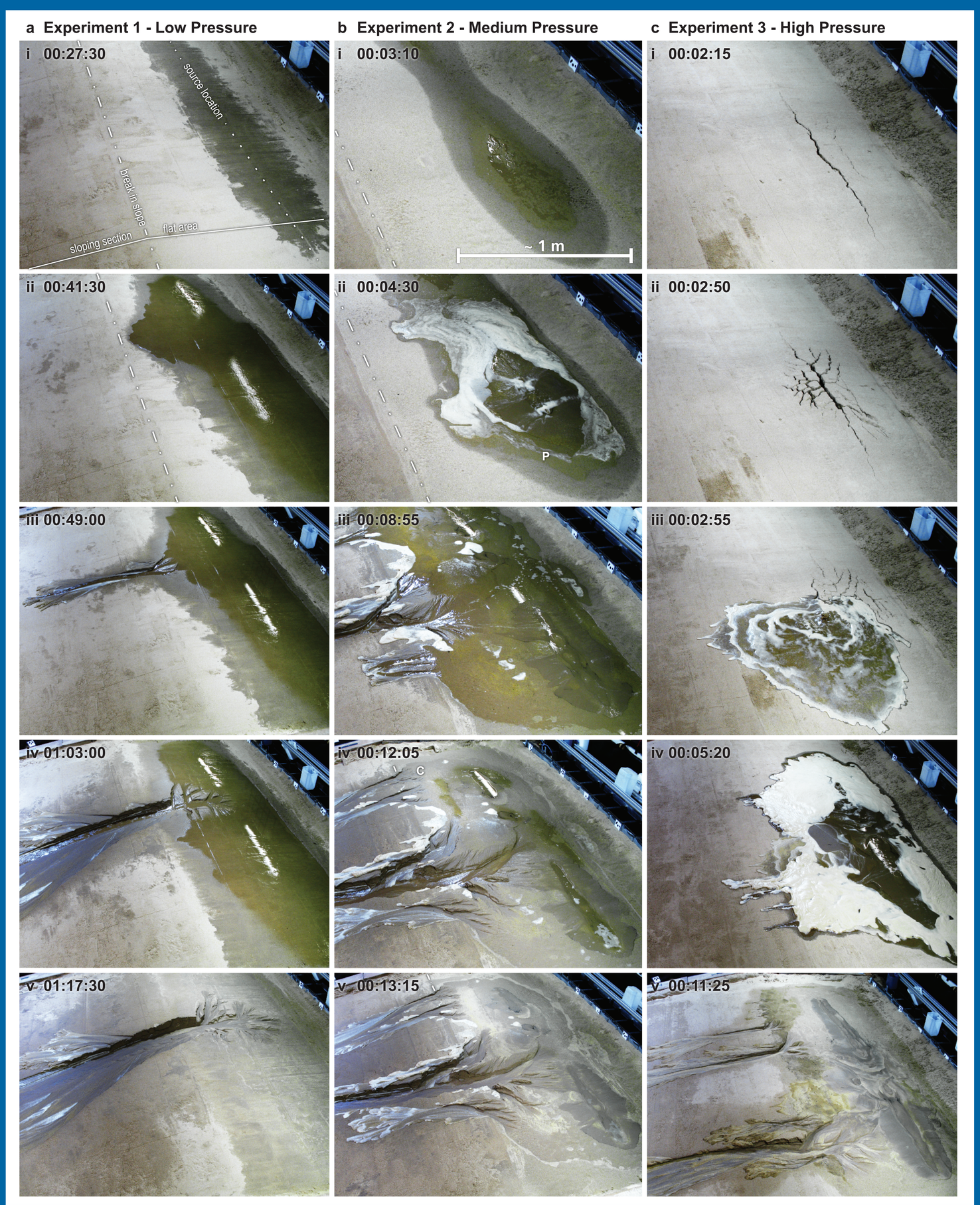
- Experimental setup consists of a flume of 6 m long x 4 m wide and 1.20 m deep.
- Pressurized aquifer release using a subsurface drainage pipe with forced discharge, at:
  - sub-lithostatic pressure (only seepage)
  - super-lithostatic pressure (breaking of surface)
  - flexure inducing pressure (surface lifted by water pressure)
- Data: time-lapse imagery and laserscan DEMs.





