CSFC & PSSAC

Rim of the World Summer Field Tour

June 26-27, 2015

Rim of the World Summer Tour

presented by

California Forest Soils Council

and

Professional Soil Scientists Association of California

Stanislaus National Forest

and

Sierra Pacific Industries

June 26–27, 2015

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CFSC/PSSAC Rim of the World Summer Tour

June 26–27, 2015

– Itinerary –

(prepared by R. Taskey, A. Janicki, C. Kvamme)[1]

Theme: Soils, geology, fire, forestry, and meadows in the Western Sierra Nevada: an integrated view

Friday, 06/26/15

WHERE: North Fork Tuolumne River & upper Clavey River watersheds, Dodge Ridge area

HIGHLIGHTS: Relationships among soils, geology, hydrology, ecosystems, land uses, and management practices on volcanic and granitic terrains in mixed conifer forests and mountain meadows

DISCUSSION TOPICS: The geologic foundations, pedology and edaphology, historical and present-day land-uses and disturbances, soil quality standards, meadow rehabilitation, forest research

STOP 1. 0845. Hwy 108 overlook (We'll call it "Little Sweden.")—view across North Fork Tuolumne River to lower Dodge Ridge

Location: Hwy 108 pullout ~ 0.3 mi. past (easterly, uphill) end of 4-lane (lat., 38.137°; long., -120.091°) (~ 25 mi. from Jamestown); the divide between Tuolumne & Stanislaus watersheds

Elevation: ~ 5,400 ft.

Topics: Introductions. Pedologic platforms and the landscape context—Sierra Nevada batholith & volcanic mudflows (lahars), landscape "reversals," glaciation. Miocene lahar of the Disaster Peak Fmn (similar to the Mehrten Fmn) overlies more deeply weathered Cretaceous granodiorite and related igneous rock types mapped as the Poopenaut Valley Fmn (Huber, 1983); glaciated landscapes northeasterly in the distance. What are the geomorphic, pedologic, and hydrologic consequences and implications for land use and management?

STOP 2. 0930. Merrill Springs Road

Location: Southeasterly off Hwy 108 near Long Barn.

Directions: ~ 3.2 mi. back down Hwy 108 from stop 1; left turn onto Long Barn Rd (38.1011°, -120.1232°), second left (~ 0.1 mi) onto Merrill Sp. Rd. (3N01), pull to rt side of road as far as possible for brief look at road cut on left. CAUTION TRAFFIC!

After road-cut stop continue ~ ¼ mi. to small pullout (lat., 38.0948°; long, -120.122°) on left; additional parking to right. We'll spend time at this stop, including a walk down the road (~ ¼ – ½ mi) and a walk back through the woods.

Elevation: ~ 5,100 ft.

Background: We enjoyed a distant view from stop 1; now we see it close up. Contrasting masses of igneous extrusive and intrusive rock of greatly different ages are further

[1] At any given time, at least one of the organizers might not have known what he was doing or thinking; therefore, any errors are the fault of someone else.

characterized by dissimilar landscape processes and landforms, all of which led to contrasting soil parent materials, distinct soils, hydrologic discontinuities, and varying forest productivity.

Topics: Geology, soil development, site productivity, and logging history across an unconformable volcanic-granitic contact. Landscape & hydrologic responses to contrasting bedrocks & weathering regimes over time.

Discussion points: Relationships of geologic events, lithology, climate, and time to landscape and soil development, hydrology, vegetative distribution, and forestry. Soils on volcanic and granitic parent materials. How old *are* soils, anyway? Where else might we find comparable conditions? Should this influence land use and management decisions?

Mapped soils: Unnamed Humic Lithic Dystroxerept (formerly Lithic Xerumbrept); McCarthy (?) (formerly medial-skeletal, mesic, Andic Xerumbrept; reclassified as medial skeletal, amorphic, mesic Humic Haploxerand) moderately deep, lower productivity soil on andesitic tuff breccia lahar of Mehrten and Disaster Peak Fmns; and Holland series (fine-loamy, semiactive, mesic Ultic Haploxeralf) deep, high productivity soil on granitic parent material (but also mapped on volcanics in SNF). SNF soil survey map sheet 474-4.

STOP 3. 1130. Cold Springs

Location: Cold Springs

Directions: From Long Barn Rd./Hwy 108 travel northeasterly on Hwy 108 ~ 6.0 mi to Cold Springs (38.1617°, -120.0564°); gas station/store on left, park on north side.

Elevation: ~ 5,670 ft.

Background: Watershed divide, S. Fk. Stanislaus and N. Fk. Tuolumne Rivers. Brief look at interbedded lahar and alluvium.

LUNCH, PSSAC Business Meeting at Round Meadow (STOP 4 area)

STOP 4. 1300. Round Meadow

Location: ~ 1 mi. south of Dodge Ridge ski area; Bell Ck–Clavey River watershed.

Directions: ~ 1.2 mi. beyond Cold Springs (~ 7.2 mi. from Long Barn Rd.) to Crabtree Rd. (lat., 38.1700°; long., -120.0376°); right onto Crabtree; ~ 6.6 mi. to FR 4N25 at the pack station (38.1768°, -119.9539°); right on 4N25 ~ 0.4 mi. to 4N02Y; left onto 4N02Y ~ ¾ mi. & park (38.1666°, -119.959°); ~ ¼ mi. walk south to Round Mdw.

Elevation: ~ 6,400 ft.

Background: Mid-elevation meadow that was heavily grazed by sheep in late 19th to early-mid 20th centuries; gully erosion lowered water table & altered hydrologic functioning. Effort underway to control erosion, rehabilitate meadow, restore hydrologic functioning, and monitor results.

