**Supplement 1. Description of soil profiles**

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| **Profile no. and coordinates** | **Soil type** | **Horizon and thickness, cm** | **Description** |
| **Soils of petrophytous stepoids** | | | |
| **4-08**  68°44’29.66” N, 161°23’59.48” E | Flow-carbonaceous grey-humus sandy loamy heavily skeletal lithozem  Hypereutric Skeletic Epileptic Regosol (Siltic, Protocalcic, Humic) | **AYsk**  0–6(9) | Dry weakly compacted brown-grey rubble light loam with a powder-like structure. Numerous living and, especially, dead roots (*d,* up to 1 mm). Rubble accounts for 30–40% of the total volume; its size, 1.5–2.0 cm. Noticeable transition according to color and rubble content; boundary is undulated |
| **Вsk,ic**  6(9)–14(15) | Dry, dense, grey-brown rubble sandy loam. Zones with a porous structure are present in the horizon. Living roots (*d,* up to 1.5 mm) are prevalent; the amount of dead roots is considerably smaller as compared with the previous horizon. Rubble accounts for 50–60% of volume; its size is to 3–4 cm; white CaCO3 cutans are frequently observed on the lower sides of rubble; weathered rubble with thick brown crusts is abundant; part of the adjacent fine earth is colored brown. Gradual transition according to rubble content and root content; boundary is diffuse |
| **BCsk,ic**  14(15)–26(28) | Fresh brown-grey stony sandy loam. Structureless. Roots are solitary. Rubble content increases downward the profile from 60 to 90%; sizes of rubble and stones are up to 5–7 cm; a few white CaCO3 cutans are observable on the lower sides of rubble; rubble is prevalently weathered |
| **8-12**  68°43’01.10” N, 161°29’02.80” E | Flow-carbonaceous duff dark-humus medium loamy weakly skeletal soil  Eutric Epileptic Regosol (Siltic, Protocalcic, Humic) | **AYrh,sk**  (0–7(10) | Fresh fine rubble light loam. Coloration is nonuniform: brown spots are occasionally observable on a grey-brown background and the zone of contact with buried soil layer in the lower part of the horizon is dark brown. Structure is grainy–powder-like. Distinct transition according to color and bulk texture; boundary is rippled |
| **AHsk**  7(10)–10(13) | Fresh, dark grey with a shade of brown, fine rubble light loam with a powder-like structure. The admixture of peat-like organic matter are observed in the horizon. Distinct transition according to color; boundary is rippled |
| **[Bsk,ic]**  10(13)–30 | Fresh brown fine rubble medium loam with a powder-like structure. White CaCO3 cutans with a thickness of up to 1 mm are observed on the lower sides of rubble. Grass plant roots run through the horizon; most of the roots concentrate in 10–20-cm layer; below, their content halves. Rubble accounts for up to 15% of volume. Gradual transition according to rubble and content of roots; boundary is diffuse |
| **BCsk**  30–45 | Dry brownish-grey rubble medium loam. Rubble is represented by fragments of andesite, accounting for 50% of volume. Roots reach a depth of 35 cm |
| **Soils of thermophilic stepoids** | | | |
| **601-08**  68°41’26.16” N, 161°31’39.34” E | Superficially turbated (zooturbated) duff dark-humus light loamy soil  Hypereutric Sodic Regosol (Siltic, Humic, Epiraptic) | **r**  0–6(8) | Horizon is the interrupted outcrop from a pocket overlapping soil profile. Dry loose porous yellowish–light grey silty light loam. Mainly structureless with some zones of weakly pronounced powder-like structure. Living roots are solitary and dead ones are few. Distinct (to sharp) transition according to all characteristics; boundary is undulate (repeats the roughness of nanorelief) |
| **AHtu**  0(8)–3(21) | Dry dense sandy loam. Colored brown–dark grey; brown shade increases in the lower part of the horizon; elements of banded coloration appear as fragmentary brownish-pale interlayer with a thickness of 1.0–3.5 cm; in addition, mottle elements resulting from zoogenic turbation are present. Structure is powder-like. Signs of peatification are occasionally observed. Large pores (cavities) of a zoogenic nature occur in the horizon. Roots (*d* of up to 4 mm) are numerous; dead roots are prevalent. Distinct transition according to coloration and root content; boundary is strongly undulated at the expense of nonuniform vegetation cover (the thickness of the horizon increases under sagebrush clumps) |
| **2AB**  15(21)–31(38) | Course is discontinuous. Dry compacted (to dense) brown-grey light loam. Structure is lumpy–powder-like. Roots (*d* of up to 3 mm) are less numerous as compared with the previous horizon. Distinct transition according to color and the content of roots; boundary is strongly undulated |
| **2Bpl**  3(38)–56(58) | Dry loosely compacted yellow-grey light loam. Color varies from yellow-grey to brown-pale. A fragmentary ochreous-brown-pale interlayer occurs in one of the walls at a depth of 26–28 cm. Structure is powder-like with some elements of foliated pattern. Roots (*d* of up to 2–3 mm) are considerably less numerous. Gradual transition according to bulk texture; boundary is diffuse |
