**US Taxonomy Mongolia WRB 2019**

**Summary:**

**M1 Aridic Calciustolls coarse loamy, mixed frigid**

**M2 Calciustolls, fine loamy mixed frigid**

**P1** **Lithic Haplocryolls, coarse loamy mixed frigid**

**P2 Vitrandic Haplocryolls, loamy skeletal, mixed frigid**

**P3 Typic Calcicryolls, coarse loamy over sandy skeletal mixed frigid**

**P-01-09 Pachic Calcicryolls, coarse-loamy over sandy, mixed, frigid (perhaps subgelic in past)**

**P-01-08 Aquic Haploturbels, coarse-loamy over sandy skeletal, mixed frigid (perhaps subgelic in past)**

**P-01-10 Aquic Haploturbels, coarse-loamy over sandy skeletal, mixed frigid (perhaps subgelic in past) if accept cryoturbation features.**

**Aquic Haplocryepts, coarse-loamy over sandy skeletal, mixed frigid if do not accept evidence of cryoturbation**

**p-11 Aeric Halaquepts sandy mixed subgelic**

**p-12 Aquic Halocryepts, coarse-loamy, mixed subgelic**

**p-13 Typic Calcicryids, loamy skeletal mixed frigid (subgelic bordering on anhydrous)**

**Or Typic Salicryids loamy skeletal mixed frigid**

**P-14 Typic Salicryid fine-loamy mixed frigid—**

**Natric Argicryid fine-loamy mixed frigid—better describes second hole with upper 30 cm describing natric features columnar prisms clay films argillic higher ESP-2-50 cm in data**

**X1 Aquic Salicryids fine, mixed(carbonatic from parent material) frigid**

**X3 Calcic Gypsicryids fine(fine-loamy if mixed sandy loam material within deep cracks) mixed frigid**

**If do not accept Gypsic horizon(no lab data to back up but visible crystals at 80-90 cm) then**

**Vertic Argicryids, fine mixed frigid (with cracks from surface to over 100 cm in profile)**

**X2-Typic Calcicryids, loamy skeletal mixed frigid**

**X-6 Typic Calicryids, coarse loamy over sandy skeletal, mixed(carbonatic?), frigid**

**X-7 Chromic Haplocryerts, fine, mixed(50%Smectitic 50% illitic),frigid**

**Bonus pit near playa on Desert Pavement(edge of playa)-Calcic Gypsicryids, fine loamy(averaged coarse-loamy to fine -frost heave vertical layers in pit), mixed, frigid**

**X-4 Typic Calcicryids, fine loamy over fine mixed frigid**

**X-8 Typic Argicryids, fine, mixed (smectitic & illlitic), frigid**

**X-9 Typic (Ustic?)Calcicryids, coarse loamy, mixed, frigid**

**M3 Ustic Calcicryolls, coarse loamy over sandy skeletal, mixed, frigid**

**Notes**

**M1**-East Ulaan Bataar Central Steppe- grassland pasture-**Aridic Calciustolls, coarse-loamy mixed frigid**

Diagnostic horizons- 23cm 10 yr 3/31>1% humus; high base sat 6.9 pH no fizz

Calcic spotty ~ 50-100cm ~5% soft masses; violent fizzing secondary carbonates

25-100 cm-fine sandy loam more than 50% sand-coarse loamy and gravelly discontinuity below—discussion of colluvial material

**M2** Near Khorakohn Temple in abandoned field more than 60yrs Central Steppe- ungrazed Sebator fields from Russians nearby **Aridic Calciustolls, fine loamy mixed frigid**- parts of the pit don’t have Mollic depth(only 13 cm) and were classified **Aridic Calciustepts, fine loamy, mixed frigid**

Plow plan active bioturbation Calcic spotty-WRB used protoCalcic, Natric(in plow layer- very marginal not diagnostic for USDA) WRB saw clay films to support their agric -no clay increase-cambic/calcic diagnostic horizon for US Taxonomy-Inceptisols

