Deflecting Slope Streaks on Mars: Possible Formation Mechanism

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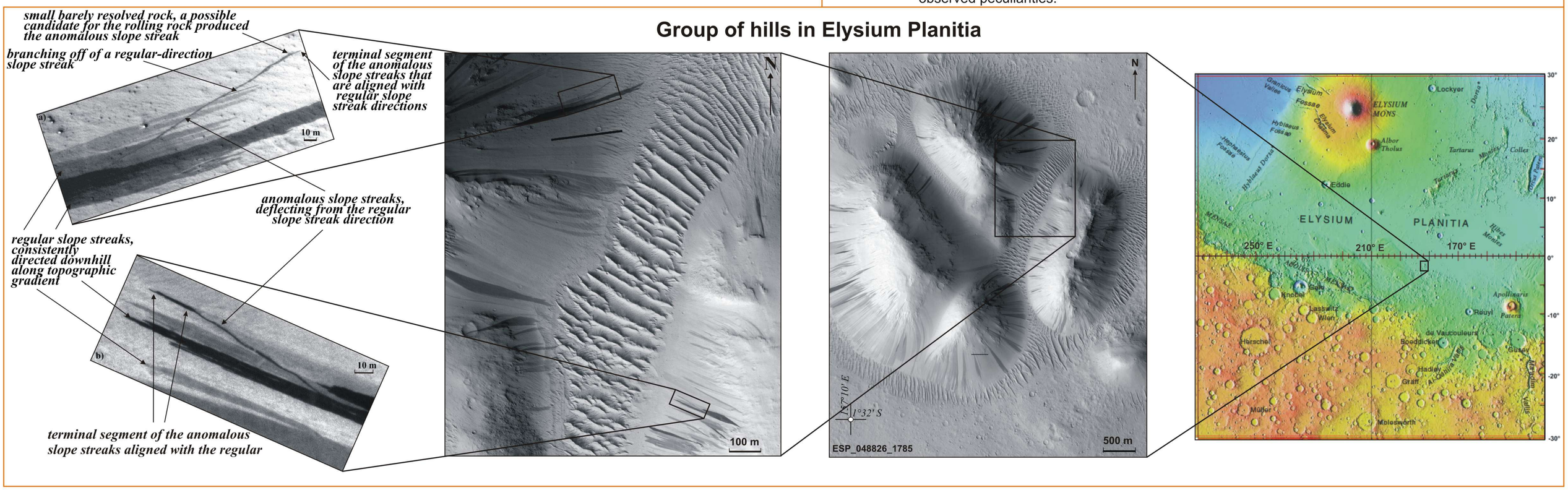
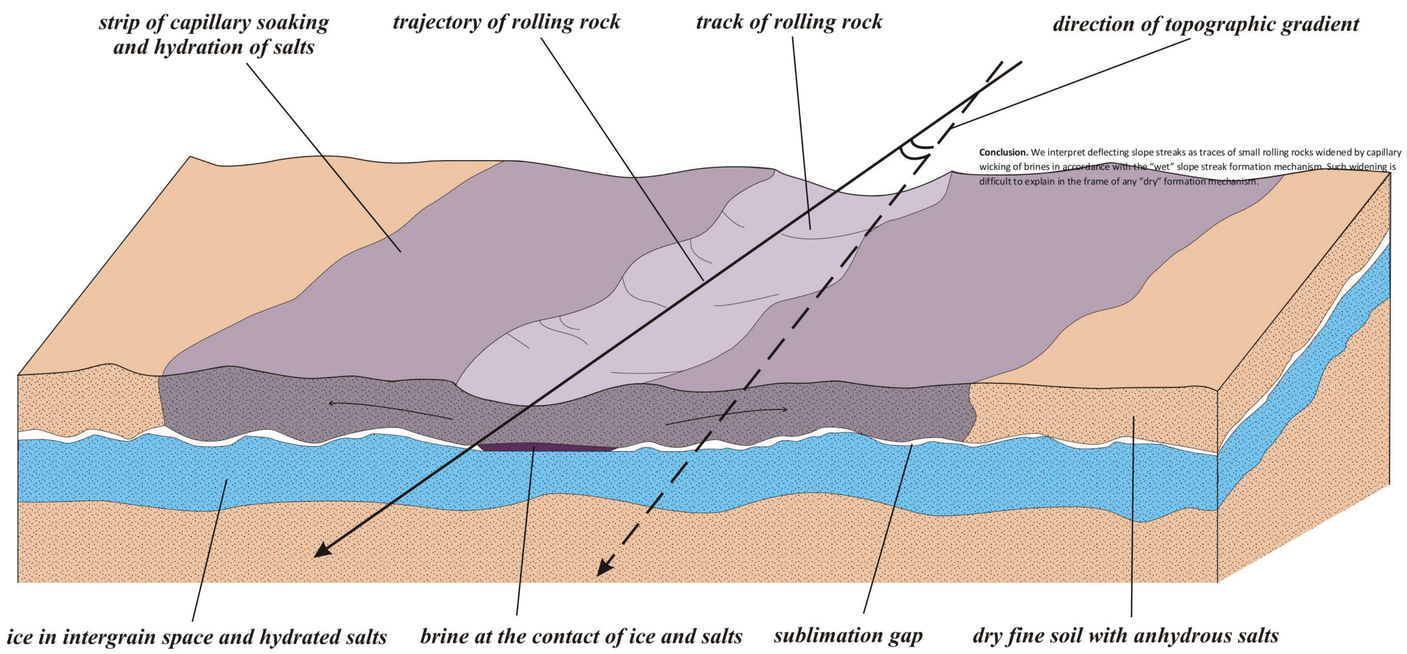
Introduction: Slope streaks are enigmatic, actively forming albedo features on slopes in dust-rich equatorial regions on Mars. They are a specifically martian phenomenon. "Dry" (dust avalanches) and "wet" (brine percolation) mechanisms of slope streak formation had been proposed, however they cannot consistently explain all observed peculiarities.

