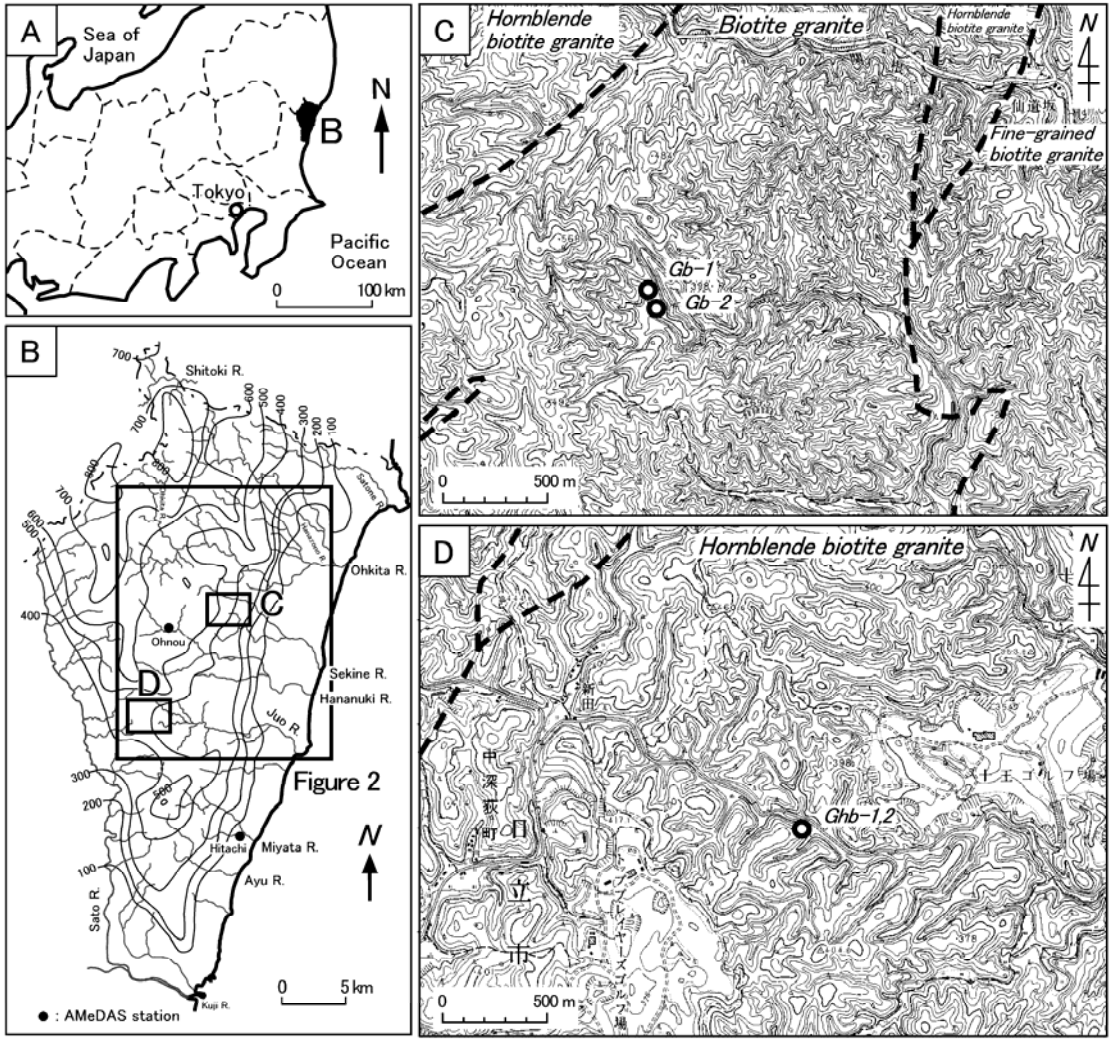

Figure 1. Map of study area and study slopes (Japan). (A) Middle part of Japan. (B) Summit Level map (2 km width) in Taga Mountains (modified after Hayakawa and Mishima (1997)). (C) Study slopes in biotite granite (Gb) area. (D) Study slopes in hornblende biotite granite (Ghb) area.