**P1** Khorgo volcano region mountain steppes **Lithic Haplocryolls, coarse loamy mixed frigid**

Mollic no carbonates depth to hard basalt flow at less than 40 cm

**P2** Cinder cone **Vitrandic Haplocryolls, loamy skeletal, mixed frigid**, no carbonates below rocks

Makes vitriandic based on cinders and volcanic glass,,,does not make andisol; mollic again no carbonates or very little

**P3** saddle position basalt **Typic Calcicryolls, coarse loamy over sandy skeletal mixed frigid**

Not enough sodium for natric properties with extreme high ph 9 accepted protocalcic which satisfies US calcic granitic stones and basalt gravels

Very high illite (greater than 60%) in control section in minerology data-granite colluvium parent material with Basalt intrusion

Haplic Kanozostem Cambic protocalcic colluvic bati skekeletal

**P-01-09 Zavkhan Province p128**

**Pachic Calcicryolls, coarse-loamy over sandy, mixed, frigid** (perhaps subgelic in past)

Cambic Phaeosem (coluvic lomic machic endoruptic bati protocalcic bati gleyic batic turbic)

No frozen layer within 2M but cold below 0C at 2M 2 years ago when sampled

Indications of wetness in sands that may have perched water in the past-from permafrost below provide moisture in 200mm of precip for large NWaspect trees Larch

Mollic to 47cm-Pachic: Calcic: Cryic temperature—Calcic marginal secondary carbonates (5%)-similar to protocalcic in WRB)

**P-01-08 Zavkhan Province p121 Larch forest**

**Aquic Haploturbels, coarse-loamy over sandy skeletal, mixed frigid (perhaps subgelic in past)**

Toeslope position colder—ice still present in pit at 110-120cm good cover of moss and folist material on surface but not enough for Histic temperature was 0degreeC at 100cm when they opened pit 2 days ago cambic no significant carbonates with rock undersurface in lower layer for evidence of secondary carbonates

Diagnostic: question by WRB whether solufluction of lower layer with lenticular lenses and wavy boundary and evidence of aquic conditions over permafrost in melting would qualify as cryoturbation

WRB and Soil Taxonomy have same diagnostic criteria for evidence of permafrost-Gelisols(US) and Cryosols(WRB)

**P-01-10 Zavkhan Province p131** Larch forest steep upper slope good moss cover folist surface not enough for Histic

**Aquic Haploturbels, coarse-loamy over sandy skeletal, mixed frigid** (perhaps subgelic in past) if accept cryoturbation features.

**Aquic Haplocryepts, coarse-loamy over sandy skeletal, mixed frigid** if do not accept evidence of cryoturbation since we did not see ice when we dug further into profile so cannot confirm permafrost within 2M

WRB did not accept lenticular structure and wavy boundary of solufluction layer as enough evidence for cryoturbation definitively ( by Soil Taxonomy interpretation it was enough for me)

definitely a borderline degrading permafrost in this position—thick layer of moss and folist layer not enough for histic and no evidence of secondary carbonates very similar profile as P-02-08 except could not dig further than 100 cm to check for ice with 2 M.

**Moved south700km to Bogd lake and now in Desert steppe less than 200 mm rainfall and very high ET with wind and solar—borderline lower reaches of Ustic moisture regime moving into Aridic of upper Gobi still extremely cold temperature in winter**

**p-11 Bogd Lake Dune depression**

**Aeric Halaquepts sandy mixed subgelic**

Evidence of cryoturbation but no permafrost to 2M

Sulfides greater than 30 cm but no sulfidic material-pH> than 9 throughout

Watertable saturated gleyed mottles to 13cm anerobic conditions from subsurface inflow and lake

