

Natural Terrain Hazard Study for Tsing Shan Foothill Area

Pilot Study – Regolith Guide

Introduction

This guide aims to distinguish the different field characteristics of the superficial deposits (regolith) within the pilot study area and subsequently for the whole Tsing Shan Foothills Study Area.

The superficial mapping was carried out by using only the relevant 1963 and 2000 aerial photographs. 1963 photographs were used due to the relatively low level of vegetation, the API was then correlated with the 2000 photographs, which proved essential when identifying features in the field. All API and field observations were recorded on orthorectified base plans.

The diagnostic properties for each regolith class are shown in bold.

General Notes

Alluvium

No separate Alluvium class has been used, as alluvium is not common within the study area. The colluvium – valley (Cv) class may include components of alluvium (e.g. fluvially graded silts, sands and gravels).

Exposed Rock Outcrop (Bg, Baf, Bvs, Bcg, Bt and BA)

The label 'B' is applied to an area of bedrock exposed at the surface. The suffix should denote the particular rock type exposed, e.g. Bg denotes an area of exposed granite outcrop, Baf – feldsparphyric andesite, Bvs – volcaniclastic sediments, Bcg – conglomerate, Bt – tuff/tuffite and BA – andesite. An example sheet of exposed rock outcrop is not given in the present regolith guide.

Saprolite Sg/Sv

Saprolite is referred to as Grade IV to V in-situ material. It has been assumed that residual soil (Grade VI)/topsoil/hill-wash colluvium may be present overlying saprolite (both Sg and Sv classes). From field mapping it has been determined that the thickness of the residual soil/topsoil/hill-wash colluvium is rarely greater than 0.5 m and more commonly less than 0.3 m.

Sg+B/Sv+B (Saprolite with boulders)

The suffix "+B" can be added to the regolith class of saprolite, if the ground surface has a boulder density of > 25%.

SRg (Saprolite with corestones)

The regolith class of SRg can be used to distinguish saprolite with exposed corestones. This regolith class can be applied if the ground surface has a corestone density of > 25%.

Colluvium Cr (Residual Colluvium) and Saprolite Sg/Sv (Granite, Volcanic)

Ground proofing was found to be essential, especially when discerning between the superficial classes saprolite (Sv/Sg), and colluvium – residual (Cr). From API, both of these classes exhibit a similar morphology, as well as being found in similar topographic locations. It has been found (from field mapping), that the presence of visible surface boulders (from API using the 1963 photographs) usually indicates the presence of Cr and not Sg/Sv.

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Colluvium Cla

The class 'recent landslide debris' (Cla) is defined as being recent landslide debris apparent in the 1963 aerial photographs or evident from field mapping (i.e. occurred post 1963). The actual source areas (main scarps) have been identified but mapped separately, as these may not contain debris from the landslide event.

Colluvium Cv

Colluvium – Valley (Cv). This class should not be applied to drainage lines that appear clean, e.g. when bedrock is exposed along the stream course, and no colluvial deposits are apparent. This tends to apply to steeper gradients, usually associated with the granitic areas. For entrainment purposes, each drainage line may need to be analysed separately.

The Cv class is generally considered to be of relatively recent age (category A). However, occasional large (> 10 m wide) boulders may be apparent along drainage lines. These large boulders were probably not transported by fluvial processes operating at the present day, therefore lag deposits of large boulders may imply a relatively older age.

Age Relationships

A general relative age may be postulated for the different regolith classes based on superposition.

Regolith Class	Relative Age
Cv – Valley Colluvium	A
Cla – Recent Landslide Debris	A
Cd – Depression Colluvium	A
Crf – Rock Fall Debris (Talus)	A
Clb – Relict Landslide Colluvium	B
Cr – Residual Colluvium	C

Key

A – Youngest, C – Oldest.

