DARK TALUS STREAKS ON MARS ARE SIMILAR TO AEOLIAN DARK STREAKS;
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Elongated dark streaks are visible on some martian taluses, if the spatial resolution is sufficiently high (Figure 1). The streaks in question are dissimilar to the slight streaking common on terrestrial taluses that is caused by slight variations in albedo of rockfall material being added to the top of the slope. They are also distinct from the dark material extending downslope from weathered igneous material of the type found in Valles Marineris (1). Several mechanisms have been proposed for the origin of dark talus streaks, including that they are due to the weathering of intrinsically darker material onto the slope, that they represent new scree deposited on an older, dust-mantled talus, or that they are deposited as some sort of a wet slurry. Each mechanism either does not explain all of the observed features of the streaks or is more complex than required, or both. A simpler model that explains all of the observed features is that the dark talus streaks are the mass-wasting equivalent of aeolian erosional streaks.

Dark talus streaks in the aureole of Olympus Mons were described by Morris, who interpreted them to be due to the weathering of dark-colored blocks in the pyroclastics of which the aureole was presumed to be composed (2). In a more detailed study of the streaks, all Viking images with spatial resolutions <100 meters/pixel were examined (3). Surface features, including dark talus streaks, were cataloged from images with resolutions <25 meters/pixel in another study (4). The following general characteristics are derived from the present and previous studies:

1. Dark talus streaks are *only* found on slopes that appear to be at the angle of repose.
2. Dark talus streaks are independent of elevation and local lithology.
3. Dark talus streaks occur *only* in regions of high albedo and low thermal inertia.
4. Dark talus streaks *always* parallel the local topographic gradient. In some instances they appear to be diverted around obstructions.
5. Dark talus streaks display a variety of contrast ratios relative to the rest of the talus. Streaks with the greatest albedo contrast relative to their surroundings have margins that are more-sharply defined than do streaks that are not as dark.
6. The upslope end of dark talus streaks are pointed and, where more than one streak exists in a given locality, the upslope ends do not necessarily terminate at the same horizon.
7. Dark talus streaks often occur in the vicinity of prominent aeolian features.
8. Dark talus streaks are more commonly found in equatorial regions.

There are significant problems with each of the mechanisms proposed to account for the dark talus streaks. If the streaks are due to the weathering of a dark block in a pyroclastic deposit as proposed in (2), then the blocks would have to be much larger than is reasonable (3). Nor is it likely that the streaks are caused by fresh dark scree being emplaced over brighter, dust-mantled scree as proposed by (5; cited in 3), because there often is no obvious scree source immediately above the streaks and the streaks in that case would not point upslope. The notion that the material in dark talus streaks was wet (3) is plausible, but the requirements for water-enhanced flow, namely a water source and some sort of protection against desiccation, are unnecessarily restrictive.

A much simpler model is that the dark talus streaks are the mass wasting equivalent of aeolian erosional streaks. Adjustments on a dust-covered scree slope by landslip would sufficiently agitate the surface to place the dust into suspension where it would be redistributed by the wind away from its original deposition site. The relative darkness of the streak would be caused by the coarser (hence, darker) material being relatively dust free compared to the surrounding slope. No water or inhomogeneity in the wall rock is required. The landslide model explains all of the observed features of dark talus streaks. They would, of course, only be found on slopes at the angle of repose, be independent of elevation and lithology, and parallel the local topographic gradient. The landslips producing dark talus streaks would only be visible on dusty slopes, those in regions of high albedo and low thermal inertia. As suggested in (3), the darker, more well-defined streaks would be younger than the more faded, less well-defined streaks because the latter have been partially obliterated by dust deposition. The landslip model would produce the observed streak shapes: the material undergoing slippage would tend to fan out as it moved downslope, unless they are forming on a "water-gathering" slope (see 6, p.191) such as a crater interior. There would be some downslope movement of material above the site of initial slippage, which would result in the pointed proximal ends of the streak. There would be no preferred position or origin point on the slope of the streaks, because the streak formation mechanism is independent of a subsurface cause. In this model, it is hardly surprising that dark talus streaks would be commonly found in conjunction with other aeolian landforms. The observation that dark talus streaks are found preferentially in equatorial regions is probably a selection effect; most of the Viking images with sufficiently-high spatial resolutions to reveal the streaks are of near-equatorial latitudes (7).

