Martian "Gullies": Unfortunate use of a Terrestrial Term! J. Dixon [1,2] and K. Coleman[2], [1] Department of Geosciences, University of Arkansas, Fayetteville, Arkansas, U.S.A. 72701. jcdixon@uark.edu [2] Arkansas Center for Space and planetary Science, University of Arkansas, Fayetteville, Arkansas, 72701. U.S.A. ksacolem@uark.edu

**Introduction:** It is unfortunate that the hillslope forms identified on Mars are referred to as gullies. This terminology is misleading because the so-called gullies on Mars do not possess morphologies that resemble those of terrestrial gullies. In particular, terrestrial gullies commonly fail to display the characteristic three-component morphology so typical of Martian gullies: alcove, channel and apron [1]. Therefore, at least on morphological grounds, it is necessary to identify more representative terrestrial analogs. This paper examines potential terrestrial analogs for gullies which more closely resemble Martian forms in terms of morphology as well as processes of formation. Three analogs are considered: debris flows, debris torrents and slush avalanches.

**Terrestrial Gullies**

Terrestrial gullies exhibit a great diversity of form and size, and result from a great variety of initiation processes. However they generally display a relatively simple single channel and a gully head that splits during predominantly headward erosion not uncommonly expanding into a ring valley at the head of the gully[2]. They commonly connect in their lower reaches to a main channel as they develop on channel side wallsThey are commonly initiated and cut into high hillslope locations. They are most commonly developed in unconsolidated materials Initiation is associated with infrequent flow resulting from seasonal or infrequent rain events and due to a lack of catchment rely heavily on direct inputs to their channel or to seepage, piping , or waterfall-related headward retreat.

**Figure 1:**. Typical terrestrial gully forms.

**Debris Torrents**

Debris torrents are channelised, coarse-grained debris flows. They have distinct source, transport and deposition zones with accompanying basin, channel and fan morphologies respectively [3]. During a debris torrent large amounts of material are mobilized in the basin and transport down the channel often increasing in volume. Upon reaching the apex of the fan the torrent begins to deposit material. Debris torrents are composed of a variety of sediment sizes. from large boulders to fine matrix.

.**Figure 2:**. Debris torrent. Coast Range, Canada.

**Slush Avalanches**

Slush avalanches are a particular type of snow avalanche that occurs along steep water courses or small valleys. Slush avalanches consist of large masses of very wet and heavy snow, ice blocks, water and variable amounts of eroded soil and bedrock. They usually occur in the spring of years with exceptionally rapid snow melt. The avalanche path is characterized by the presence of a source area, a transport channel and a deposition/fan component [4]. The runout fan typically consists of debris of a range of sizes from fine to coarse boulders. The surface of the fan displays the presence several distributary channels (Fig 3).

**Figure 3** . Slush avalanche path Swedish Lapland.

**Debris flows and avalanches**
In periglacial environments abundant snow and high relief combine to produce various types of snow and debris avalanches. Most avalanches begin as snow avalanches which then pick up varying amounts of debris ultimately becoming debris avalanches or slides. Debris flows are rapid movements of masses of rock and or debris gliding on a glide plane producing frictional erosion. They are characterized by a distinct slide scar and an eroded slide track terminating in a slide tongue or lobe [5] (Fig 4).

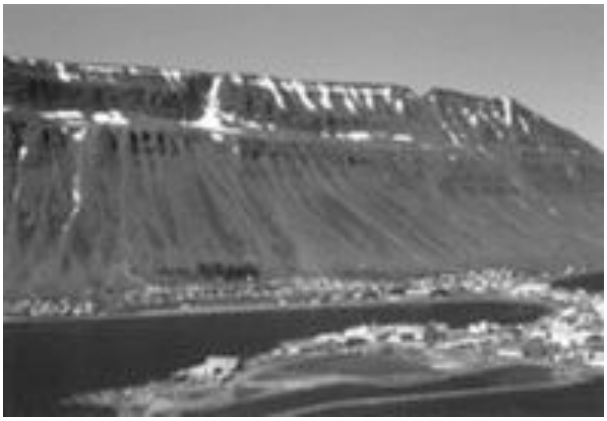

**Figure 4:** Debris avalanche paths, Spisbergen.
**Conclusions**
It appears, based on morphological grounds, that debris flow and avalanche-related forms occurring in high relief, snow and ice dominated environments may be amongst the most appropriate earth analogs for the "gully" forms observed on Mars. These terrestrial forms display the morphological components frequently observed in Martian forms. In addition they represent forms which result from processes which can reasonable be expected to occur under prevailing environmental conditions on mars including seasonal "snow" and seasonal thawing of ice-rich regolith.

**References:** [1]Malin, M.C. and Edgett K.S. (2000) *Science*, 288, 2330-2336. [2] Wells, N.A. (2004) *Encyclopedia of Geomorphology*, 503-506. [3] Sterling, S and Slaymaker, O. (2007) *Geomorphology* 86, 307-319. [4] Slaymaker, O. (1988) *Journal of Hydrological Sciences* 33, 567-573. [5]Decauline, A. and Saemundsson, T. (2006) *Geomorphology*, 80, 80-93.