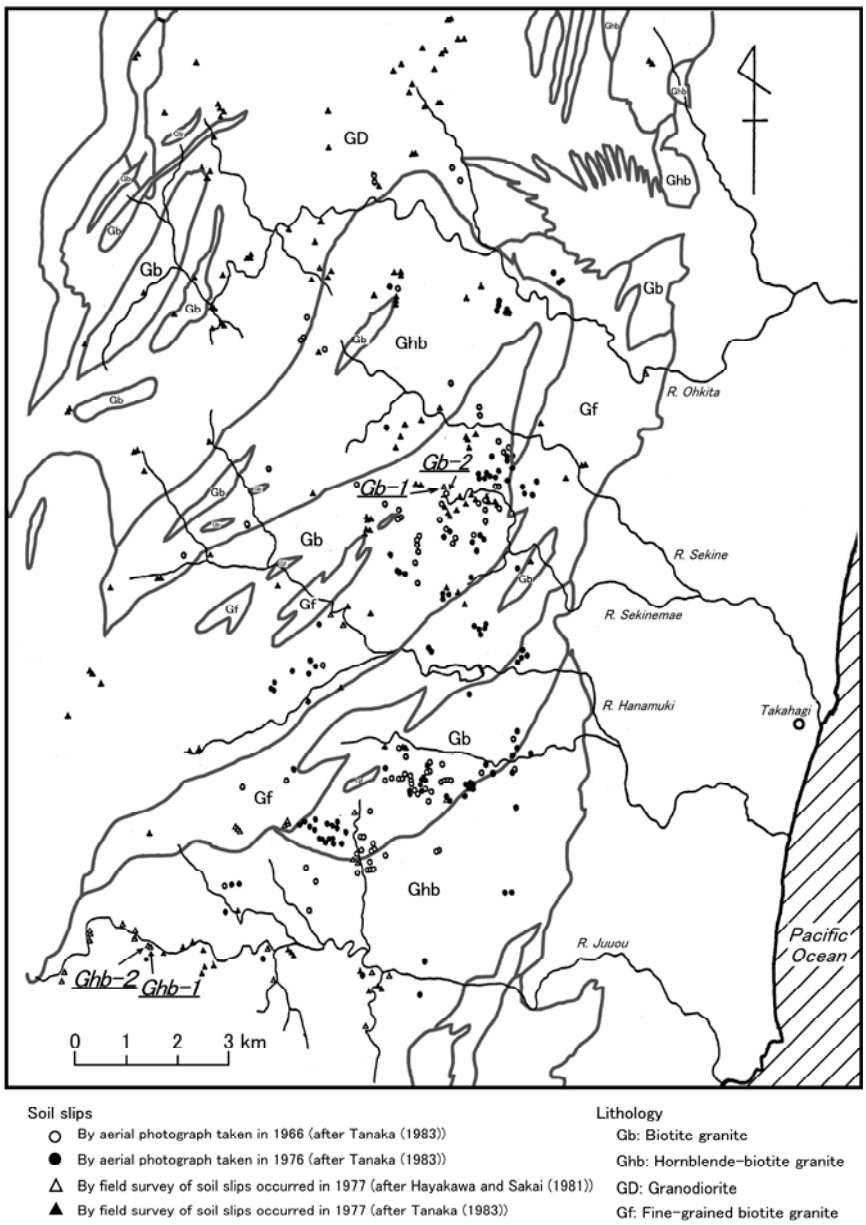

Figure 2. Lithology and distribution of soil slips in Taga Mountains (modified after Tanaka, 1983). Location of this map is shown in Figure 1B.

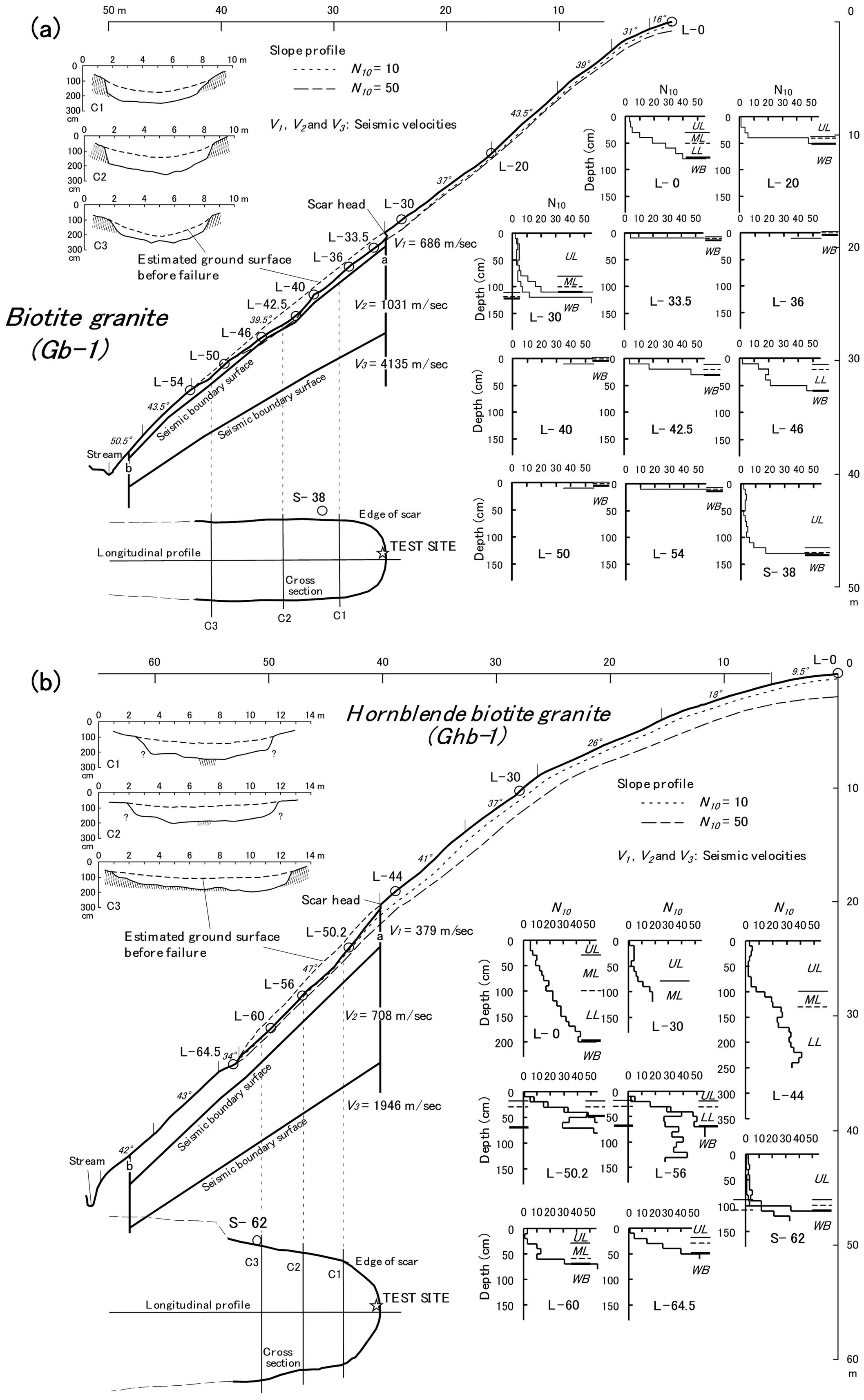

Figure 3. Slope form and structure – (a) biotite granite (Gb-1) and (b) hornblende biotite granite (Ghb-1) slopes.
L : Test points on the longitudinal profile, S: Test point beside the soil-slip scar. The numbers attached to these letters as suffixes show the distance (m) from the ridge.