Wavy boundary with chroma greater than 3 at 15-30 cm-Aeric subgroup

Salt Crust- extremely high pH

pH greater than 9 Carbonatic but no secondary carbonates for calcic; greater than 20 ESP implies Salic horizon in Inceptisol; EC dS/M(x10)10 to 50 greater than 4 in profile-not clear on measurements

greater than 60% illite minerology—illitic family?—not clear on how was measured to fit definitition

p-12 Bogd Lake Dunal material higher position

**Aquic Halocryepts, coarse-loamy, mixed subgelic**

Very cold position from downdraft mountains upper 50 cm with cryoturbation with gleyic soil at greater than 50 cm

not-aquic within 50 cm(subsurface flow from inflow/outflow to lake)

not calcic no secondary carbonates, possibly salic 10-100 cm if multiply dS/M by 10 (.4-.5(we are reevaluating to multiply by 10)

ESP less than 15% but close 14.2% not natric

p-13 near Bogd Lake upper terrace desert pavement Gobi Steppe

2 interpretations depending on if follow lab data-profile slightly different than data-

**Typic Calcicryids, loamy skeletal mixed frigid (subgelic bordering on anhydrous)**

Or Typic Salicryids loamy skeletal mixed frigid(high 5 ds/M at 95-100 cm for salic—not really relevant for how the soil should be classified but Salic does key out first before calcic)

Strong calcic with secondary carbonates at 50 -75 cm skeletal and cemented in places but not continuous for petrocalcic or duripan

Very dry position(less than 125mm) but potentially extreme cold in winter with downdraft from high elevation mountains

Need Yermic qualifier to denote desert pavement and discontinuous vesicular layer in US Taxonomy-definitive feature of surface that controls water infiltration

P-14 very high older fluvial terrace near Bogd village(profile was misplaced for demonstration, highly degraded—argillic and natric has been eroded and disrupted—dug a second hole at the summit that better depicted the surface upper 50 cm-

**Typic Salicryid fine-loamy mixed frigid**—depicting first profile with lab data(salic at 11-75 cm)

**Natric Argicryid fine-loamy mixed frigid**—better describes second hole with upper 30 cm describing natric features columnar prisms clay films argillic higher ESP-2-50 cm in data Salic does keyout first in US Taxonomy but does not fully describe this situation well.

Strong desert pavement but very weak or no vesicular structure below—very sandy wind blown surface

Moved to Dalanzagad region lower precip annual less than 100mm; higher summer average summer temperature up to 38 degrees C lower winter temp-20 degrees C cryic temperature regime 0-8 degrees C average soil temperature very high wind and ET solar evap

X1 Depression concave level with sandy dune hummocks temperature cool clear very windy high solar

**Aquic Salicryids fine, mixed(carbonatic from parent material) frigid**

Sulfides dominate-new sodium sulfate crystals on pit wall surface that have crystalized with evaporation since opening pit; depression collects runoff from region as temporary lake underground as well as meltdown from deep frost; impressive cryoturbation with churning of organic matter into profile and cracks from freeze thaw; high carbonates but no secondary carbonates; hi EC in surface with salt crusting fine textures to surface wind blown hummocks with vegetation are sandy; parent material is lake sediments from Mezoic that are reworked and windblown in Holocene

X3-Plateau Semi Desert in Gobi profile slightly misplaced on slope degraded/eroded and refilled—second smaller handug pit to better show surface desert pavement and degraded Natric horizon

**Calcic Gypsicryids fine(fine-loamy if mixed sandy loam material within deep cracks) mixed frigid**

If do not accept Gypsic horizon(no lab data to back up but visible crystals at 80-90 cm) then

**Vertic Argicryids, fine mixed frigid (**with cracks from surface to over 100 cm in profile)

No sodic no salic(one EC reading at 40-60 cm—8dC/M diluted by 10 but could be affected by high gypsum for elevated reading) no calcic

2.5YR 5/6 colors in Btn; desert pavement sandy loam/silt loam vesicular; columnar pores and platy 5 cm thick

X2-lower slope level terrace degraded with gullies from road and driving where stable desert pavement

**Typic Calcicryids, loamy skeletal mixed frigid**

Long discussion of cemented vs indurated no laminar cap or petrocalcic on lower calcic horizon-hyper calcic did not slake after an hour of soaking but soft and malleable and easily crushed with hands

