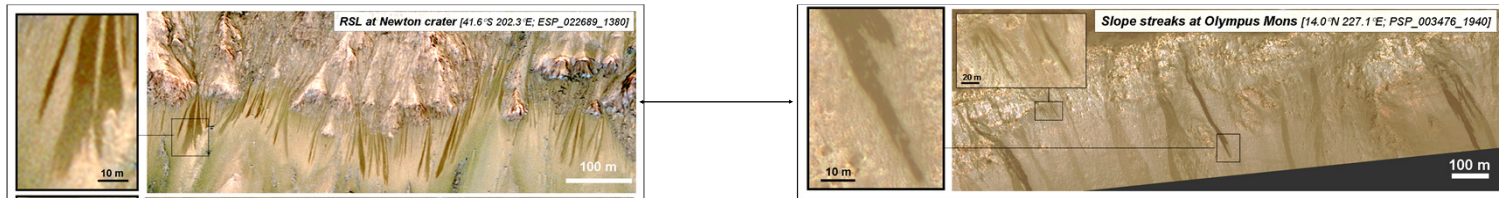


# A BRINE EXTRUSION MODEL FOR RECURRING SLOPE LINEAE ('RSL')

A. Mushkin<sup>1,2</sup>, A. R. Gillespie<sup>1</sup>, D. R. Montgomery<sup>1</sup>, C. A. Hibbitts<sup>3</sup> and B. C. Schreiber<sup>1</sup>

<sup>1</sup>University of Washington, <sup>2</sup>Geological Survey of Israel, <sup>3</sup>John Hopkins Applied Physics Lab



Are slope streaks & RSL fundamentally different or do they just differ in scale like rivers & streams?

### Physical commonalities between RSL and low-albedo slope streaks

**Spectral similarities:**  
→ Lack of distinctive absorption bands in CRISM data for both slope streaks<sup>[3]</sup> and RSL<sup>[4]</sup>.

→ Comparable HiRISE color properties for slope streaks and RSL that are distinct from other scene elements

**Fading mechanism:**  
Wind streaks form and fade next to persistent slope streaks → a 2<sup>nd</sup> streak-fading mechanism in addition to dust deposition.

→ Global dust storms do not 'erase' streaks

**Time-scales of fading:**  
→ RSL, seasonal  
→ Streaks, years-decades<sup>[5]</sup>

### Ambiguities in suggested taxonomic distinctions<sup>[1,2]</sup>

McEwen et al., 2011, Table 2: Slope streaks versus RSL	Explanation of typical distinction	Genetic distinction
1. Scale	Low-albedo regions on Mars were mapped using coarse resolution images (PSP, color or grayscale) and slope streaks were mapped using higher resolution images (HiRISE, color or grayscale)	no
2. Color	Color maps of slope streaks (RSL) are not as consistent as those of slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
3. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
4. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
5. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
6. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
7. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
8. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
9. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
10. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
11. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
12. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
13. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
14. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
15. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
16. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
17. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
18. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
19. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
20. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
21. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
22. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
23. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
24. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
25. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
26. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
27. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
28. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
29. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
30. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
31. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
32. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
33. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
34. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
35. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
36. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
37. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
38. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
39. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
40. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
41. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
42. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
43. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
44. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
45. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
46. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
47. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
48. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
49. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
50. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
51. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
52. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
53. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
54. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
55. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
56. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
57. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
58. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
59. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
60. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
61. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
62. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
63. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
64. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
65. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
66. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
67. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
68. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
69. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
70. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
71. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
72. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
73. Scale	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
74. Color	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
75. Shape	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
76. Location	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
77. Persistence	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
78. Seasonality	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
79. Fading	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no
80. Spectral properties	Slope streaks (RSL) are not as consistent as those of slope streaks (RSL)	no

→ Ambiguities in the proposed differences between slope streaks and RSL<sup>[1,2]</sup> do not support a genetic distinction

### Slope streaks and RSL represent a continuum of dynamic low-albedo slope features that differ in scale and are consistent with the brine seepage model previously suggested for slope streaks<sup>[3]</sup>

**Brine extrusion model<sup>[3]</sup>**

→ Both streak<sup>[3]</sup> and RSL surfaces are "dry" at time of data acquisition

→ Precipitation of a metastable stain (ferric oxides?)

III - The brine evaporated, solidified leaving behind dry surfaces. 1) A transparent coating, 2) amorphous FeO, and 3) microcrystalline FeO, which is effectively larger FeO, which is more resistant to erosion.

I - Unobscured slope mantled by a thin porous dust layer

II - Solar insolation warms the thin dust layer to allow short term horizontal seepage of brine from a deeper source. The brine evaporates during seepage and/or freeze and solidifies when the transient warm conditions cease.

### Size-frequency distribution

→ RSL and slope streaks plot along a continuum in terms of their size-frequency distribution

### Conclusions:

→ Geomorphic and spectral commonalities place slope streaks and RSL on a continuum of dynamic low-albedo slope features on present-day Mars.

→ We propose the brine-seepage model suggested by Mushkin et al., 2010 for low-albedo slope streaks as a testable model for RSL and slope-streak activity.

[1] McEwen et al., 2011, Science (333); [2] McEwen et al., 2014, NatureGeoSci; [3] Mushkin et al., 2011 GRL (37); [4] Ojha et al., 2013, GRL (40); [5] Bergonio et al., 2013, Icarus (225).