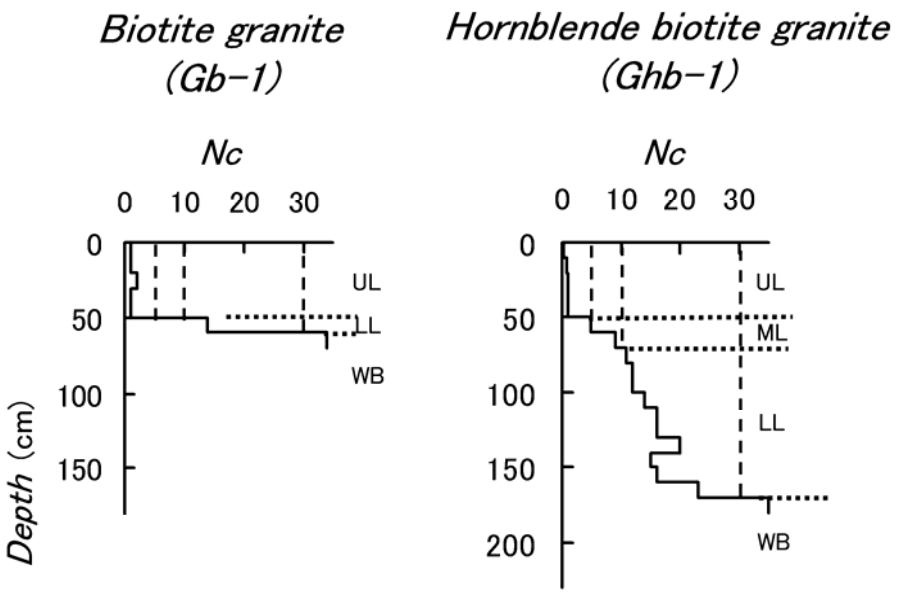

Figure 4. Profiles of *Nc* value and classification of soil layer on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc<10$), LL: *lower layer* ($10 \leq Nc<30$), WB: *weathered bedrock* ($Nc \geq 30$)

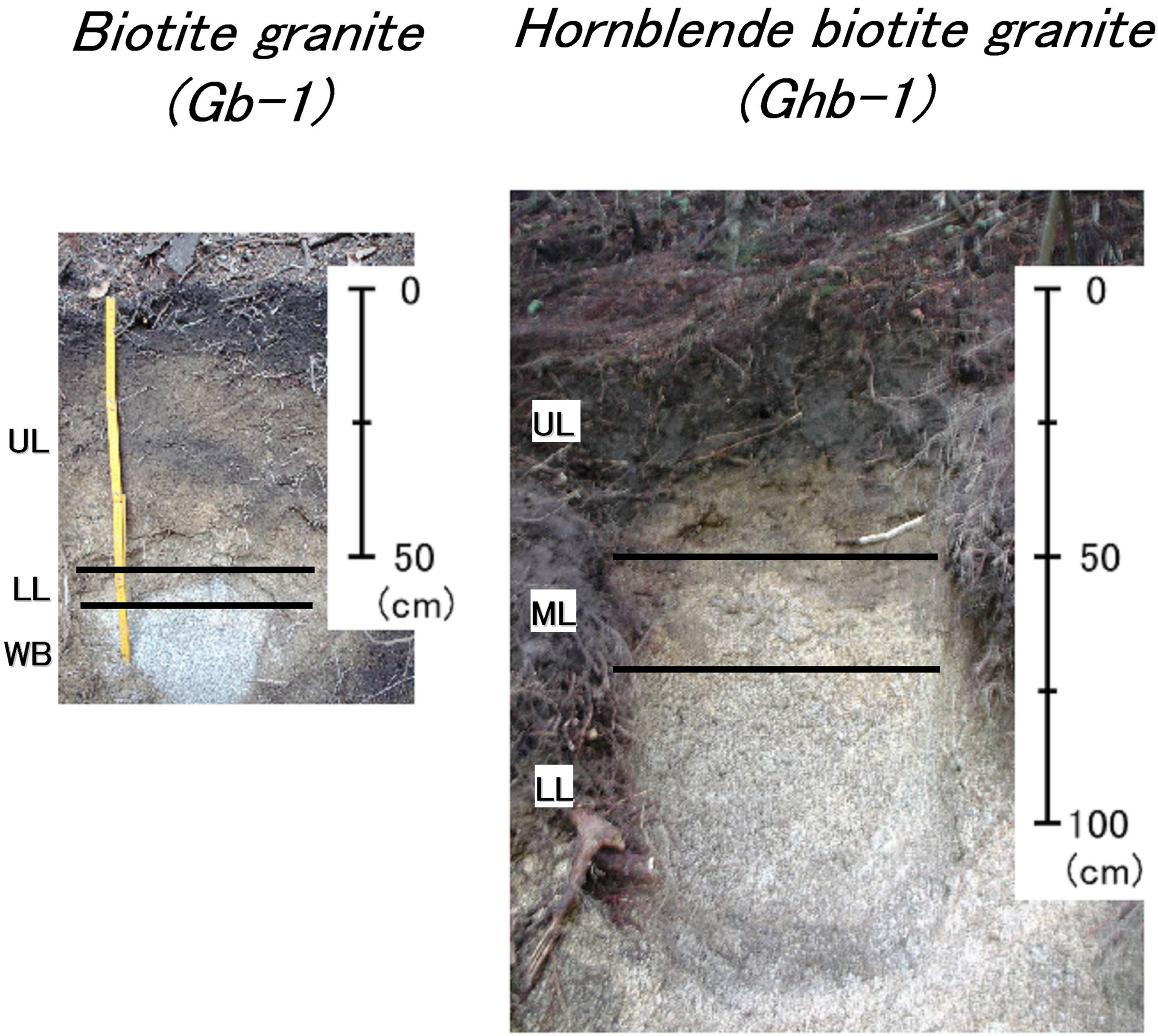

Figure 5. Photographs of soil profile on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* (*Nc*<5), ML: *middle layer* (5?*Nc*<10), LL: *lower layer* (10?*Nc*<30), WB: *weathered bedrock* (*Nc*?30)

