Experimental Study of CO$_2$ Sublimation as a Trigger for Mass Wasting

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**BACKGROUND**

- CO$_2$ sublimation proposed source of Mars gully evolution [1]
- Proposed mechanisms for Mars gully modification by sublimation
  - CO$_2$ frost avalanches [2,3]
  - Frosted granular flow [3]
  - Sediment fluidization [4]
  - Trigger for debris avalanches [5]
- First direct experimental study of CO$_2$ sublimation as trigger for mass wasting

**METHODS**

- Stratified Slope Models
  - 5 – 10 mm layer of granulated CO$_2$ ice mixed in JSC Mars-1 regolith simulant
  - JSC Mars-1 base
  - 150 W halogen lamp 25 cm above slope (Fig.1)
  - 6°C ambient temperature
  - Stereo HD videography
  - Digital elevation model (DEM) & motion detection analyses

**RESULTS**

**EVENT FREQUENCIES VS CONTROLS**

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**DISCUSSION**

- Variety of mass wasting styles related to surface activity
- Low activity:
  - Slope slides as single mass along basal plane (Fig.1a)
  - Surface subsidence controlled by CO$_2$ concentration (Fig.1b)
- High activity:
  - Individual particle slides dominate
  - Single particles trigger larger-scale movements
  - Infrequent formation of pits and scarps
- Water frost developed on slope surfaces (Figs. 1b & 2)
  - Unquantified influence on surface morphology & activity
  - Locally enhanced stability due to increased surface cohesion
  - Decreased stability due to additional mass

**CONCLUSIONS**

- CO$_2$ Sublimation can trigger small-scale mass wasting.
- Frequency of trigger events increased by (Fig.4):
  - Steeper mean slope angles
  - Increased initial CO$_2$ ice mass
  - Decreased ambient temperature
  - Increased relative humidity

**REFERENCES**


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