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Simulating Outburst Floods from East Jezero Crater Using D-Claw

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THE RED PLANET'S WATERY PAST

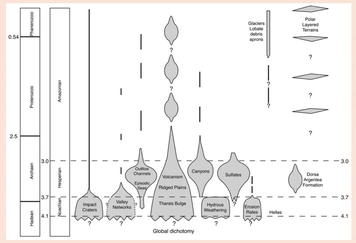


Figure 1: Timeline of geologic activity on Mars (Carr & Head, 2009)

- During the Noachian Period (4 billion years ago), liquid water existed on the surface of Mars
- Evidence for stable surface water include river valley networks and lake paleoshorelines

JEZERO CRATER

- Two inflow channels indicate Jezero Crater contained a paleolake
- In November 2018, Jezero was selected as the landing site for Perseverance Rover
- There is an observable outflow channel and gap in Jezero's crater wall
- Lake outburst floods often inundate broad areas with shallow flow

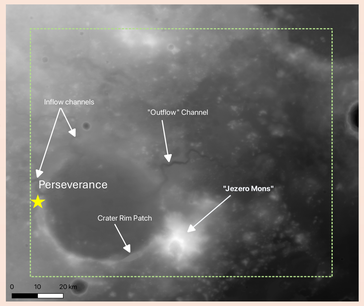


Figure 2: Domain of model with significant areas marked

Can Sediment Travel from an Outburst Flood from Jezero Crater and Where Would it Go?

MODEL SETUP

D-Claw

We ran a series of 2D hydrodynamic models using the two-phase granular fluid model D-Claw (Georgie & Iverson 2014). Models are run using an adaptive resolution mesh with a minimum cell size of $2.04*10^{-4}$ degrees, or about 12 meters (m) over a CTX and HRSC mosaic DEM.

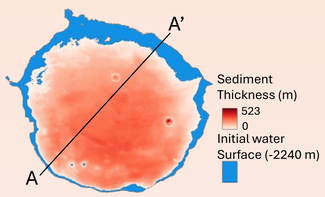


Figure 3: Sediment thickness gradient over Jezero Crater used in flood model

The model ran with two different initial parameters:
1) No sediment, initial water height of -2240 m
2) Initial sediment height of -2400, initial water height of -2240 m