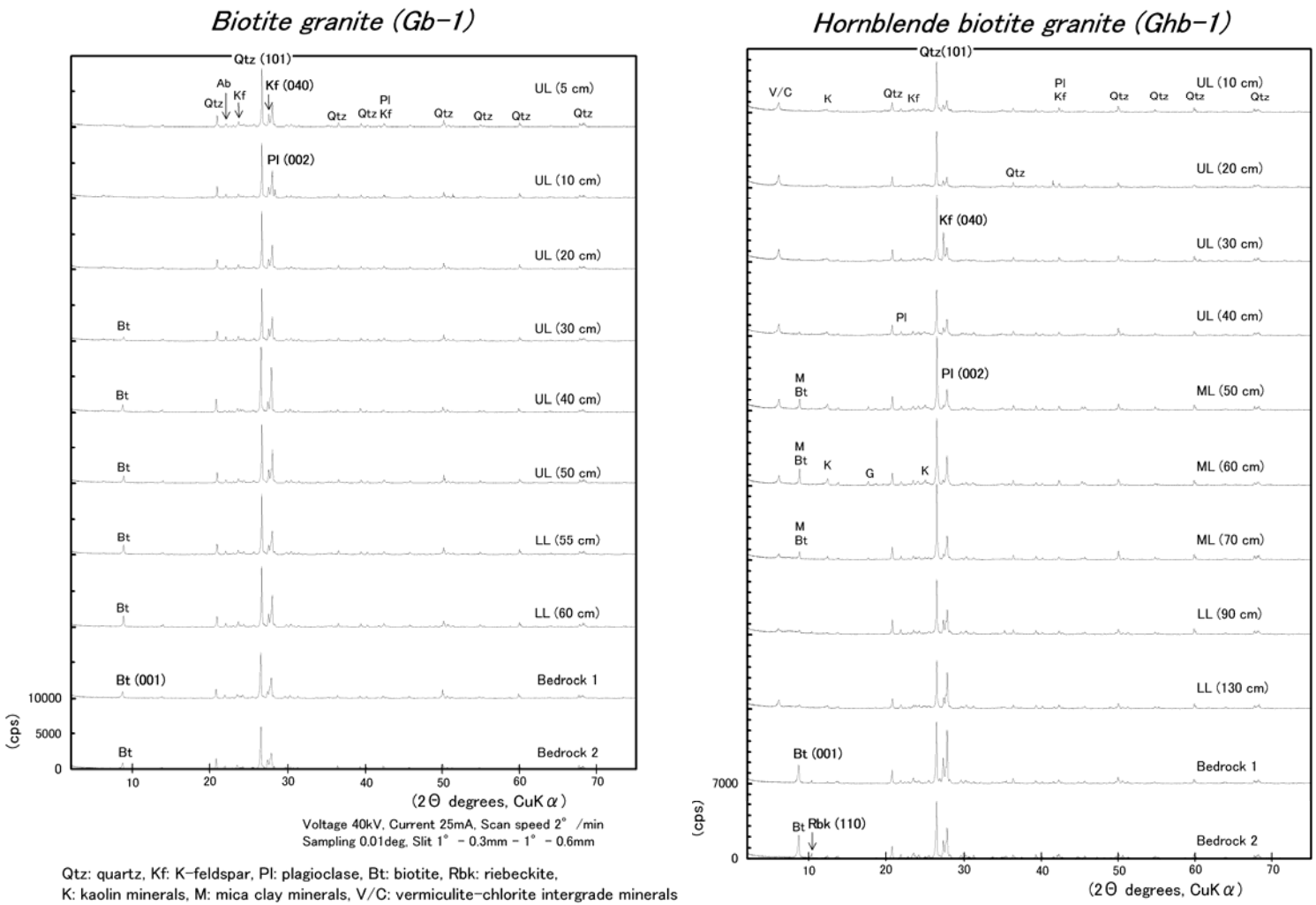

Figure 6. X-ray diffractograms for bulk samples at different depths in soil profile and bedrock on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$)

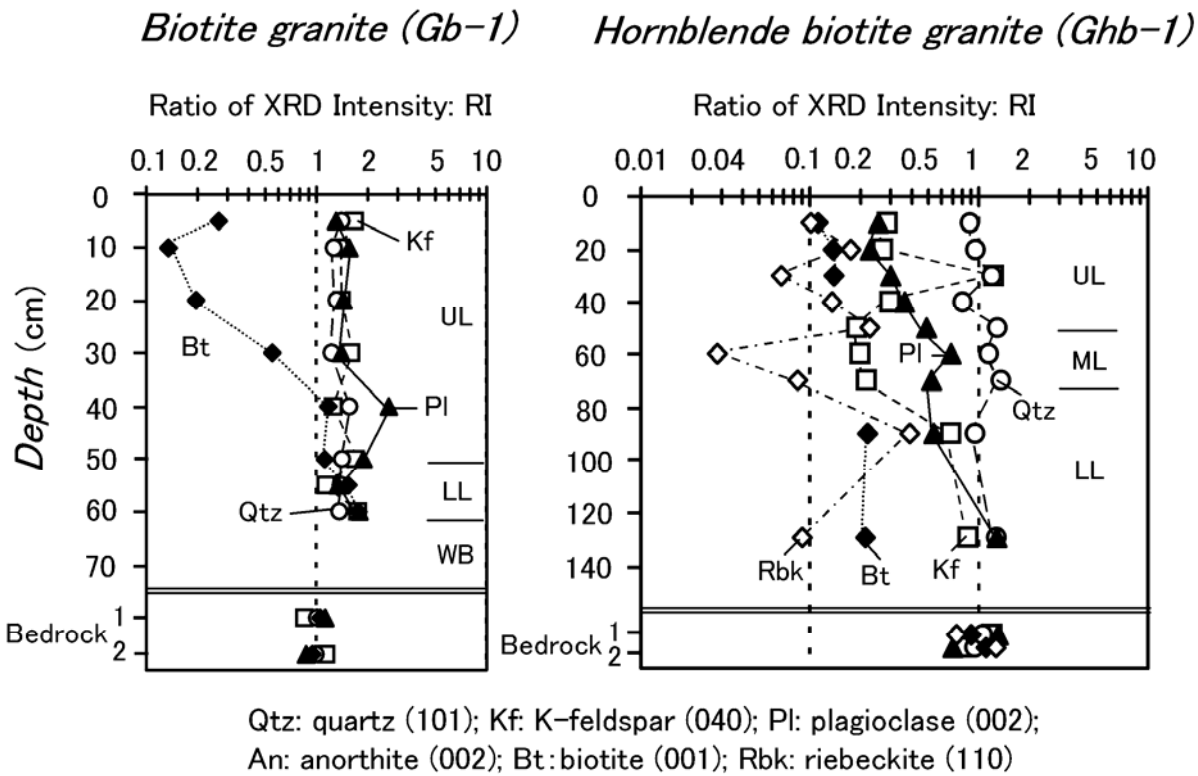

Figure 7. *RI*-values at different depths in soil profile and bedrock on biotite granite (Gb) and hornblende biotite granite (Ghb) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$), WB: *weathered bedrock* ($Nc \geq 30$)