Broader geographic perspective: Volcanism and glaciation have separated watersheds in this region. Pinecrest Lake is in S. Fk. Stanislaus R. watershed; Dodge Ridge ski area and Stanislaus-Tuolumne Experimental Forest are in N. Fk. Tuolumne R. watershed; and Round Mdw is in Clavey River watershed. The pack station we passed is about on the N. Fk. Tuolumne & Clavey divide. The Clavey is tributary to main Tuolumne River; confluence ~ 3 mi NNW of USFS Groveland Ranger Station on Hwy 120.

Topics: Degradation and rehabilitation of an historically overgrazed moist meadow. Soil-hydrology-land use relations; effects of gully erosion, cumulative impacts, rehabilitation, and current grazing management.

Discussion points: The place and function of mountain meadows. Soil-hydrology-vegetation-grazing relations, soil redox, site history & erosion, cumulative impacts, rehabilitation program, water-table monitoring, grazing on national forests. Meadow rehabilitation—why do it?

Mapped soils: Entic Cryumbrepts (Mountain meadow soils tend to be varied and complex. Soils would be reclassified in the most recent *Keys to Soil Taxonomy*, perhaps as a complex of Fluventic Humicryepts and Oxyaquic Humicryepts, or several great groups of Humudepts, among other possibilities. Soil temperature regime is mapped as cryic, but probably is marginal to frigid.) SNF soil survey map sheet 473-2.

STOP 5. 1530. Stanislaus-Tuolumne Experimental Forest

Location: Sheering Ck–N. Fk. Tuolumne River watershed; northwest slope of Dodge Ridge, along Crabtree Rd.

Directions: From STOP 4, head back to jct of 4N25 and Crabtree Rd. (at the pack station); left on Crabtree Rd ~ 2.8 mi. to dirt road (4N70) to the left (38.1813°, -119.9806°) (Note: If we have > 10 vehicles, continue another 0.7 mi to a small quarry at FR 4N10 (Google shows this incorrectly as 4N11) (38.1773°, -119.9883°)

Elevation: ~ 6,000 ft.

Background: 690 ha experimental forest in two units—Stanislaus (156 ha) and Tuolumne (534 ha)—within the Stanislaus NF, administered cooperatively by USFS Pacific Southwest Research Station and SNF Summit Ranger District. Dominantly mixed conifer forest w/ minor red fir at highest elevations; overall high site quality. Forest research, including much by Duncan Dunning, conducted here since 1920s. A resurgence of studies, including those on variable-density thinning, in the last decade build on century-old silvicultural plots.

Topics: Historical and current research efforts; silvicultural philosophies and practices, from early timber mining to variable-density forest thinning; experimental cutting & monitoring plots.

Discussion points: Approaches to tree harvesting for various purposes from timber production to fuel reduction. How these have changed since the mid-19th century and in recent decades? High grading, clear cutting, selection harvests, "thinning from below" & shaded fuel breaks w/ evenly spaced dominant & codominant trees, variable-density thinning, and attempts to stop or retard the spread of large fires. What works or doesn't work, and do soils play a role?

Mapped soils: Dominantly Ultic Haploxeralfs of Wintoner (fine-loamy, mixed, frigid) and Inville (loamy-skeletal, mixed, frigid) series, derived from igneous intrusive parent materials (SNF soil survey map sheet 473-2)

(Note: S-T Ex. Forest website (http://www.fs.fed.us/psw/ef/stanislaus_tuolumne/) indicates Holland (fine-loamy, mixed, mesic), with shallower soils derived from lava cap on high slopes and ridges. [note by RDT: mesic temperature regime doubtful; shallower soils probably Inceptisols(?) derived from lahar])

RETURN to Hwy 108 via Dodge Ridge Rd & moraines

From STOP 5 backtrack ~ ½ mi. on Crabtree Rd. to Dodge Ridge Loop Rd. Turn left, ~ ½ mi. to Dodge Ridge Rd. Turn left, continue ~ 3.0 mi. to Pinecrest Lk. Rd. Turn left to return to Hwy 108. Driving along Dodge Ridge Rd., you will travel along & through a beautifully-developed moraine above (south of) Pinecrest Lake. The moraine diverted water from N. Fk. Tuolumne R. to S. Fk. Stanislaus River; hence, it's now the watershed divide. Note glacially-scoured region above Pinecrest Lk.

REPAST AND EVENING PROGRAM. 1900. Buck Meadows Restaurant

Location: Buck Meadows, Hwy 120 ~ 10 mi. east of Groveland (~ 8 mi. east of Pine Mtn campground), between Groveland and Yosemite NP.

Elevation: ~ 3,000 ft.

Buck Meadows Background: During the time of stage-coach travel, beginning in the 1870's in this region, Buck Meadows was a rest stop known as Hamilton's Station. As is the case today, most travelers were headed to and from Yosemite, which became a national park in 1890. In early 20th century, Buck Meadows became a boom town of sorts when the Hetch Hetchy water project was approved and work began on construction of O'Shaughnessy Dam.

Speakers: Jerry DeGraff, Forest Geologist, Emeritus, Sierra National Forest.
"Progress in Quantifying Post-fire Debris Flows and Rock Falls"

Dr. Cajun James, Research and Monitoring Manager, Sierra Pacific Industries.
"Post-Wildfire Salvage Logging, Soil Erosion, and Sediment Delivery—Ponderosa Fire, Battlecreek Watershed, Northern California"

Dr. Ron Taskey. Some background for tomorrow's tour.