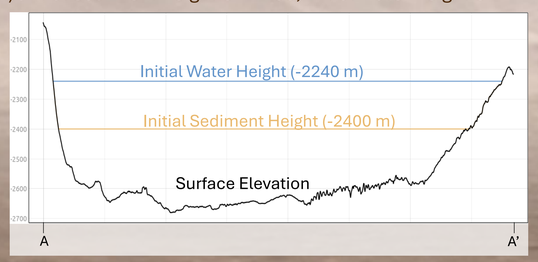
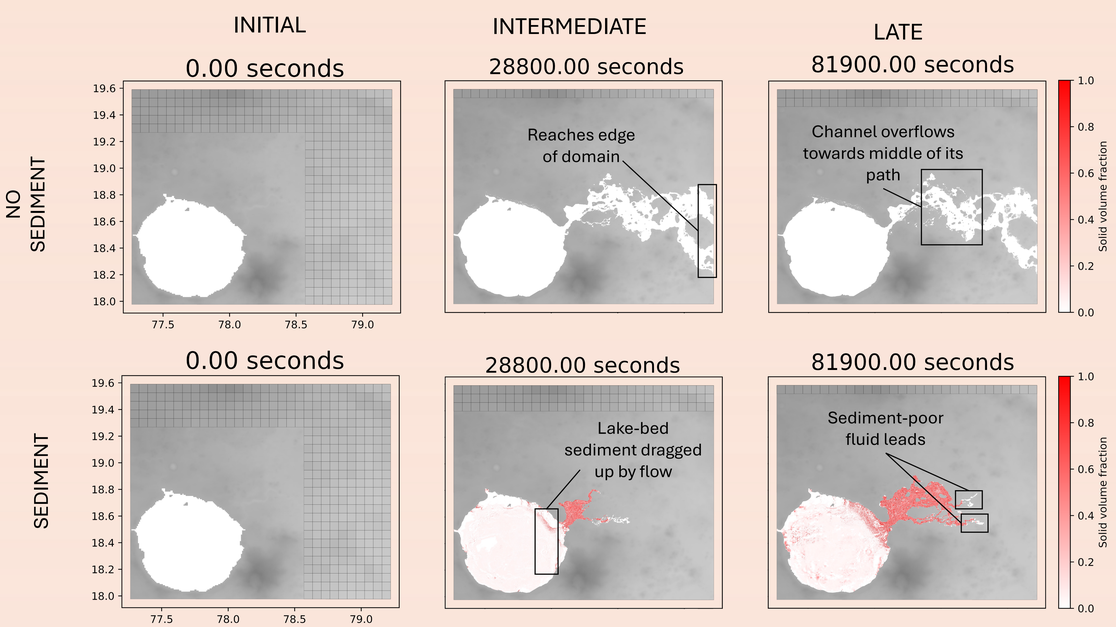
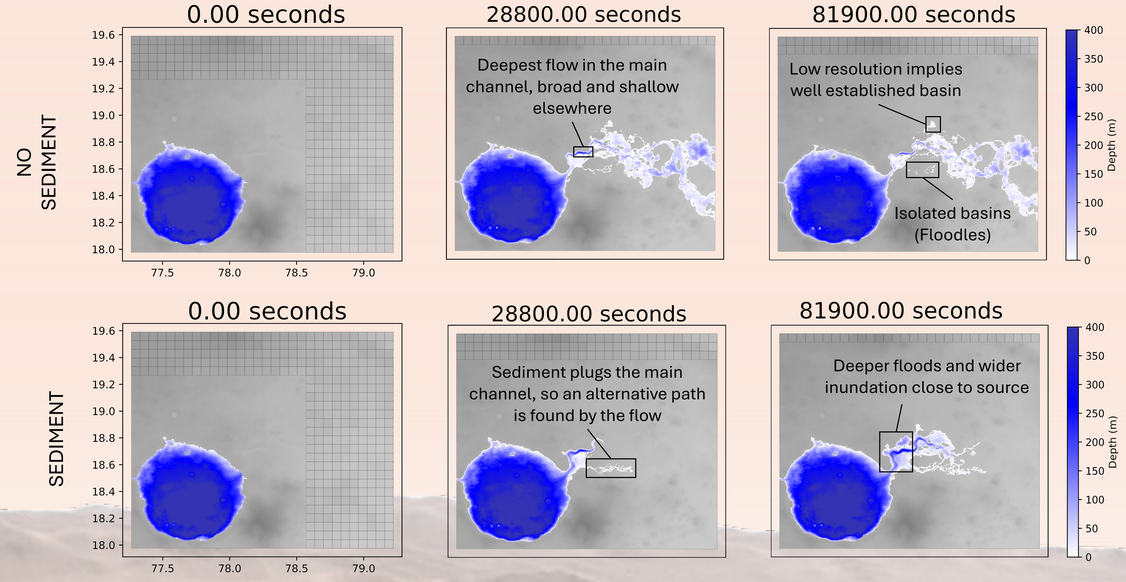


Figure 4: Elevation profile across Jezero crater corresponding with the points A and A' in Figure 3

FLOOD MODEL RESULTS





TERRESTRIAL FIELD ANALOGS

Outburst floods have transferred impressive amounts of sediment including large boulders on Earth.

Pictured Left: Landscape carved by the Ice Age Bonneville Flood
Pictured Right: Author (Laurel Bourg) standing next to a boulder carried by the historic Bonneville Flood

DISCUSSION

Theoretical relationship between varying initial sediment and the number of isolated basins inundated

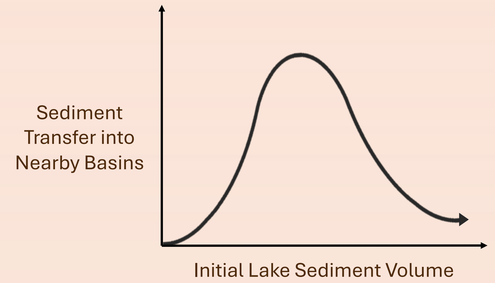


Figure 5: Interpretation of the relationship between initial lake sediment volume and the amount of sediment transferred into nearby basins. Low starting sediment leads to low sediment deposited, but high sediment volume means less spread over the domain from the channel

Using near IR and visible spectrum spectroscopy over the domain used in these models, I hope to find evidence of lake sediment deposition that we could use to determine the extent of inundation for an outburst flood out from Jezero

CONCLUSIONS

- We observed the phenomenon of "floodles" (isolated basins inundated by floods) in our simulations. This could be a key process of transportation for sediment and possibly life across Mars's surface
- As the initial volume of sediment increases, the flow becomes slower and more confined, and complex damming dynamics occur along the flood route

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