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1963 Aerial Photograph



2000 Aerial Photograph



Oblique Field Photograph

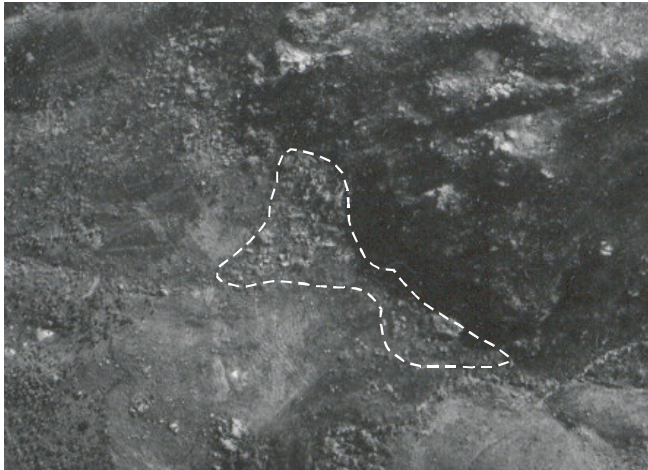
Regolith Type	Cla (Recent Landslide Debris)
General Description	Definite main scarp/source area and trail evident, with only minor vegetation apparent (if present, usually associated with intact displaced rafts of material).
Topographical position	Forms as a result of relatively recent landslides in many topographical positions. (Topography forms only one controlling factor.)
Morphology	<p>Landslide scarp/source area/trail and debris must be evident.</p> <p>Can form lobate or fan-like deposits.</p> <p>Commonly truncated/incised by drainage lines/gullies/rills, but rarely incised/truncated by other recent landslides.</p> <p>The source area should be mapped as a landslide scarp (not Cla) if no landslide debris is evident within the source area.</p>
Material Properties	Remoulded debris, intact displaced material and/or clastic debris sometimes evident.
Vegetation	Only minor vegetation apparent within source area and/or along trail (intact displaced material can also be apparent).
Relative Age	Relatively recent (Category A).

Aerial Photograph Characteristics

1963	Appears as an area of bare soil, which generally has a high albedo. A main scarp and trail must be apparent.
2000	May appear partly/fully vegetated, though areas of bare soil still commonly visible. A distinct main scarp and trail must also be apparent.

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1963 Aerial Photograph



2000 Aerial Photograph



Oblique Aerial Photograph

Regolith Type	Crf (Rock Fall Debris - Talus)
General description	Forms below rock slopes/escarpments either as a result of individual rock block failures or rock avalanches. The size of the rock blocks generally depends upon joint characteristics (e.g. spacing and orientation).
Topographical position	<p>Must occur down-slope of rock outcrops.</p> <p>Commonly can form on planar (unconfined) slopes.</p> <p>Rock fall deposits can commonly be confined by topographic depressions e.g. gullies/ephemeral drainage lines.</p>
Morphology	<p>Concave break in slope usually occurs at the toe of the deposit.</p> <p>Can commonly be fan-shaped, becoming more linear on steeper slope angles.</p> <p>Can form a planar surface, which locally appears hummocky/irregular.</p> <p>Individual boulders commonly apparent.</p> <p>Occasionally incised/truncated by recent landslides or drainage lines.</p>
Material Properties	<p>Must be clastic debris comprising angular boulders and cobbles with fine material either not present or present in minor amounts. The size of the blocks is dependent upon both joint spacing and the degree of comminution the blocks suffer in transport.</p>
Vegetation	Can be bare on steep slopes, but commonly vegetated by both ferns and grasses if topographically confined.
Relative Age	Relatively recent (Category A).
Aerial Photograph Characteristics	
1963	Appears as a hummocky/irregular surface with boulders commonly apparent.
2000	Commonly vegetated with tall grasses; larger boulders can be apparent protruding above the vegetation.