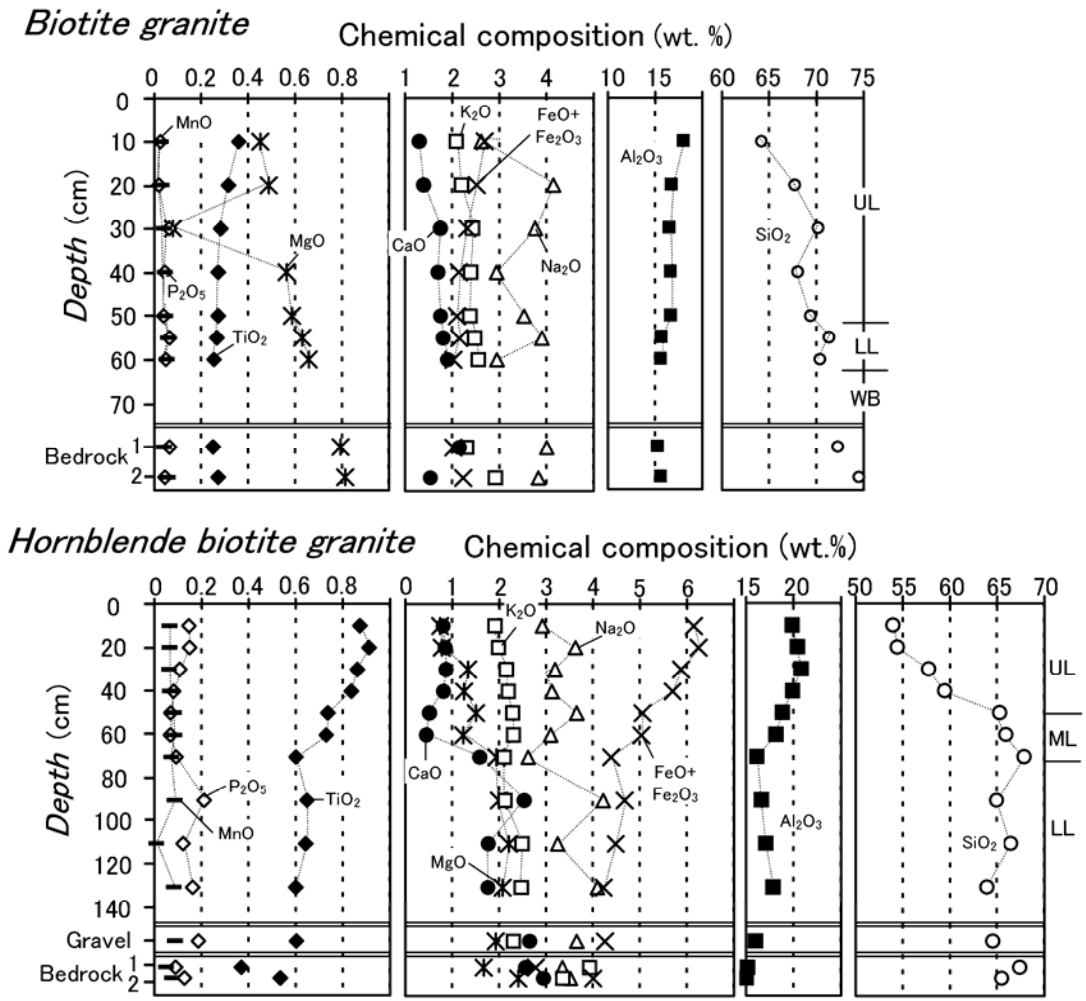

Figure 8. Chemical properties at different depths in soil profile and bedrock on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$), WB: *weathered bedrock* ($Nc \geq 30$)

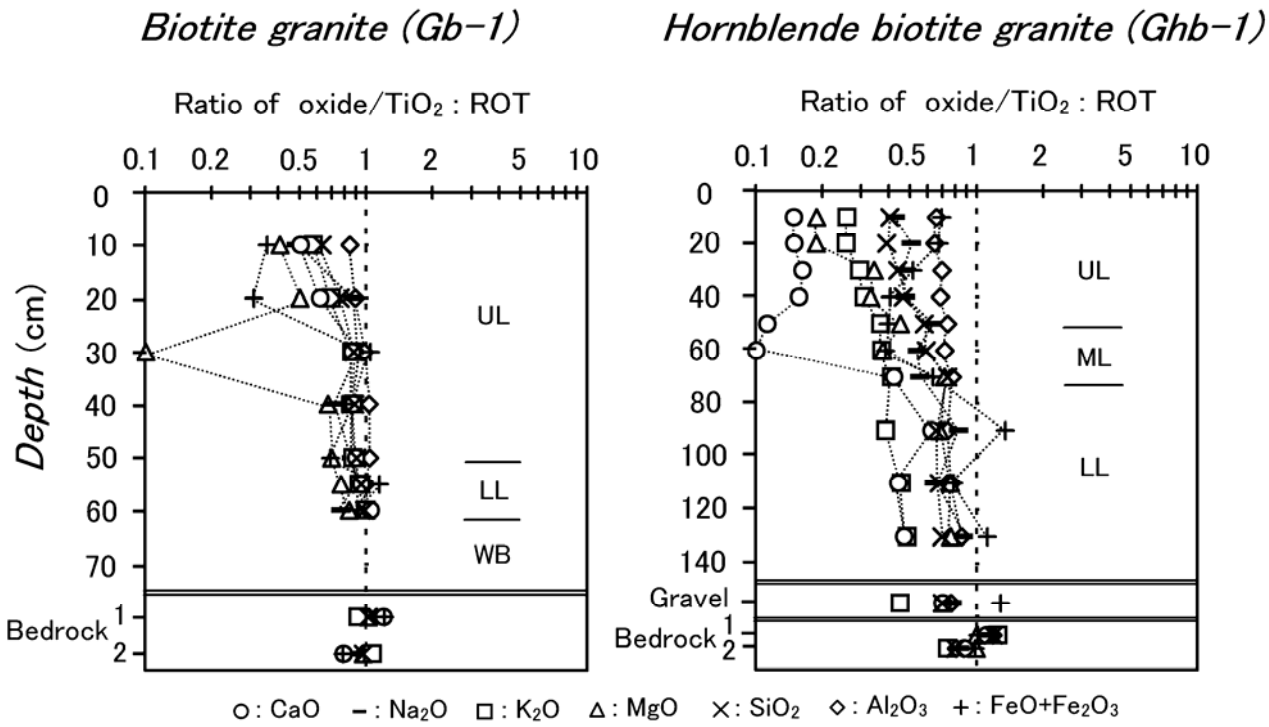

Figure 9. Ratios of oxides / TiO_2 (*ROT*) of soil layer to bedrock on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* (*Nc*<5), ML: *middle layer* (5≤*Nc*<10), LL: *lower layer* (10≤*Nc*<30), WB: *weathered bedrock* (*Nc*≥30)