Saturday, 06/27/15

Where: Middle Fork Tuolumne River watershed, near Sawmill Mtn. and along Cherry Lk road

Highlights: More—and a bit different—geologic foundations, landscape development, and pedology and edaphology, with timber harvesting and fire superimposed. Metamorphic and granitic terrains of contrasting plutons in mixed conifer forests, much of which burned in the Rim and earlier fires. Post-fire missions, goals, and responses by a public agency (USFS) and a private company (Sierra Pacific Industries (SPI)).

Discussion Topics: Relationships of soils to geology, ecosystems, and forest practices. Deep past to shallow present: What're the connections and so what? Fire influence on soils and on the broader ecosystems. Contrasting human responses in a complex society (whatever that means).

STOP 1. 0830. Hwy 120 Rim of the World overlook. View across confluence of South Fork and Middle Fork Tuolumne River to Jawbone Ridge

Location: Hwy 120 pullout ~ 9.7 mi. easterly from Yosemite Pines RV Resort (the driveway) & ~ 1.1 mi. past (easterly) Buck Meadows restaurant (lat., 37.8219°; long., -120.0392°); above confluence of Middle Fk. and South Fk. Tuolumne River.

Elevation: ~ 3,100 ft.

Background: Refer to "Overview of the Sierra Nevada" later in guidebook.

Topics: Introductions. Continued overview of western Sierra Nevada geology, geomorphology, watersheds, soils, ecosystems, fire history.

STOP 2. 0930. Sawmill Mtn. Rd.—Middle Fork Timber Sale area, Stanislaus NF

Location: Along Sawmill Mountain road (1S03) north of Hwy 120.

Directions: From Rim of the World overlook, head easterly ~ 4.8 mi. to Sawmill Mtn Rd (37.8225°, -119.9658°), turn left onto 1S03, ~ 0.6 mi. park in landing on right (37.8261°, -119.9584°).

Elevation: ~ 3,950 ft.

Background: Multiple-entry forest harvesting on contrasting soils; wet-season 2012 forest thinning for fuel reduction and forest health. Pre- and post-harvest soil mitigation measures. Significant forest fuels have been accumulating since the 1987 Stanislaus Complex fire. As fuels build up, the danger to local residential and recreational developments increases, as does the probability of disease and insect infestation in the forest. The 2012 forest thinning was implemented to reduce fire danger and maintain forest health. Approximately 700,000 b.f. (board feet) of timber was selectively harvested from about 300 ac. Cutting began during dry weather in February and ran through a period of spring rains. Some soils were able to withstand wet-season harvesting activities, while others were not. The Rim Fire struck the following year. We'll look at two adjacent sites.

Topics: Three-year old wet-season logging for forest thinning and fuel reduction. Soils concerns in planning and administering timber sales. Contrasting soil susceptibility to wet season forest activities. Post-harvest treatments of compacted areas. Hazard tree removal after 2013 Rim Fire. Soil water repellency and chemistry.

Discussion points: Why is one site more productive than the other? During wet-weather logging, why might one site resist impairment more than the other? Contrasting soil parent materials; site productivity; soil response to logging activities and mitigation of effects;

thinning for fuel reduction; soils and environmental assessment; interaction of forester and soil scientist.

Mapped soils: Moderately deep to very deep Holland (granitic) (fine-loamy, mixed, mesic Ultic Haploxeralfs) and Fiddletown (granitic and metamorphic) (loamy-skeletal, mixed, mesic, Pachic Xerumbrepts) series.

Minimize number of vehicles for stop 3. It's a short drive, and we'll come back shortly to pick up vehicles left at the stop 2 landing.

STOP 3. Overlook from Sawmill Mtn Rd.

Location: Above Middle Fk Tuolumne R., along forest road 1S03

Directions: Continue along 1S03 ~ 1.2 mi. (37.841860°, -119.9595°) NARROW ROAD, WATCH FOR TRAFFIC (possible logging trucks)! After viewing, continue along 1S03 ~ 1/10 mi. to 1S04, turn around and return to Hwy 120.

Elevation: ~ 4,165 ft.

Background: Northwesterly view across Middle Fork Tuolumne River. Landscapes developed on contrasting plutons; Pilot (1999) and Rim (2013) burn areas; distant view of Stop 4.

A different, wide-angle perspective of the geology-landscape-pedology picture seen close up at STOP 2. Standing on Granodiorite of Sawmill Mountain (Cretaceous, U-Pb age 116.1 Ma) (Dodge and Calk, 1987) looking toward Tonalite of Granite Creek (Jurassic).

Topics: Properties and significance of contrasting plutons. Introduce contrasting fire effects, water repellency, and erosional processes. (Note: This is not an optimal site for a close-up view of fire effects on soils derived from granodiorite; it is a compromise, selected because of time and logistical constraints.)

Discussion points: You name it. As at all other stops, competing hypotheses and arguments welcome!

LUNCH and CFSC Business Meeting. Location TBA (San Jose Family Camp, Jones Mdw, or ?)

STOP 4. Spinning Wheel Grade and Gravel Range

Location: Lower Cherry Lake Rd (1N07) corridor, southern end of Gravel Range.

Directions: From STOP 3 return to Hwy 120, turn right, heading westerly for ~ 3.0 mi. to Cherry Lk Rd. (FR 1N07) (Before Cherry Lk Rd: We MIGHT make a brief stop into a Hwy 120 pullout on the right about half way there—depending on number of vehicles and traffic.)

At Cherry Lk Rd turn right, then quick right to continue on Cherry Lk Rd.