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1963 Aerial Photograph

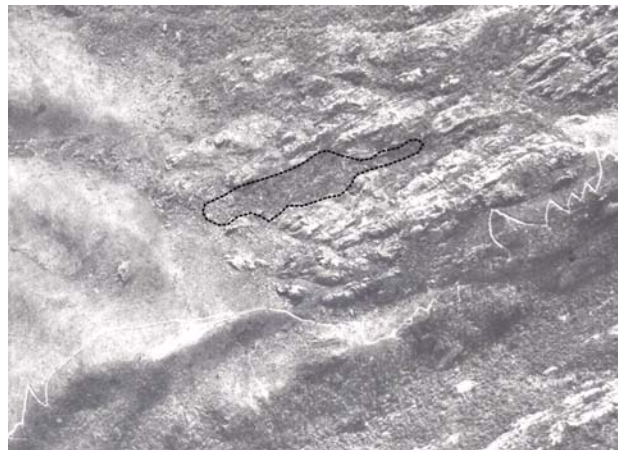


Oblique Aerial Photograph

Regolith Type	Cv (Valley Colluvium)
General description	Generally narrow linear/ribbon-like features topographically confined within drainage lines (refer to SPR5/2000 for drainage line definition). In-situ rock can commonly be exposed along the streambed (see notes). Concave breaks in slope usually define the lateral boundaries of the deposit.
Topographical position	Occurs along valley axis.
Morphology	Narrow linear/ribbon-like deposits. Concave break in-slope commonly defines lateral extent of deposit. Can be in the order of 20 m wide max, with a minimum extent of between 1-2 m.
Material Properties	Comprises boulders, cobbles and gravel sized clasts, which can vary from angular to sub-rounded in shape. Commonly clast supported, and contain graded silts, sands and gravel (dependent on source material). Fluvial processes may continue to operate.
Vegetation	Commonly vegetated by small trees and tall shrubs.
Relative Age	Relatively recent (Category A)
Aerial Photograph Characteristics	
1963	Generally low reflectance where vegetated, but with abundant highly reflective boulders/exposed bedrock.
2000	Vegetated with tall shrub and trees; generally appears dark green with a hummocky/irregular surface.

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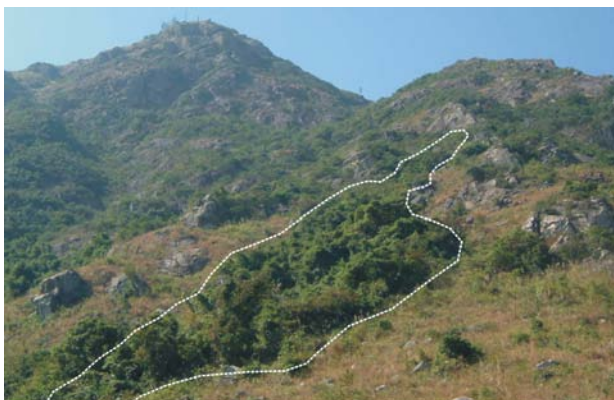
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1963 Aerial Photograph



2000 Aerial Photograph



Oblique field photograph of Cd – Predominantly clastic colluvium infilling a structurally controlled rock gully.

Regolith Type

Cd (Depression Colluvium)

General description

Colluvium retained within a concave depression (the depression can be defined by a continuous convex change in slope, i.e. former highly degraded landslide scar, rock gully etc). Material may have several origins (individual rock block failures, minor landslides, slope wash etc). The depression can be completely filled to the existing ground surface. The depressions usually appear well vegetated.

Topographical position

Topographically confined.

Can form within any topographic depression, e.g. within confined gullies in-between rock outcrops (typically within the steeper Tsing Shan Peak granite areas).

Morphology

Commonly the boundary of the colluvium infill can be defined as a concave change in slope.

The downslope extent can be marked by a convex change in slope.

A drainage line can also mark the downslope extent.

Material Properties

Dependent very much on the source material, i.e. source material rock fall debris, then the material within the depression may dominantly be formed of boulders and cobbles.

Vegetation

Usually vegetated by small trees, shrubs and grasses, as the depression acts to concentrate surface water flows.