| **2Box**  56(58)–68(72) | Dry compacted (to dense) light loam. Color is marbled, represented by alternation of low contrast light grey (25–30%) and grey-yellow (70–75%) morphons (*d* of 2–5 to 10–12 mm); uniform yellow-grey coloration is occasionally observed. Structure is powder-like and poorly nonuniformly pronounced. The amount of roots is medium with prevalence of dead ones. Gradual transition according to color; boundary is diffuse |
| **2BD**  68(72)–95(97) | Dry yellow-grey light loam. Structureless with occasional areas of poorly pronounced powder-like structure. Roots (*d* of up to 1 mm) are few with prevalence of dead ones |
| **2D**  95(97)–155 | Dry compacted structureless grey light loam. Living roots are absent and dead ones are few. Unthawed permafrost starts from a depth of 155 cm |
| **35-85**  68°42’41.93” N, 161°30’24.40” E | Superficially turbated (zooturbated) grey-humus light loam soil  Hypereutric Regosol (Siltic, Gelistagnic, Raptic) | **О**  0–1 | Dry loose grass waste; the main part is minced; the degree of decomposition is low |
| **АYtu**  1–19 | Dry grey cohesive sand with a powder-like structure. Horizon is saturated by minced grass residues with moderate amount of roots. Gradual is according to color; boundary is diffuse. |
| **2АВ**  19–39 | Dry light grey compacted light loam with lamellar structure; roots are solitary. Gradual transition according to color; boundary is diffuse |
| **3Вq**  39–80 | Dry grey-olive loose structureless sandy loam. Occasionally, the content of grass roots sharply increases. Gradual transition according to color nonuniformity; boundary is diffuse |
| **4ВСq,g**  80–119 | Fresh loose structureless light loam. Coloration is nonuniform: a few small blue-grey patches are distinctly observable on grey-olive background. Unthawed permafrost with a massive cryotexture starts from a depth of 119 cm |
| **Soils of sparse larch forests** | | | |
| **501-08**  68°44’22.36” N, 161°23’31.35” E | Pale-metamorphosed cryometa-morphic light loam soil  Cambic Turbic Cryosol (Ereutric, Humic, Siltic, Thixotropic) | **T**  0–2(6) | Moist greyish–dark brown peaty horizon compacted by roots. Peatified plant residues of a medium (to weak) degree of decomposition are represented by mosses, root waste, birch and dwarf shrubs leaves. Mineral component is absent. Fungus scent is evident. Living and dead roots are abundant. Distinct transition according to the degree of decomposition and appearance of mineral component; boundary is undulated |
| **H**  2(6)–6(8), Pockets to 18 | Slightly moist brown–dark grey loose organomineral horizon is discontinuous. Zones with powder-like structure are occasionally observed. Horizon contains detritus mainly of a root origin. Weak fungus scent is observable. Sharp transition according to all characteristics; boundary is undulated with pockets |
| **Вg**  6(8)–10(14) | Horizon is fragmentary; it is absent under pockets of H horizon. Slightly moist compacted light loam. Marble coloration is represented by the alternation of light grey (30–35%), grey-brown (25–30%), and ochreous-brown (35–40%) morphons. Size of morphons varies from 1 to 8 mm; contrast is mainly low. Structure is scaly and is occasionally absent. Spherical ochreous-brown iron concretions (*d* of up to 1.5–2.0 mm) are observed in the horizon. The amount of roots is lower as compared with the previous horizon. Distinct transition according to coloration; boundary is undulated |
| **CRMpl**  8(18)–12(21) | Horizon is discontinuous. Slightly moist compacted medium loam. Color changes along the profile from brownish–light brown to brownish; coloration is occasionally banded. Structure is scaly–powder-like. Roots occur in a medium amount. Distinct transition according to color; boundary is undulated |
| **CRM@**  12(21)–24(30) | Moist compacted porous medium loam. Coloration in nonuniform and represented by alternation of very low contrast pale-brown, grey-brown, and pale-yellow morphons. Structure is scaly and occasionally laminar scaly. Rare cryoturbation lenses represented by dark grey humus loam with an admixture of well-decomposed peat-like matter are observed in the horizon. Roots are few. Gradual transition according to color and disappearance of cryoturbation inclusions; boundary is diffuse |
| **CRM**  24(30)–48(54) | Slightly moist (to moist) brown-grey compacted light loam. Structure is foliated-scaly. Roots are few. Distinct transition according to structure and bulk texture; boundary is strongly undulated |
| **CRMCg**  48(54)–60(65) | Moist yellowish-grey dense light loam. Structure is laminar and is occasionally absent. Roots are prevalently dead; living roots are solitary; unthawed permafrost with subvertical ice schlieren (thickness to 0.5 mm) starts from a depth of 60–65 cm |