Continue ~ 2.2 mi. to unmarked dirt road with gate on right (37.8474°, -120.0006°). Parking will be directed, but many **vehicles will need to BACK up the road** far enough to accommodate the others. Walking distance ~ ¼ mi. to site, ~ ½ mi. farther to alluvium. (NOTE: the weather at this site could be HOT; we will alter plans accordingly.)

Elevation: ~ 3,500 ft.

Background: Soils formed in parent materials derived from deeply weathered Jurassic tonalite (quartz diorite) are severely eroded and support a sparse chaparral plant community. Boulders dot the surface, and in places the soils are capped by Tertiary-aged alluvium. Exposed soils continue to erode, but post-fire erosion appears to be quite different from that on nearby sites.

The region was heavily railroad logged during the first half of the 20th century. The most recent fires burned in 2013 (Rim) and 1999 (Pilot).

Topics: Weathering, soil age, modern erosion on ancient erosion, post-fire response, site productivity. Soil and ecosystem characteristics and post-fire responses contrasted to sites at STOPS 2 and 3; soil water repellency, slope stability, erosion, pluton influence.

Discussion points: Comparisons with previously visited sites; post-fire conditions. How did all this come about? What does it mean to modern-day events and interpretations. Did early logging or other human-caused disturbances initiate the erosion we see today; if so, where's the evidence? Where did all the boulders come from? What about time as a soil-forming factor? Is it true?—plutons rule?

Mapped soils: Ultic Haploxeralfs–Red Bluff (fine, kaolinitic, thermic Ultic Palexeralfs) family complex; Pinole (fine-loamy, mixed, thermic Ultic Argixerolls), Holland, deep (fine-loamy, mixed, mesic Ultic Haploxeralfs)

STOP 5. Sierra Pacific Industries—Rim Fire salvage logging and erosion monitoring

Location: Gather at intersection of 1N07 (Cherry Lk rd) & 3N01 (37.9185°, -119.9724) (NW ¼ S 26, T1N, R18E) (Note: Google shows 3N01 incorrectly as 1N04.) Sites most likely will be along Cherry Lk Rd. (1N07) in NE ¼ S 24 or about a mile beyond on 1N12Y (approx. 37.931541°, -199.9375°) in S 13.

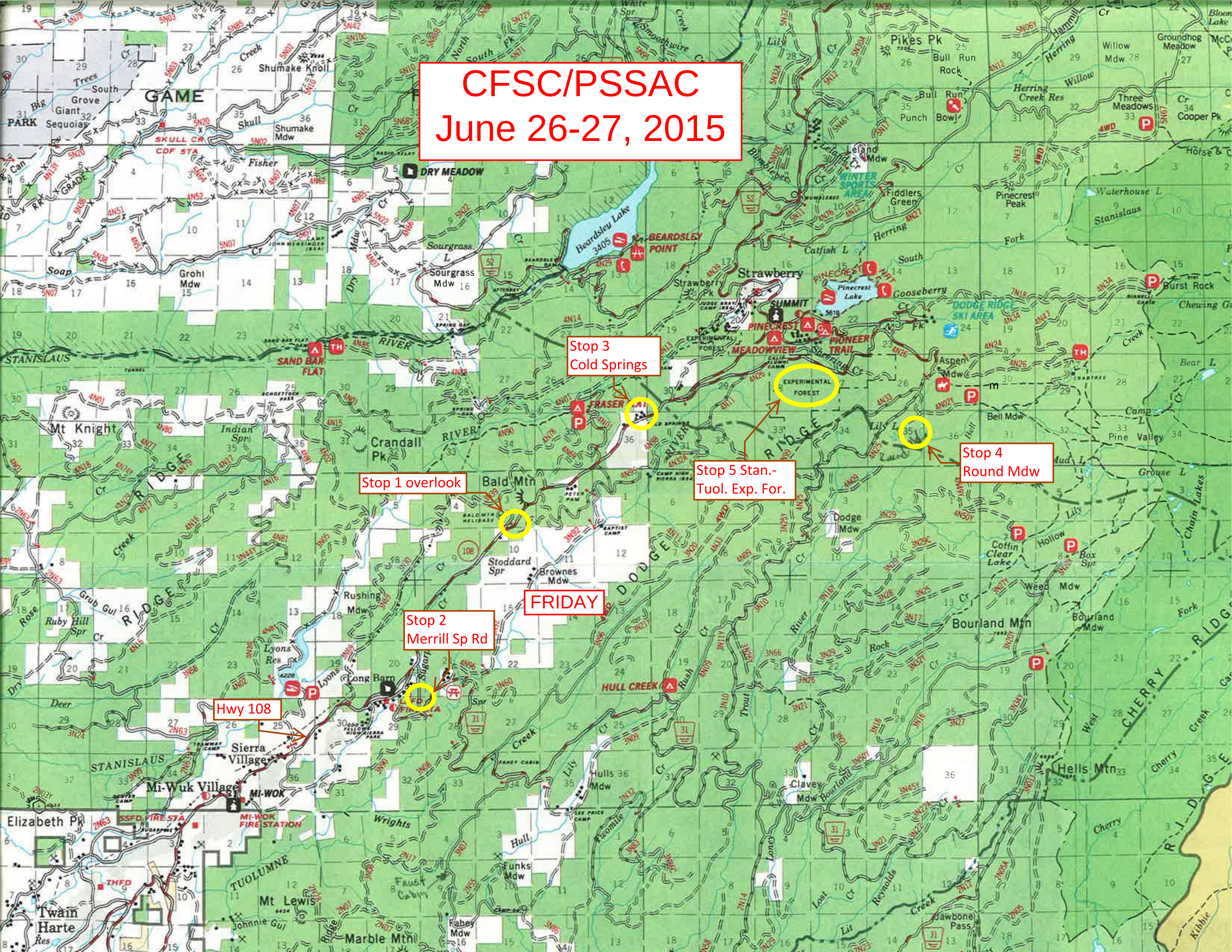
Directions: From stop 4, continue on Cherry Lk Rd (1N07) ~ 16.5 mi (~40-45 min) to 3N01 to gather, then on to 1N12Y.