Relative Age

Can be either relatively recent (Category A) but occasionally could be older (Category B).

Aerial Photograph Characteristics

1963

Generally Cd has a low albedo, with vegetation commonly apparent. Surface boulders tend to be visible.

2000

Generally appears dark green with a hummocky/irregular surface.

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1963 Aerial Photograph



2000 Aerial Photograph

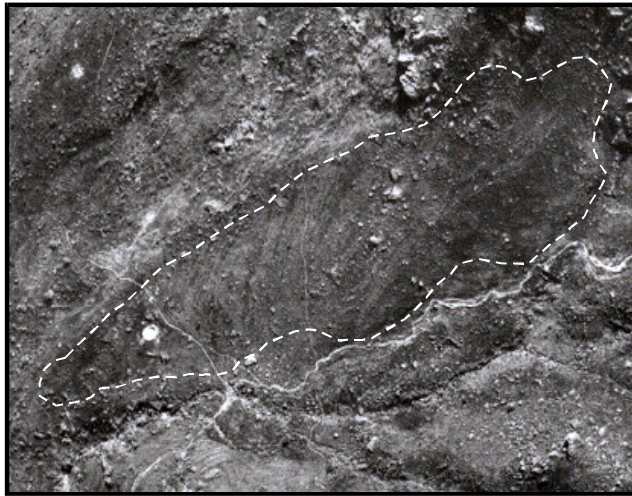


Oblique Aerial Photograph

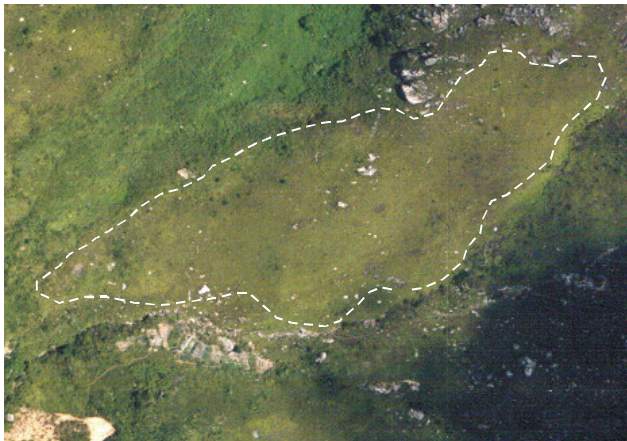
Regolith Type	Clb (Relict Landslide Debris)
General Description	Can form as a result of either a single landslide event or the coalescing of debris from multiple events. Exhibits distinct morphological characteristics, with generally a fan-like or lobate form. Potential source area and landslide trail appears degraded and well vegetated. Commonly incised/truncated by drainage lines and associated Cv or other units of Clb. Recent landslides can occur within Clb or add to the Clb.
Topographical position	Occurs down-slope of a potential source area.
Morphology	Can commonly be found on planar and concave slopes but less commonly on convex slopes, below rock outcrops and within depressions. Potential landslide source/scarp and trail can be observed, which typically appear degraded. The deposits form either lobate or fan-like shapes, with a concave change in slope defining the lateral extent of the deposit. Commonly truncated/incised by drainage lines (Cv) and/or more recent landslides (Cla).
Material Properties	Can comprise a clay/silt/sand matrix with boulders, cobbles and gravel sized clasts, which can vary from sub-rounded to rounded in shape, and tend to be moderately to completely decomposed (dependent on source material).
Vegetation	Commonly vegetated by grasses ferns and tall shrubs with occasional small trees.
Relative Age	Category B. Relatively older than Category A.
Aerial Photograph Characteristics	
1963	Medium grey tone, with uneven texture (irregular surface), clusters of boulders commonly apparent on surface.
2000	Medium to dark green in tone, with a smooth surface; individual boulders and/or clusters of boulders may be apparent.