Need to check definitions but terms are used in multiple contexts in USDA field guide

Pale-turbation in deep hypercalcic horizon

some cryoturbation in frost heave zone in upper 60 cm depth with hypercalcic pockets

no argillic (perhaps cambic but weak-long discussion) no sodic no salic

Desert pavement away from profile intact

90 Kilometers to next site (mineral spring and village with old 1700’s temple(soil prayer for renewal of local Mongolians ceremony)

X-6 Semi Desert expected gypsum but was not apparent—erosional cut in landscape good desert pavement

**Typic Calicryids, coarse loamy over sandy skeletal, mixed(carbonatic?), frigid**

No sulfate data-recommended to detect suspect gypsum

No obvious gypsum crystals throughout; carbonates throughout

Not petrocalcic

big prisms below surface

ancient fluventic layers big discussion as to whether should be identified in WRB

Cambic, yermic, ochric

No data to confirm or deny salic

Sodic but not enough for Natric ESP about 12% in subsoil

X-7 Playa Semidesert-dried with cracking on surface

**Chromic Haplocryerts, fine, mixed(50%Smectitic 50% illitic),frigid**

Vertisol-cracks, wedges and slickensides to 40cm

Polygonal cracking of surface- takyric to be added to WRB

Low carbon average in surface Ah and value4/chroma 3 throughout—Ochric/Chromic

Not Natric (sodic -WRB ESP-10%) ESP less than 15%

Not salic EC low

Bonus pit near playa on Desert Pavement(edge of playa)

Finally saw gypsum with crystals throughout starting at 20 cm!

**Calcic Gypsicryids, fine loamy(averaged coarse-loamy to fine -frost heave vertical layers in pit), mixed, frigid**

No data brief discussion- WRB Gypsisol

Local owners wanting to plant forage fodder—difficult to recommend with conditions and water shortage even with well. Mixed pasture radish/legume/oats mix? Focus on area with vertisol with water management?

X-4 final pit in south Gobi terrace desert pavement nearby but not at pit-- erosional cut face in deep gully with halophytes

**Typic Calcicryids, fine loamy over fine mixed frigid**

No salic low EC-

No yermic desert pavement

No natric (proto sodic at 80-90 cm) hoping for data support with large prism structure 4-50 cm sandy clay loam texture

Calcic (proto calcic for WRB)

Interesting frost heave(pale?) wedges in other parts of erosional gully cut than pit face

**X-8 moving north and east toward middle Gobi near highway desert pavement siltstone greenish highway construction pit obscured original site from 2012**

**Typic Argicryids, fine, mixed (smectitic & illlitic), frigid**

Wished there was enough Gypsum for Calcic Gypsicryrids—

Argillic with clayfilms, proto calcic for WRB(3-30 cm) but did not have the option in US taxonomy with strong argillic horizon keying out first.

EC was salic in Btny(over 10 dS/cm) associated with Gypsum but did not have enough gypsum (many crystals visible for 5 percent Gypsic horizon

Proto sodic WRB in subsoil with large distinct prisms but not enough for natric

**X-9 moving North into Middle Gobi**

**Typic (Ustic?)Calcicryids, coarse loamy, mixed, frigid**

Transition bordering on Ustic---Starting to rain steadily— start to consider that we are borderline ustic

low EC.08-.06 in surface no salic

No argillic or clay films

No desert pavement at site but some desert pavement closeby

Mixed solufluction paleo deep in profile

Calcic associated with gravellier parts of profile in 2 layers above 100 cm but pendants of secondary CaCO3 throughout surface and fizzing

**M3 near the Experiment station near Derian—Middle Gobi Central Gobi**

**Ustic Calcicryolls, coarse loamy over sandy skeletal, mixed, frigid**

Proto calcic in sandy soil—fulfills calcic in US taxonomy

3/3 0-20 cm enough OC for mollic?

No salic

No Gypsic

No cambic-but some clay films and some structure in Bwk if not Mollic next best classification Calcic Haplocryepts

Marginal mollic question on soil carbon lab data just short of 0.6