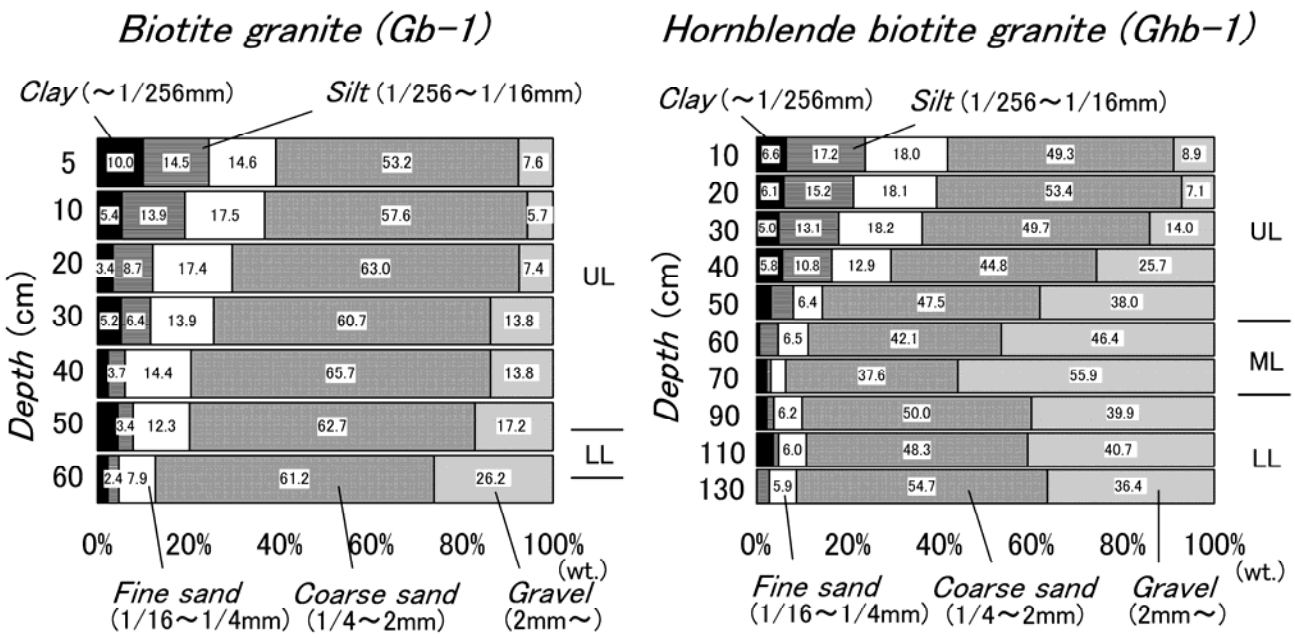

Figure 10. Grain-size distribution at different depths in soil profile on the biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes. UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$)

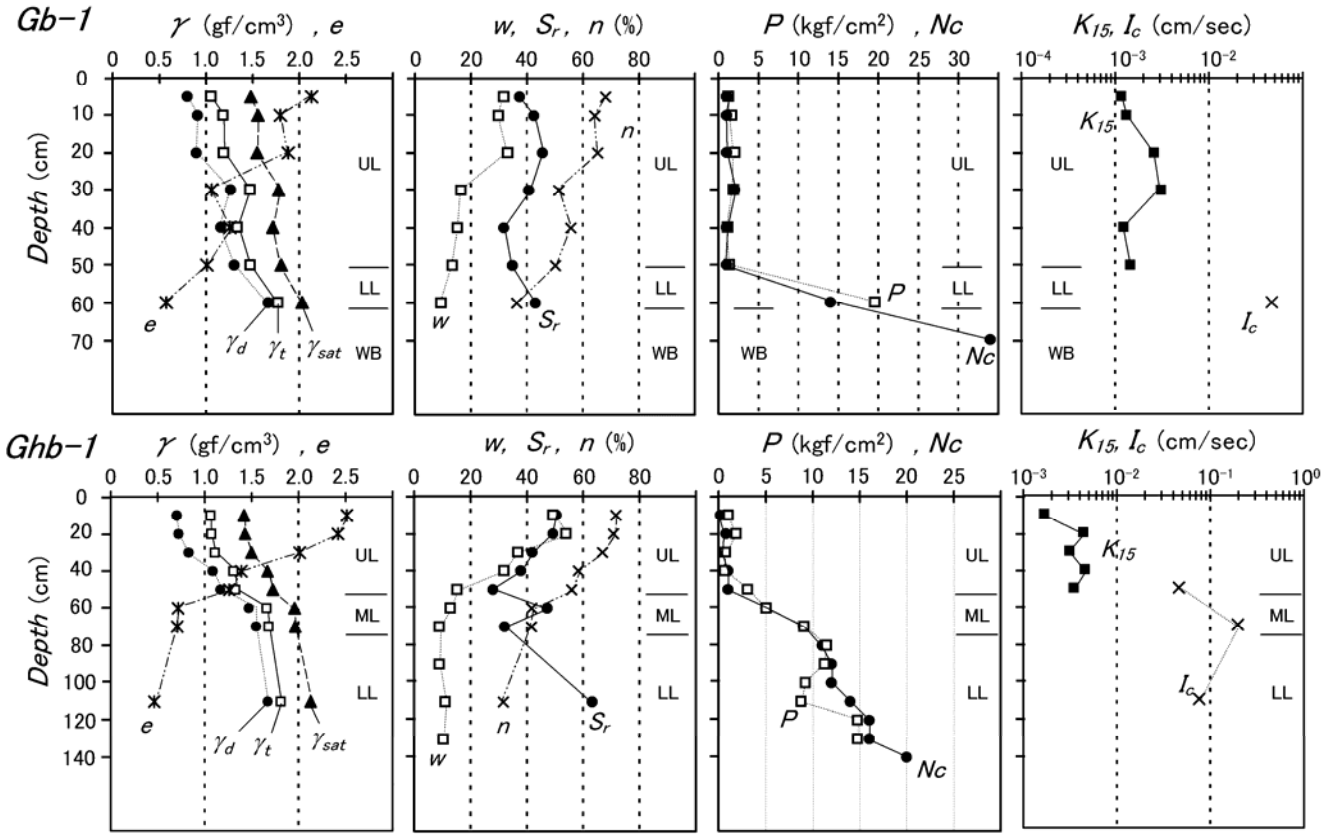

Figure 11. Physical and mechanical properties at different depths in soil profile on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$), WB: *weathered bedrock* ($Nc \geq 30$) .