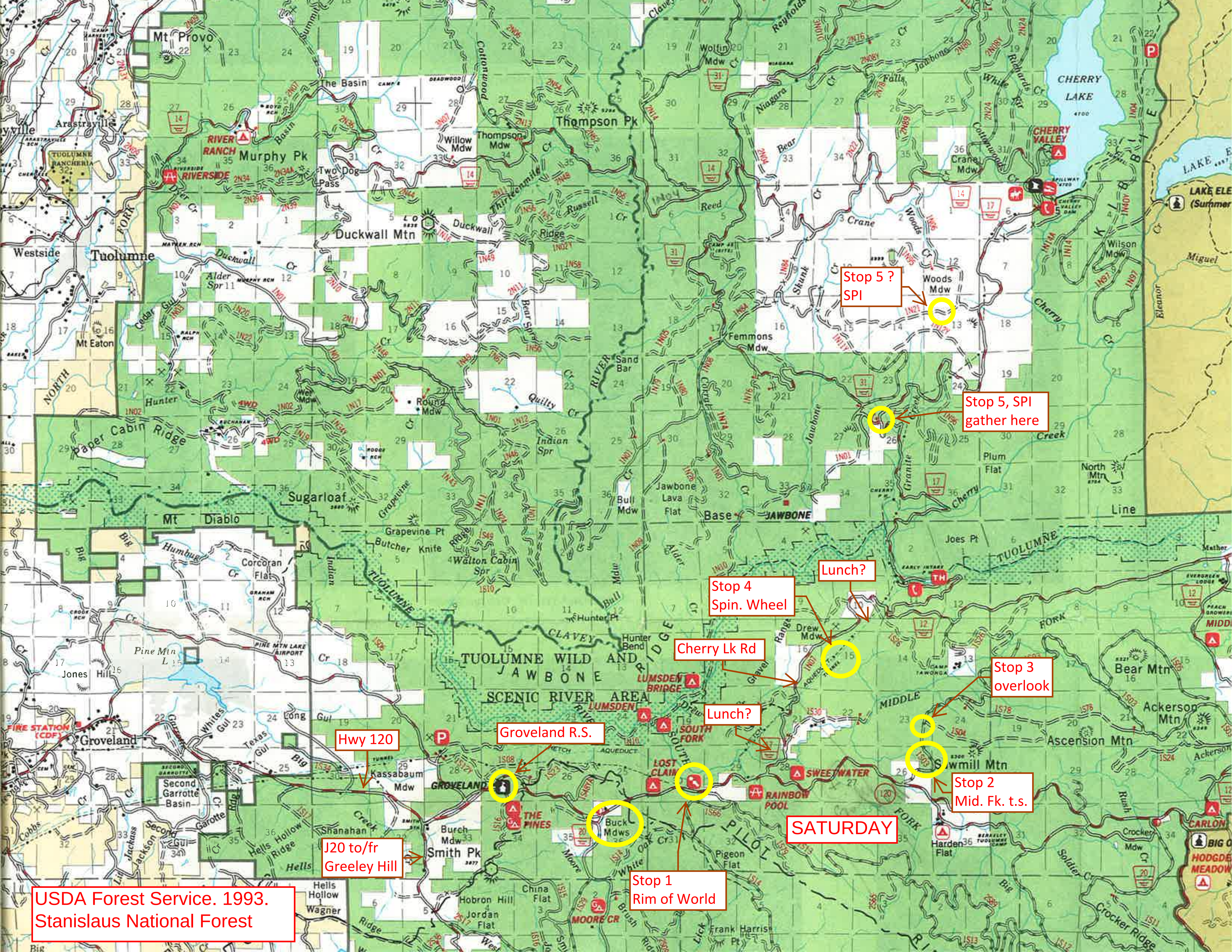
Elevation: ~ 5,000 ft.

Background: Rim Fire burned Aug. 2013. Salvage logged, contour tilled, planted.

Topics: Post-fire conditions, salvage logging, site preparation, tree planting

Discussion points: Again, what effects might soil parent materials have on forests, fire, and forest practices?


CFSC/PSSAC
June 26-27, 2015
FRIDAY
Hwy 108
Stop 1 overlook
Stop 2
Merrill Sp Rd
Stop 3
Cold Springs
Stop 4
Round Mdw
Stop 5 Stan.-
Tuol. Exp. For.
Strawberry
Beardsley Lake
Pinecrest Lake
Bald Mtn
Crandall Pk
Mt Knight
Long Barn
Sierra Village
Mi-Wuk Village
Twain Harte
Elizabeth Pk
Mt Lewis
Bourland Mtn
Hells Mtn
DRY MEADOW
DODGE RIDGE SKI AREA
EXPERIMENTAL FOREST



Stop 5 ?
SPI
Stop 5, SPI
gather here
Stop 4
Spin. Wheel
Lunch?
Cherry Lk Rd
Stop 3
overlook
Lunch?
Groveland R.S.
Hwy 120
Stop 2
Mid. Fk. t.s.
SATURDAY
J20 to/fr
Greeley Hill
Stop 1
Rim of World
USDA Forest Service. 1993.
Stanislaus National Forest

STANISLAUS NATIONAL FOREST OVERVIEW

GENERAL NATURE OF THE FOREST

Size and location: Approx. 1 million acres, on the west slopes of the Sierra Nevada in parts of Alpine, Calavaras, Mariposa, and Tuolumne counties.