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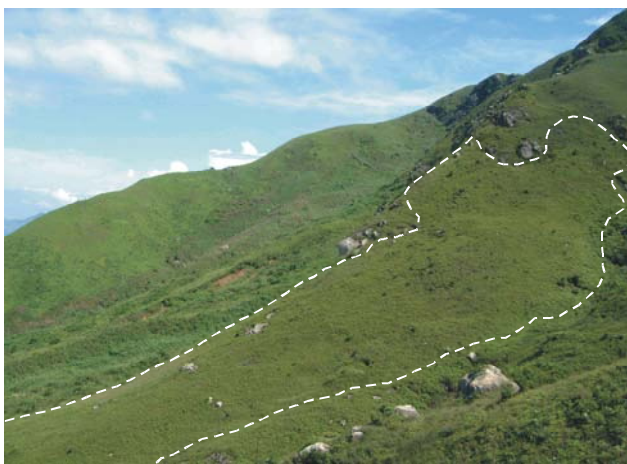
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1963 Aerial Photograph



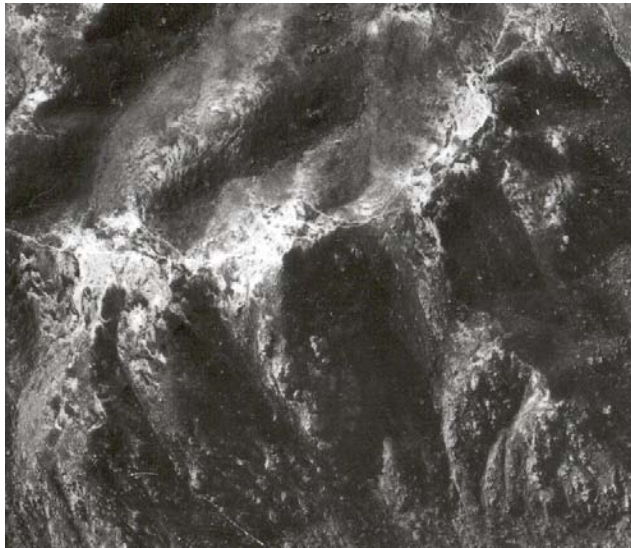
2000 Aerial Photograph



Oblique Field Photograph

Regolith Type	Cr (Residual Colluvium)
General Description	Relatively old colluvium, which probably formed as result of the coalescing of debris from multiple (relict) landslide events. Not topographically confined. Can be found on both open hill-slope and ridge/spur lines. Potential source area/areas and trails not defined. Commonly truncated/incised by relict landslides, recent landslides and drainage lines. Usually occurs on slope angles < 25°.
Topographical position	Ridge/spur lines and planar slopes (generally found on the lower, less steep slopes of Tsing Shan).
Morphology	Not topographically confined. Scattered boulders may be apparent. Commonly truncated/incised by relict landslides (Clb), recent landslides (Cla), drainage lines and valley colluvium (Cv).
Material Properties	Generally comprises a clay/silt/sand matrix with boulders, cobbles and gravel sized clasts, which can vary from sub-rounded to rounded in shape, and tend to be highly/completely decomposed, (dependent on source material).
Vegetation	Commonly vegetated by grasses, tall shrubs trees and plantations.
Relative Age	Category C. (Relatively older than categories A and B.)
Aerial Photograph Characteristics	
1963	Generally a medium grey tone (low albedo) with a smooth texture; boulders commonly apparent (see General Note)
2000	Generally displays a smooth even texture, with individual boulders still apparent.

