TABLE 1. DIAGNOSTIC MORPHOLOGICAL AND SEDIMENTOLOGICAL CHARACTERISTICS OF ROCK AVALANCHE DEPOSITS (after Heim, 1932; Longwell, 1959; Kreiger, 1977; Fahnestock, 1978; Johnson, 1978; McSaveney, 1978; Porter and Orombelli, 1980 Laznicka, 1988; Yarnold and Lombard, 1989; Hewitt, 1999, 2002, 2006; Strom, 2006; Hewitt et al., 2008).

A. *Lithology*

- Monolithological: single rock type at any sample site within rock avalanche deposit
- Martrix/clast relation: lithology is the same for both
- Provenance: bedrock outcropping on local rock walls
- Spatial pattern: lithologic bands reflect sequence in bedrock; “remnant stratigraphy” (Heim, 1932)
- Exceptions : basal zone intrusions and mobilized substrate; material entrained at front of rock avalanche

B. *Sediment properties*

- Fragmental angular rubble with matrix ranging down to dust size
- Cataclastic material produced by fracture (compression), shatter (impact), and pulverization
- Texture: dominantly coarse
- Grain size: blocks may dominate; some may exceed 40 m in diameter; matrix dominated by granule, sand and silt-size materials
- Sorting: unsorted or slightly coarsen upward; coarse carapace common
- Clast/grain shape: angular or very angular, ‘sharpstones’, ‘chinkstones’ (Longwell, 1959)
- Clast fracturing: boulder-size clasts may show *cackle, jigsaw or mosaic brecciation*
- Porosity: main body of deposit densely compacted with low permeability; surface carapace commonly *open-work* and permeable

C. *Sedimentary facies/architecture*

- Framework: interlocking coarse and matrix clasts; commonly *clast-supported*, but rarely *matrix-supported*
- Packing: surface is *openwork;* main body is tightly compacted and *over-consolidated*
- Contacts: commonly sharp at margins and base; in some cases, a *splash zone* of rock avalanche fragments or fluidized substrate material lies beyond the distal rim
- Vertical sub-sequence:

  Carapace: open-work blocks grading down into increasingly matrix-rich and compacted material; up to 15 m thick. Surface blocks may display fabric, with preferential orientation or imbrication

  Main body: matrix-rich and denely compacted; in thick deposits, may include patterns resulting differentially crushed lithologies and bedrock structures contorted and smeared-out in the direction of movement

  Basal zone: may incorporate some substrate fines, diapirs, flames, and dykes of intruded substrate Substrate may be a) undisturbed, b) eroded and entrained, c) intruded and incorporated
- ‘Chaos’ facies: may occur with break-up of rock avalanche in mobile wet valley fill

D. *Morphologies of rock avalanche deposits*

- Little or no topographic interference

  Sheet-like; thin compared to area

  Lobate or tongue-like

  Low (<2 m relief) hummocks, longitudinal and transverse ridges

  Raised rims
- Emplacement affected by topographic obstructions or substrate materials

  Large (5-50m relief) longitudinal and transverse ridges

  Run-up on opposing slopes and over high ground

  Asymmetrical thickening against opposing slopes and bodies of deformable substrate, which may form the main accumulation

  Redirectional facets where debris collapses and moves away from thickened masses

  Impact slope *brandung* or ‘surge’ ridge and ‘*brandung’ valley*, a linear depression between the ridge and valley slope (Heim, 1932)

‘Caroming flow”, superelevation at beds in path (Fahnestock, 1978). Like the *brandung,* these create anomalous valley side depositional remnants that are distinct from, if often mistaken for, stream terraces, lateral moraines, or glacier trim lines

Debris splitting into multiple lobes that travel along several valleys

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TABLE 2. TCN SAMPLE LITHOLOGIES (after Petterson et al., 1990; and Searle, 1991)

Landslide	Rock unit	Sample lithology
Katzarah	Kohistan-Ladakh Batholith	Quartz veins in granodiorite
Dhak Chauki	Kohistan-Ladakh Terrane	Quartz veins in metasedimentary rocks
Gol Ghone 'S'	Kohistan-Ladakh Batholith	Quartz veins in granodiorite and greenschist
Upper Henzul	Kohistan-Ladakh Batholith	Quartz veins in granitoid rocks
Baltit-Sumaiyar	Karakoram Batholith	Granodiorite
Ghoro Choh 1	Main Karakoram Thrust Zone	Tonalite
Satpara-Skardu	Kohistan-Ladakh Batholith	Quartz veins in granodiorite

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TABLE 3. CRONUS-CALCULATOR V2.2 INPUT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
KATZII	35.428	75.46	2310	std	5.00	2.7	0.972	0	155654	3257.61	KNSTD	0	0	KNSTD
KATZIV	35.443	75.4333	2500	std	6.00	2.7	0.960	0	167275	4158.31	KNSTD	0	0	KNSTD
GGI	35.285	75.8667	2590	std	8.00	2.7	1	0	94026	4120.64	KNSTD	0	0	KNSTD
GGII	35.285	75.8667	2590	std	8.00	2.7	1	0	88763	2873.22	KNSTD	0	0	KNSTD
STSKI	35.248	75.6283	2850	std	8.00	2.7	1	0	108727	3015.95	KNSTD	0	0	KNSTD
STSKII	35.247	75.6283	2850	std	2.00	2.7	0.970	0	115244	3233.69	KNSTD	0	0	KNSTD
STSKIII	35.233	75.6283	2850	std	8.00	2.7	1	0	106397	2645.04	KNSTD	0	0	KNSTD
DChII	35.895	74.435	1500	std	8.00	2.7	1	0	73065	1999.26	KNSTD	0	0	KNSTD
DChIII	35.895	74.435	1500	std	8.00	2.7	1	0	70862	1706.99	KNSTD	0	0	KNSTD
UhenI	35.996	74.2	1800	std	0.70	2.7	0.982	0	125161	2562.73	KNSTD	0	0	KNSTD
UhenII	35.996	74.2	1810	std	1.50	2.7	0.982	0	236293	5669.76	KNSTD	0	0	KNSTD
UhenIII	35.996	74.2	1800	std	8.00	2.7	1	0	114541	2823.82	KNSTD	0	0	KNSTD
BaSuI	36.304	74.673	2200	std	3.00	2.7	0.967	0	82699	1807.92	KNSTD	0	0	KNSTD
BaSuII	36.304	74.673	2200	std	2.00	2.7	0.967	0	79660	2180.3	KNSTD	0	0	KNSTD
BaSuIII	36.304	74.6738	2195	std	3.00	2.7	0.967	0	75275	2155.71	KNSTD	0	0	KNSTD

Column labels: **1**-sample ID, **2**-latitude, **3**-longitude, **4**-elevation, **5**-atmospheric data mode, **6**-thickness (cm), **7**-density (g cm^{-3}), **8**-shielding and dip factor, **9**-erosion rate, **10**-^{10}Be concentration (atoms/g), **11**-^{10}Be AMS error (1s atom/g), **12** and **15**: AMS standard, **13** and **14**-fields for Al concentration and error.