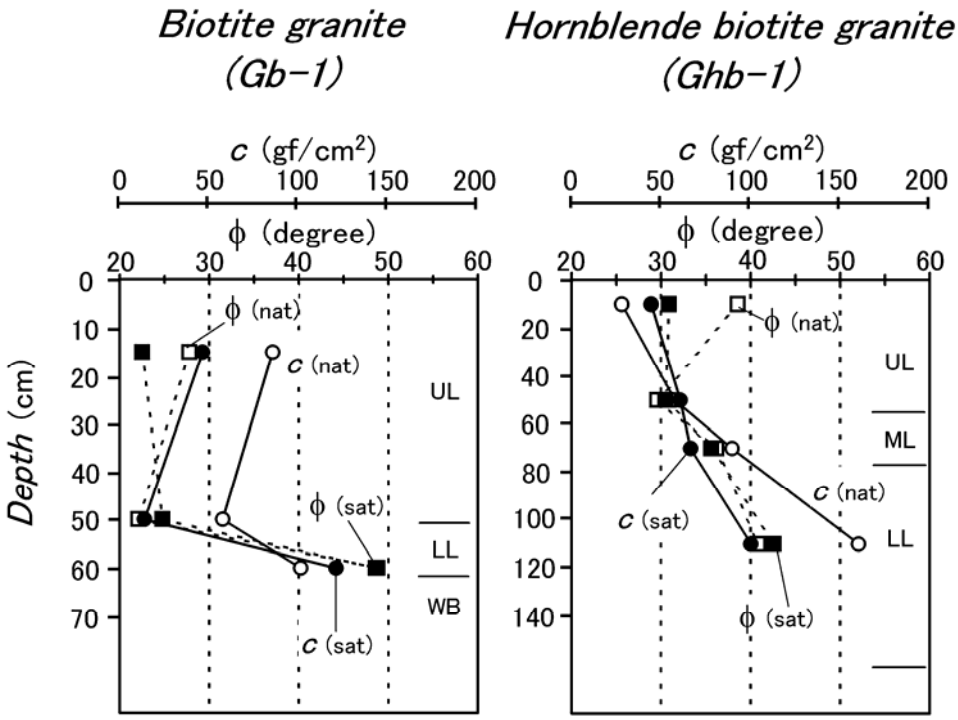

Figure 12. Shear strength parameters *c* and ϕ at different depths in soil profile on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* ($Nc<5$), ML: *middle layer* ($5 \leq Nc < 10$), LL: *lower layer* ($10 \leq Nc < 30$), WB: *weathered bedrock* ($Nc \geq 30$)

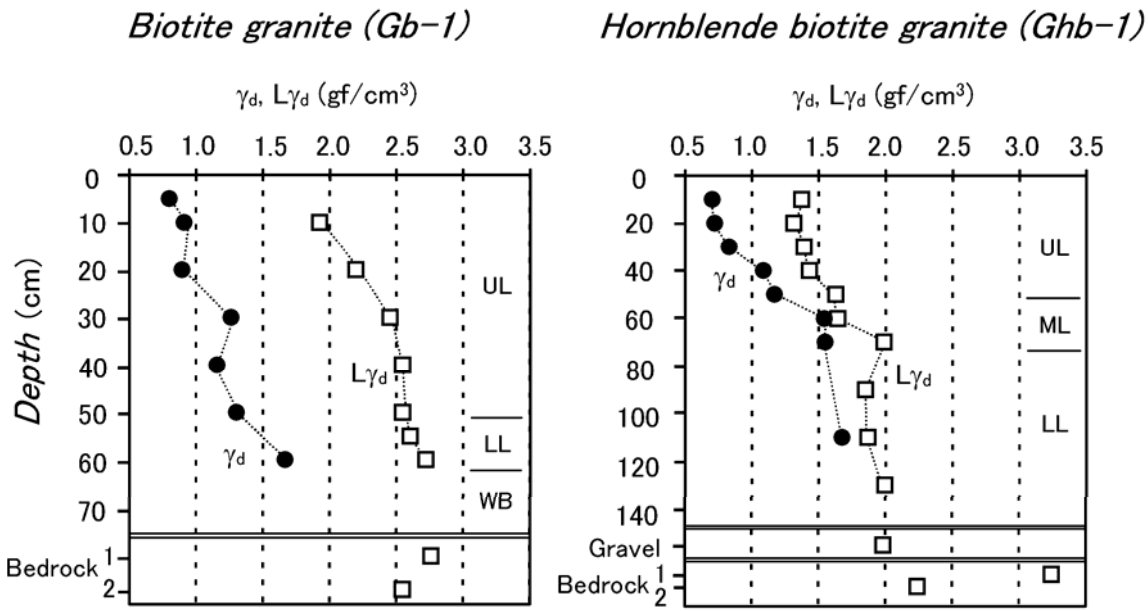

Figure 13. γ_d and $L\gamma_d$ –values of soil layer and bedrock on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* (Nc<5), ML: *middle layer* (5≤Nc<10), LL: *lower layer* (10≤Nc<30), WB: *weathered bedrock* (Nc≥30)