Headquarters: (Forest Supervisor's Office) in Sonora. 4 ranger districts: Mi-Wok, Summit, Calavaras, Groveland.

Elevation range: approx. 1,100 ft. to >11,000 ft.

Major watersheds from north to south: Mokelumne, Stanislaus, Tuolumne, Merced. Rivers flow in a generally southwesterly direction to the Central Valley.

Watersheds in our field trip area: North Fork, Middle Fork, and South Fork Tuolumne. Pinecrest Lake is in the South Fork Stanislaus River drainage.

General geology and physiography: Sierra Nevada batholith and associated masses of volcanic rock, with glacial deposits and small amounts of alluvium in meadows and along water courses, as well as the western metamorphic belt (Mother Lode country) along the low elevation western margin. Generally broad to narrow westerly-sloping ridges separated by steep canyons.

Vegetation types: The overall forest supports a number of vegetation types ranging from chaparral and meadows of perennial and annual grasses to various forest types to alpine dwarf scrub. The bulk of our tour will take place in the mixed conifer-pine vegetative series (Parker and Matyas, 1979). Principal species include ponderosa pine and sugar pine with associated white fir, incense cedar, and occasional black oak and Douglas-fir. Dominant shrubs include manzanita and ceanothus.

SOILS HIGHLIGHTS

Soils of the Stanislaus NF area can be considered in three management groups, arranged by elevation and forest productivity. Most commercial timber production is between 3,000 and 7,000 ft. elev.

Below 3,500 ft.

Typical Mediterranean climate with mild, wet winters and hot, dry summers. Avg. ann. ppt. 30-45 in. Avg ann. temp. 47-65˚ F. South facing slopes: mostly thermic soils supporting chaparral, oak woodland, foothill pine, ponderosa pine. North facing slopes: more mesic soils supporting manzanita, ponderosa pine, mixed conifer-pine series.

Mostly low timber productivity. Site class 7 to 6, producing <50 ft^3/ac/yr. except Josephine, Sites, Holland, and Fiddletown soils, which may be site class 4 to 3, producing 85 to 165 ft^3/ac/yr.

Important forest soils by geologic parent material:

Metasedimentary: Josephine (now Jocal), Sites, Fiddletown

Granitic: Holland, Fiddletown

Management implications: This elevation zone supports little timber management, because of limited soil moisture. Highest elevation, northerly aspects, especially those with Josephine, Sites, Holland, and Fiddletown soils, are most productive, and may be available for early and late season logging. Soil compaction and puddling are concerns under wet conditions.

3,500 - 6,500 ft.

Cold, wet winters, mild summers. Ppt 40-55 in. with snow. South facing slopes: mostly mesic soils supporting manzanita, black oak, ponderosa pine, mixed conifer-pine series. North facing slopes: mesic and frigid soils supporting ponderosa pine, mixed conifer-pine, mixed conifer-fir, and lower elevation red fir.

Highest timber productivity. Site classes 4 to 2 are common, producing 85 to 225 ft^3/ac/yr. Lower classes (5 to 7) also are found. No site class 1 (>225 ft^3/ac/yr) mapped on the Forest.

Important forest soils by geologic parent material:

Metasedimentary: Josephine (now Jocal), Sites, Fiddletown

Granitic: Holland, Fiddletown, Gerle, Hugo,

Volcanic: McCarthy, Inville

Management implications: Many soils in this elevation zone support intensive timber management. Early and late season logging can compact and puddle soil causing decreased productivity. Intensive timber harvest activities can decrease long-term productivity if topsoil is removed or displaced. Moderate erosion hazard on slopes <30%, high to v. high on slopes >30% when cover removed. Severe erosion likely without protection.

6,500 - 9,500 ft

Cold, wet winters; mild to cool, short summers. Ppt. 50-70 in. mostly snow. Occasional summer thunderstorms. Frigid and cryic soils supporting mixed conifer-fir, red fir, Jeffrey pine, western juniper and mountain hemlock, lodgepole pine, aspen, black cottonwood in drainages.

Timber productivity is moderate (site classes 3 to 5) to high (site classes 2 and 3) at low elevation, low (site classes 6 and 7) at high elevation.

Important forest soils by geologic parent material:

Granitic: Gerle, Wintoner

Volcanic: Inville, Windy

Management implications: Intensive timber management at the lowest elevations. Moderately shallow soils are common at highest elevations; large openings become droughty, leading to tree regeneration problems. Snow melt can maintain cold soils into summer, delaying seed germination and root initiation.

MEADOWS

Soils of the meadows contrast dramatically to those of surrounding landscapes. Meadow soils are derived dominantly from alluvial deposits, with lesser amounts of eolian, colluvial, and glacial debris. They tend to be very deep, well stratified, and relatively free of rock fragments. They are rich in decayed organic matter and often have a high water table, which makes them fertile, dark colored, and often redoximorphic at depth. The depth of redox features reflects the depth to a seasonal water table. Wet meadows might or might not have gleyed soils at depth, depending on the water's temperature and flow rate. Soils having warmer, slow moving water have a much greater probability of being gleyed than do soils that have cold water moving through the system; the latter soils might exhibit oxyaquic conditions.