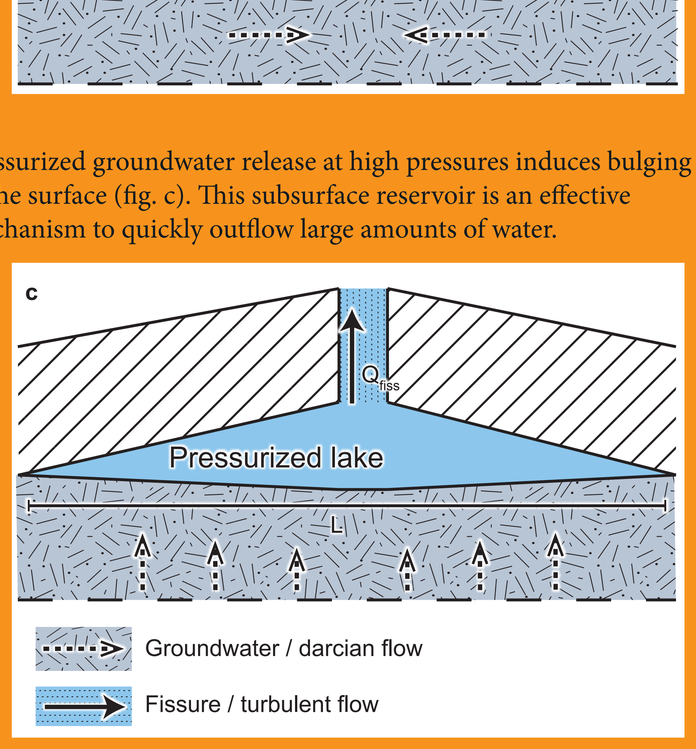
EXPERIMENT RESULTS: DIFFERENT OUTFLOW PROCESSES AT DIFFERENT PRESSURES

- Low pressure: normal seepage
- Medium pressure: fissure seepage, fissures are created by the surface
- High pressure: bulging of surface and fomation of sub-surface pressurized lake which later erupts

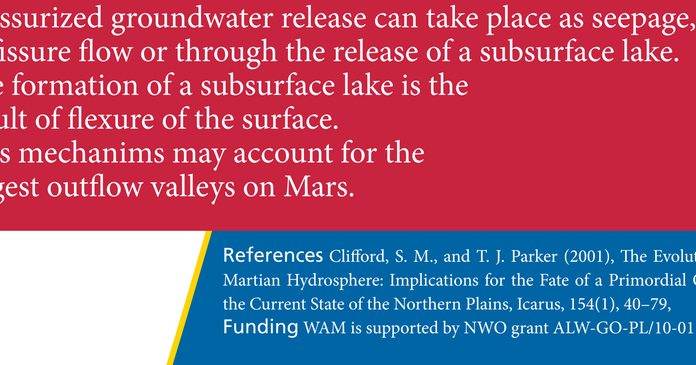


IMPLICATIONS

- Groundwater flow alone does not explain the large outflow channels, the expected discharge of only seepage (fig. a) is too low.



- Fissure seepage (fig. b) is more effecive than normal seepage, but still limited by groundwater rescharge to the fissures.



- Pressurized groundwater release at high pressures induces bulging of the surface (fig. c). This subsurface reservoir is an effective mechanism to quickly outflow large amounts of water.

CONCLUSIONS

- Pressurized groundwater release can take place as seepage, as fissure flow or through the release of a subsurface lake.
- The formation of a subsurface lake is the result of flexure of the surface.
- This mechanims may account for the largest outflow valleys on Mars.

References Clifford, S. M., and T. J. Parker (2001), The Evolution of the Martian Hydrosphere: Implications for the Fate of a Primordial Ocean and the Current State of the Northern Plains, Icarus, 154(1), 40–79,

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