There are only three ways to oversteepen and cause failure on a talus: add material to the top, remove material from the toe, or cause internal changes in the talus to reduce its angle of repose (8). Martian taluses have little, if any, significant erosional processes acting to remove material from the toe, compared to their terrestrial counterparts. It is also not necessary to invoke the most common way of altering the angle of repose internally, the addition of water to increase the pore pressure, to account for the slope failure. What is significant is the addition of new scree from the weathering of bedrock. Exposed bedrock is not common on Mars and detection of its presence is important for remote sensing compositional studies (9), therefore, the presence of landslip-caused dark talus streaks is important. The approximate rate of dust deposition is known to be on the order of up to ~250 microns/year (10), and assumptions can be made regarding the thickness of dust needed to conceal the darker substrate on the talus. Hence, the rate of modification of talus slopes and the rate at which new material is added to them can be inferred. Since at least a few centimeters of dust would be required to bury a dark talus streak, therefore, they have lifetimes on the order of centuries to millennia. Seeing several of them on a given surface indicates that landslips are not uncommon, even compared to those on Earth.

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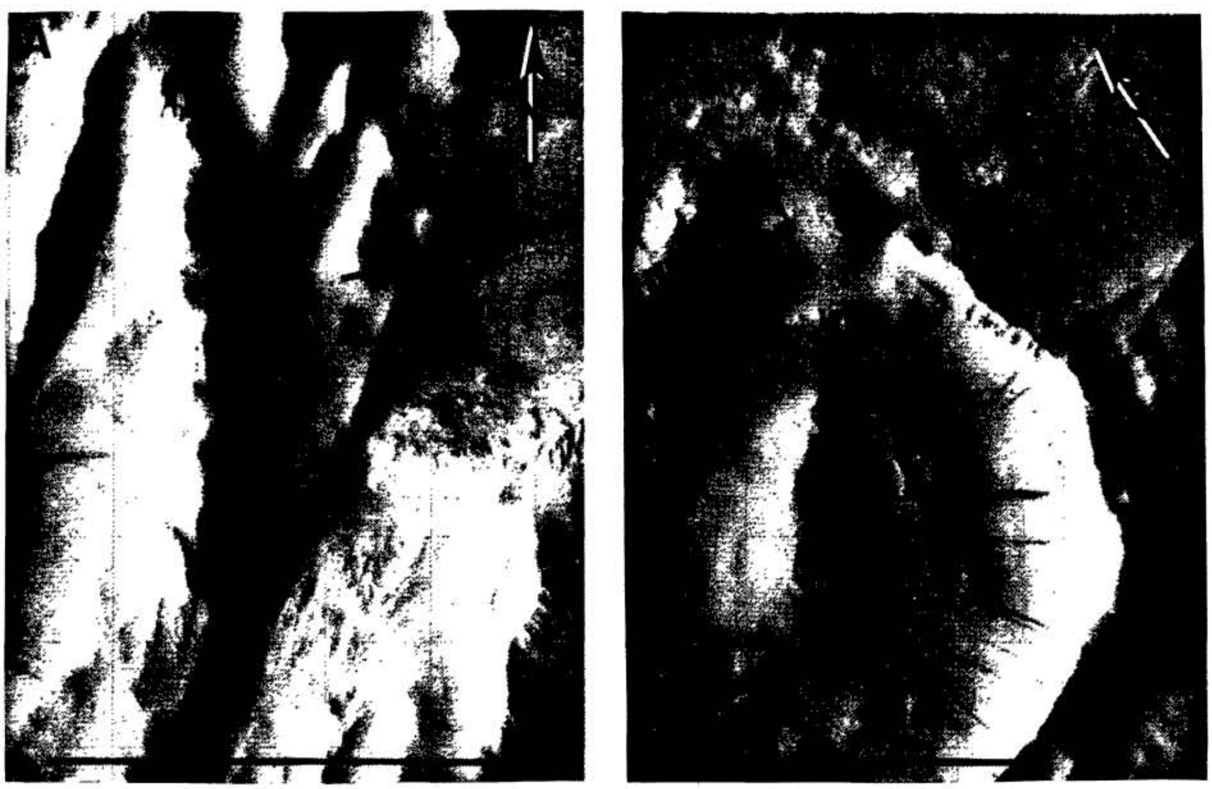

Figure 1. **A.** Dark talus streaks in the Olympus Mons aureole are fan-shaped, display a variety of albedo contrasts, and are parallel to the local topographic gradient, even diverting around obstructions (arrow). Dunes are common in the aureole. Portion of Viking frame 441B02, NGF orthographic projection. **B.** Dark talus streaks on crater walls and other concave slopes are not fan-shaped, as in this example from the Sinus Sabaeus region. Portion of Viking frame 748A12, NGF orthographic version. The scale bars are 5 km long.