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1963 Aerial Photograph



2000 Aerial Photograph



Oblique Aerial Photograph

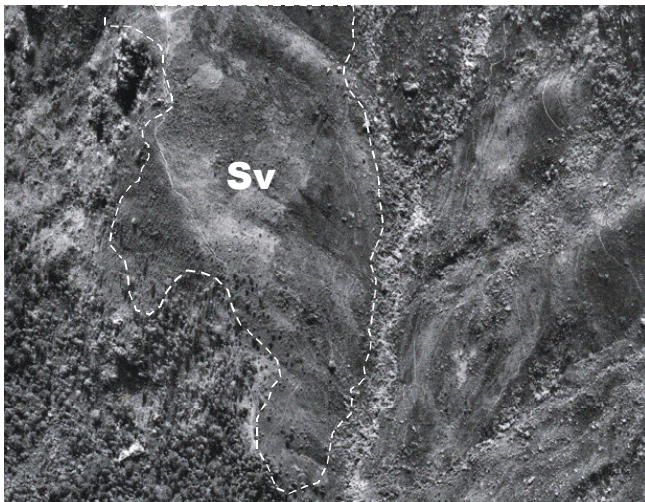
Regolith Type	Sg (Saprolite Granite Grade IV to VI)
General Description	Grade IV to VI Granite, appears as bare soil on hilltops or ridge lines, with low shrubs, grass or ferns on slopes. Generally unconfined with no visible boulders. (May also have a thin horizon, typically < 0.3 m, of slope wash, colluvium and/or residual soil, see notes.)
Topographical Position	Hilltops, spur/ridgelines as well as mid slopes (generally in Tsing Shan, the granite saprolite forms the majority of the upper slopes in the north of the study area, in the south, the saprolite tends to form on the ridge/spur lines).
Morphology	Generally, topographically unconfined with no surface boulders visible (see notes).
Material Properties	Grade IV to VI Granite. Silty sand with gravel and occasional clay e.g. kaolin) seams apparent in places.
Vegetation	Can commonly appear bare, with low, shrub, ferns and grasses in less exposed areas. Ferns in areas of higher moisture.
Relative Age	Old; however, weathering processes appear to be ongoing. There appears to be a particular slope aspect that is favourable to saprolite development, e.g. slopes facing south to southeast.

Aerial Photograph Characteristics

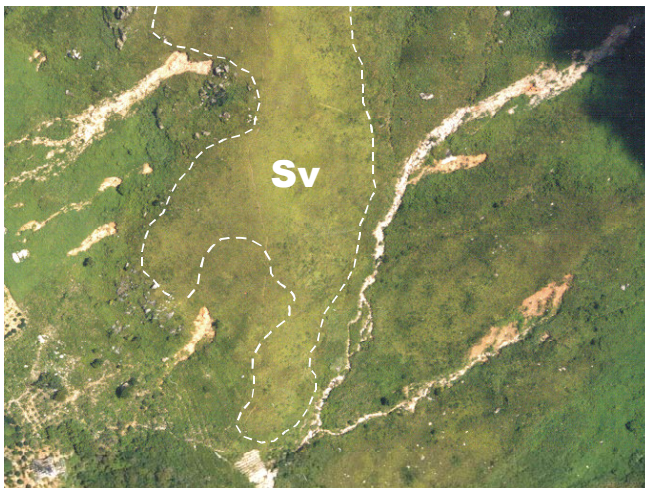
1963	Generally appears as bare/exposed soil with a high albedo. When vegetated, usually appears smooth with an even grey tone.
2000	Appears as bare exposed soil on ridge/spur lines; colour tends to be light orangish to yellowish brown. When vegetated, usually appears as smooth with light green, even tone.
Notes	<p>The suffix “+B” can be added to the regolith class of saprolite, if the ground surface has a boulder density of > 25%.</p> <p>The regolith class of SRg can be used to distinguish saprolite with exposed corestones. This regolith class can be applied if the ground surface has a corestone density of > 25%.</p>