Whereas proper grazing can enhance forage productivity, improper grazing can greatly decrease it. The soils that are capable of producing the most forage—namely those in wet and moist meadows—also are the most easily damaged by heavy or poorly timed livestock use or other disturbances. These soils, which tend to be medium textured and often contain medium to fine volcanic ash, have high water holding capacity, but also are easily compacted and eroded. Once an erosion gully develops, the meadow's water table begins to drop, leading to decreased productivity and hydrologic function.

North Fork Tuolumne River Watershed: Historical Background

R.D. Taskey

Early indigenous people, primarily those of the Me-Wuk, Mono, and Washoe tribes, regularly traversed east and west across this part of the Sierra Nevada, probably taking advantage of easy passages provided by some of the geologic features that we will tread on today. For them—especially the youngsters—the most anticipated trip of the year might have been the first one in the spring, which found them trekking betwixt patchworks of remnant snow, the icy meltwater running fresh and free over their toes. In the fall, they might have celebrated the seasonal turn by lighting fires to thin the undergrowth and rejuvenate favored plants. Although the native people used frequent fire to manipulate low-to-mid elevation ecosystems, their ecological impact was minor compared with what was to come in the mid-19th century.

The first Euroamerican party to make a trans-Sierran passage through this region probably came in the early 1840s, and within a generation the displacement of indigenous cultures and customs was well underway. Within two decades the acorns and arrowheads that had been toted along a well-trod foot path had been supplanted by heavy loads of gold and goods hauled on the Sonora-Mono toll road. Foot travel quickly stepped aside for toll-paying stage coaches and freight wagons, and today we travel pretty much the same route when we drive along Hwy 108.

Before completion of its higher elevation stretches, the Sonora-Mono toll road began serving construction of an earthen dam at the site of present-day Pinecrest Lake (formerly Strawberry Lake), which was completed in 1856 to serve lower-elevation mining schemes (Tuolumne County Historical Society www.tchistory.org). Today's concrete dam, built in 1916, provides for regulated water flow to power a down-stream hydroelectric plant; thus, water that once had cooled the toes of migrating populations began generating electricity that warms the toes of urbanites.

During the 1850's, gold mining and the associated population boom in the western foothills and beyond induced timber mining in higher elevation lands. Harvesting accelerated to a frantic pace with the advent of steam-powered mills, locomotives, and donkeys. In the lumbering industry, logging railroads and black smoke quickly superseded wagon roads and horse manure. But decades would pass before forestry would begin to supplant timber mining.

Railroad logging expanded rapidly during the couple of years either side of 1900, with major operations by West Side Lumber Company and Standard Lumber Company, which established the Sugar Pine Railway, Strawberry Branch, to haul logs to the mills (Tuolumne County Historical Society www.tchistory.org). Lumber sawn from large, old-growth ponderosa pine, sugar pine, and red fir supplied residential and commercial demands as well as local and regional mining needs. Forests now were serving an industrializing society, but as yet little regard seems to have been given to future forest conditions and productivity, or for that matter to soil and water quality.

Lumber demand surged in 1906, when a massive earthquake and subsequent fires struck San Francisco in April of that year. The intense rebuilding effort stripped forests from up and down the Sierra Nevada as well as the Coast Range. Then, before San Francisco had been put back together, a 1908 contract between Standard and Fruit Growers sent more than 10 million board feet of wood to the Los Angeles area, where it went into orange crates and other types of produce boxes (Tuolumne County Historical Society www.tchistory.org). Thus, in only a half century Sierran forests had been transformed, and their uses had expanded and diversified so greatly that forest products had become more valued than the forests themselves. Countless children born in the era of seasonal migrations lived to see it all.

The harvested trees originated from privately owned lands and from huge tracts of the newly established national forests, including the Stanislaus Forest Reserve (est. 1897), part of which became the Stanislaus National Forest. (Parts of several national forests were created from the Stanislaus Forest Reserve.) Whether from private or public lands, tree removal, transport, and milling operations were carried out by private companies. Numerous small operators (known somewhat derogatorily in the trade as "gyppos") came and went over the decades, and the few large lumber companies changed hands and names several times during the 20th century.

In the 1920s, Standard Lumber Company (along with its Sugar Pine Railway) and West Side Lumber Company and its railway were taken over by Pickering Lumber Company. But with the 1930's economic depression, Pickering sold its interests in West Side back to the original owners. Pickering folded for a few years, until it was revived by the depression-era version of an "economic stimulus package." The company and its logging railroad continued to operate until 1965, when it was bought by Fiberboard, which three decades later filed bankruptcy and was taken over briefly by Louisiana Pacific (LP) in the early 1990s (Tuolumne County Historical Society www.tchistory.org). (Part of the company's former office in Standard—long known as a "company town" near Sonora—is now a restaurant and bar, called "Standard Pour.") Then, in 1995, LP sold its lands and mills to Sierra Pacific Industries (SPI), which operated until 2009, when the company briefly laid off its milling operations. Today, SPI maintains an active forestry program and continues to supply wood products from its operations in Standard.

Roughly a half-century after the 1910-era logging boom—beginning most notably in the late 1940s and at elevations below about 5,200 feet—wildfires (including the local Wrights Creek (1949) and Flora (1960) fires) swept through parts of the North Fork Tuolumne River watershed (interpreted from Goolsby, 2013). Following the fires, trees were salvage logged and sites were prepared to generate the next forest. As was common in those days, site preparation often included bulldozing slash and with it a few inches of topsoil—which contained seeds of undesirable vegetation (brush)—into windrows or piles, and exposing bare mineral soil for new tree seedlings. The intense activity compacted considerable soil, especially in the preferred growing areas between windrows. The goal was to establish a thriving new forest, but maintaining soil integrity was not a controlling criterion—as a result, the forests established under these severe conditions often fade more than they flourish. (Nearby evidence can be seen in the Wrights Creek watershed. See also Powers, 2002.)