Group of hills in Elysium Planitia



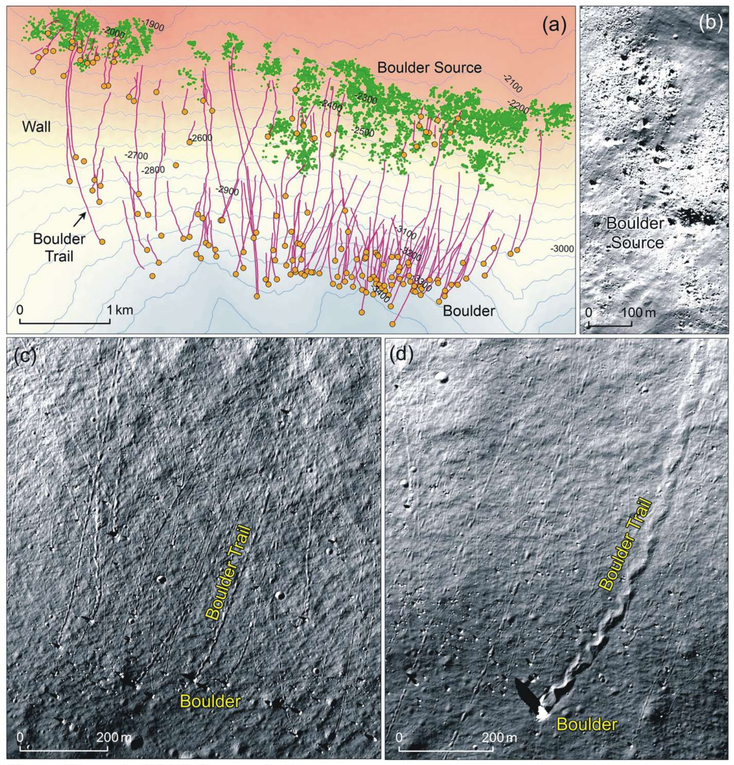
Model of deflecting slope streak formation



Conclusion. We interpret deflecting slope streaks as traces of small rolling rocks widened by capillary wicking of brines in accordance with the "wet" slope streak formation mechanism. Such widening is difficult to explain in the frame of any "dry" formation mechanism.

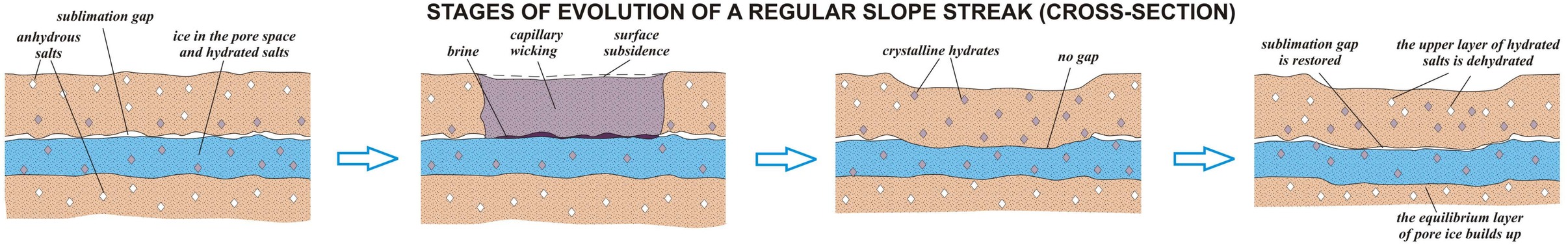
A key feature of the deflected slope streak is the absence of gravitational brine flow, which could be caused by closure of the sublimation gap and disruption of the underlying ground ice crust

On the lunar surface, the rock track also often deviate from the "normal" direction



* From: Senthil Kumar,P., et al. (2016) Recent shallow moonquake and impact-triggered boulder falls on the Moon: New insights from the Schrödinger basin, J. Geophys. Res. Planets, 121, 147–179, doi:10.1002/2015JE004850

STAGES OF EVOLUTION OF A REGULAR SLOPE STREAK (CROSS-SECTION)



In areas with loose dust cover, a significant vertical temperature gradient during the warm period draws moisture from the atmosphere and causes formation of hydrated salts and pore ice at a certain shallow depth. A thin "sublimation gap" forms on the surface of this layer due to temperature fluctuations and seasonal sublimation of ice.

As a result of heating and local dehydration of hydrated salts, the first brine appears, which flows along a slope in the "sublimation gap", is absorbed by fine soil and hydrates dry salts. Heat is released, the underlying ice melts and water flows to the next section below. Heating from -50°C and melting of 1 kg of ice requires 31.5 kcal of heat, while crystallization, for example, of hydrated magnesium perchlorate $Mg(ClO_4)_2 \cdot 6H_2O$ with the same amount of H_2O produces 302.9 kcal of heat, therefore, the process is highly exothermic, and therefore, can be self-supporting.

The wetted soil sags and the "sublimation gap" closes. This impedes the development of a new slope streak over a fresh one.

Hydrated salts gradually lose water to the atmosphere and to the underlying ice layer. If the slope strip is not covered by a layer of new dust, then it becomes lighter than the background due to dehydrated salts.

Conclusion. We interpret deflecting slope streaks as traces of small rolling rocks widened by capillary wicking of brines in accordance with the "wet" slope streak formation mechanism. Such widening is difficult to Explain in the frame of any "dry" formation mechanism.