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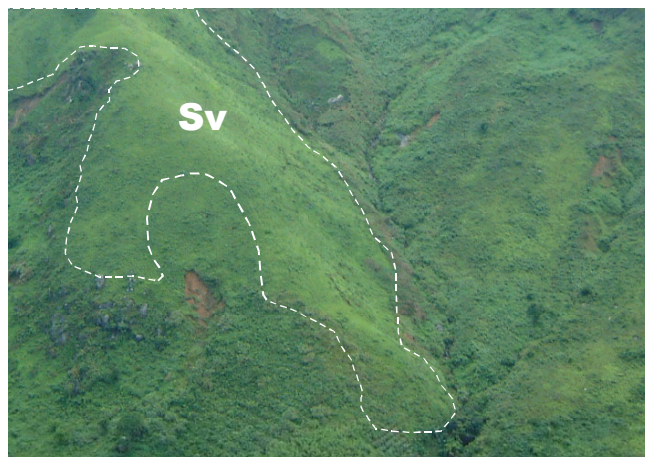
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1963 Aerial Photograph



2000 Aerial Photograph



Oblique Aerial Photograph

Regolith Type	Sv (Saprolite Volcanic)
General Description	Grade IV to VI volcanics , including feldsparphyric andesite, volcaniclastic sediments, rhyolitic quartz tuff and andesite, (there may also be a thin horizon, typically < 0.3 m of slope wash, colluvium and/or residual soil overlying the Grade IV to V material). Generally found on the lower less steep slopes of Tsing Shan, associated with distinct vegetation types e.g. sword grass, dense shrubs and trees.
Topographical Position	Generally found on the lower, less steep slopes of Tsing Shan, but can, in part, be found in areas of steep terrain (e.g. Ho Tin Valley in the pilot study area).
Morphology	Usually appears very smooth but can be punctuated by rock outcrop, e.g. conglomerate outcrops. Drainage lines tend to incise readily on the lower, less steep slopes, with associated landslide scars apparent adjacent to the drainage lines.
Material Properties	Generally Grade IV to V volcanics with minor Grade VI. Material tends to be silty CLAY/clayey SILT with occasional quartz veins visible.
Vegetation	Strong association between Sword grass and volcanic saprolite, vegetation tends to be well established with dense tall shrubs and trees apparent. These areas were also heavily planted (due to the less steep slope angles).
Relative Age	Old.
Aerial Photograph Characteristics	
1963	Generally appears vegetated but can appear sparsely vegetated. The vegetation gives a smooth appearance with an even light grey tone.
2000	Appears well vegetated on the lower slopes, with less vegetation on the upper steeper slopes. The general appearance is smooth with a light to darkish green tone.

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Oblique Aerial Photograph showing many small individual granite rock outcrops, Regolith Class Bg. Given the difficulty and time required to identify each outcrop, the Rg classification below can be used.



Oblique aerial photograph showing intermittent granite outcrops with typically less than 1.0 m of regolith cover in between, Regolith Class Rg.

Regolith Type	Rg (Intermittent Granite Outcrop), Rvs, (volcaniclastic sediments), Rt (tuff) etc
General Description	Intermittent rock outcrop with typically less than 1 m of regolith cover in-between the exposed outcrops.
Topographical Position	Can occur in many topographic positions, but commonly occurs adjacent to geological boundaries e.g. lithological and structural boundaries, and near areas of continuous rock outcrop.
Morphology	A slight convex change in slope may exist delineating the extent of regolith cover of approximately < 1.0m thickness.
Material Properties	Rock outcrop with typically < 1.0 m of regolith cover in between the exposed outcrops.
Vegetation	Vegetation typically apparent in between the exposed rock outcrops.
Relative Age	Not Applicable.
Aerial Photograph Characteristics	
1963	Appears as many small intermittent rock outcrops with vegetated areas in between the outcrops; a slight convex change in slope may exist delineating the extent of regolith cover < 1.0 m thick.
2000	Appears as in 1963 but the rock outcrops tend to have a grey appearance, with the vegetated areas in between the outcrops appearing as light to dark green.

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Schematic diagram showing the field relationships between the mapped regolith classes. The line work was mapped by using the 1963 aerial photographs, and then reproduced schematically on a 2001 oblique photograph.