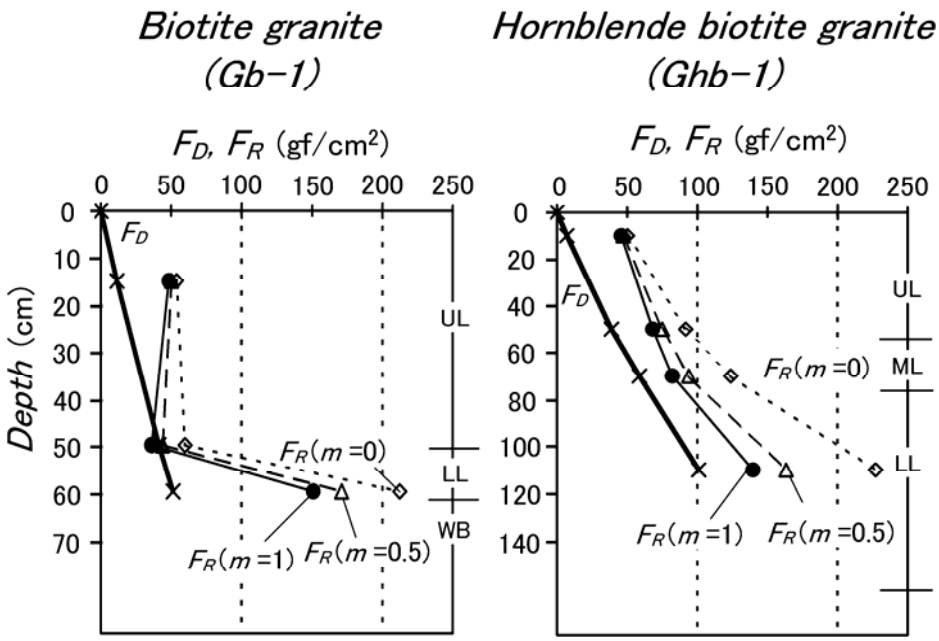

Figure 14. Shearing forces (F_D) and shearing resistances (F_R) at different depths in soil profile on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.
UL: *upper layer* (Nc<5), ML: *middle layer* (5≤Nc<10), LL: *lower layer* (10≤Nc<30), WB: *weathered bedrock* (Nc≥30)

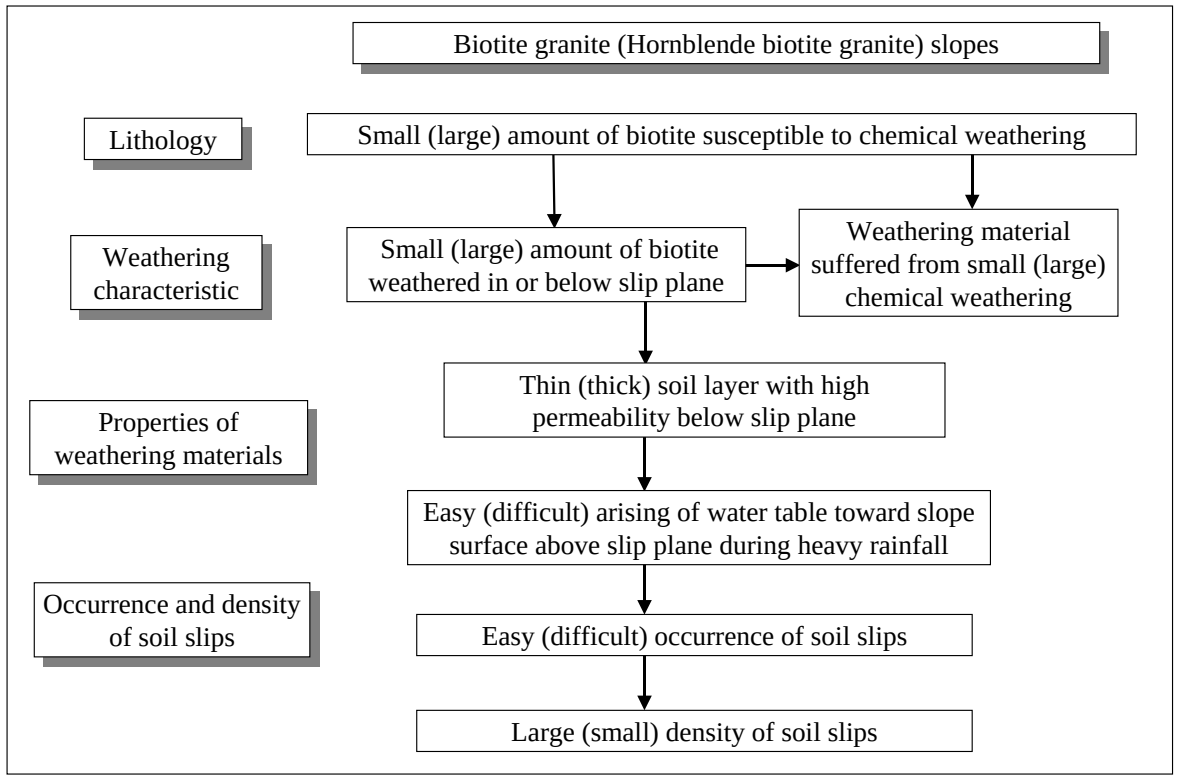

Figure 15. Effect of mineral composition of bedrock on soil-layer structure for biotite granite and hornblende biotite granite slopes.

Table 1. Slip depth and slope angle of soil-slip scars on biotite granite (Gb) and hornblende biotite granite (Ghb) slopes.

		Slip depth (cm)	Slope angle of slip scars (degree)
Biotite granite (Gb)	Figure 1. Map of study a	70	39.5
		80	48.2
Hornblende biotite granite		80	47.2
		100	42.5

Table 2. Normative mineral composition of biotite granite and hornblende biotite granite.

	Quartz	Orthoclase	Albite	Anorthite	Femic (mafic) minerals	total
Biotite granite (Gb)	35.6	15.5	33.1	8.8	4.5	97.5
Hornblende bioteite granite (Ghb)	23.9	21.5	29.0	13.1	9.2	96.7

(unit: wt %)

Normative minerals; Quartz: SiO_2, Orthoclase: $K_2O\ Al_2O_3\ 6SiO_2$,
Albite: $Na_2O\ Al_2O_3\ 6SiO_2$. Anorthite: $CaO\ Al_2O_3\ 2SiO_2$
Femic (mafic) minerals: $FeO\ TiO_2$, $FeO\ Fe_2O_3$, $3(CaO\ P_2O_5)CaF$, $(Mg, Fe)O\ SiO_2$

Table 3. Clay minerals in soil layer on biotite granite (Gb-1) and hornblende biotite granite (Ghb-1) slopes.

Sample	V/C	M	K	G
Biotite granite				
Upper layer – 10 cm	+ +	(+)	+	+
Upper layer – 20 cm	+ +	(+)	+	+
Upper layer – 30 cm	+ +	(+)	+	+
Upper layer – 40 cm	+ +	+	+	+
Upper layer – 50 cm	+	+	+	+
Lower layer – 60 cm	+	+	+	+ +
Hornblende biotite granite				
Upper layer – 10 cm	+ +	(+)	+	+
Upper layer – 30 cm	+ +	(+)	+	+
Upper layer – 50 cm	+ +	+ +	+	+
Middle layer – 60 cm	+	+ +	+	+
Middle layer – 70 cm	+	+	(+)	(+)
Lower layer – 110 cm	+	+	(+)	(+)

V/C: intergradient vermiculite–chlorite, V: vermiculite
M: mica clay minerals, K: kaolin minerals, G: gibbsite

++ abundant; + present; (+) poor