In addition to producing trees, the Sierra of course provides scenic beauty, natural diversity, and water, each of which contributes to the area's increasing popularity for diverse uses, including outdoor recreation, homes, and commercial developments. The increasingly diverse population that accompanies urbanization generates new forest management issues and land-use controversies. Thus, the Sierra Nevada is well into its third era of human exploitation. By now, toes have trod on its soils in moccasins, logging boots, and jogging shoes. What next?

References

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Powers, Robert F. 2002. Effects of soil disturbance on the fundamental, sustainable productivity of managed forests. USDA Forest Service Gen. Tech. Rept. PSW-GTR 183: 63-82.

Some Geologic Background

R.D. Taskey

Geologic Time Scale				
Era	Period	Epoch	Mybp*	Selected Highlights**
Cenozoic	Quaternary (Q)	Holocene (Recent) Pleistocene (Ice Age)	0.01 1.65	Recent alluvium & landslides. Glaciation, till deposits.
	Tertiary (T)	Pliocene Miocene Oligocene Eocene Paleocene	5.3 24 34 55 65	Volcanism (e.g., Mehrten Fmn.)
Mesozoic	Cretaceous (K) Jurassic (J) Triassic (TR)		145 200 251	Sierra Nevada batholith (granitic rocks)
Paleozoic	Permian (P) Pennsylvanian (IP) Mississippian (M) Devonian (D) Silurian (S) Ordovician (O) Cambrian (Ɛ)		300 311 355 418 441 490 544	Sierra Nevada metamorphic rocks
Precambrian				

*Approximate age in millions of years before present (Mybp) when the epoch or period began (Plummer et al., 2007).
**Highlights are limited to rocks and features we most likely will see. They are neither exclusive nor all-inclusive. For example, although alluvium is listed under Holocene, much older (e.g., Eocene) alluvium is common in the Central Valley and parts of the western Sierra Nevada.

Current geologic thinking interprets the Sierra Nevada batholith to be the uplifted root of a long-gone volcanic arc that was active during the Triassic period. The batholith tilted westerly during uplift, resulting in an overall gentle dip to the west and a more precipitous elevational drop on the eastern flanks. Although the overall westerly dip is gentle, erosion has cut deep canyons having very steep side slopes.

The batholith consists of numerous (hundreds?) plutons of various ages and varying chemical and mineralogical composition. Commonly, these intrusive bodies are themselves intruded by dikes and other younger igneous rock masses of contrasting composition. The plutons also are broken by joints and fractures, and sometimes marked by contact metamorphism along their margins.

Along its western margin, the batholith is flanked by assemblages of Paleozoic metasedimentary and metavolvanic rocks, and is capped in places along the summit by scattered remnants of metamorphic roof pendants. The range further is dappled by numerous volcanic flows and lahars, mostly of Miocene age in this region.

From low elevation to high elevation, west to east, plutons exhibit a general trend of often older and more mafic rock to somewhat younger, more felsic rock. Although the correlation is by no means perfect, rock types grade from diorite and hornblende-tonalite (quartz diorite) to biotite-granodiorite to quartz monzonite and granite. The more mafic rocks, being richer in Ca-plagioclase and hornblende have a greater potential for chemical weathering than do the felsic rocks, which are richer in resistant quartz and orthoclase (Figure 1, Table 1); these latter rocks

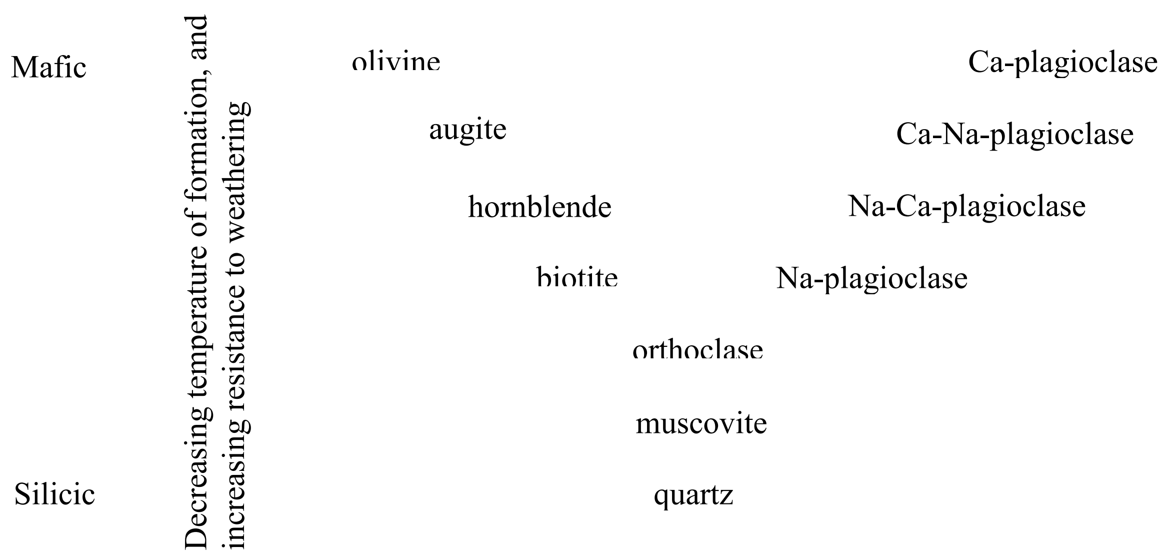


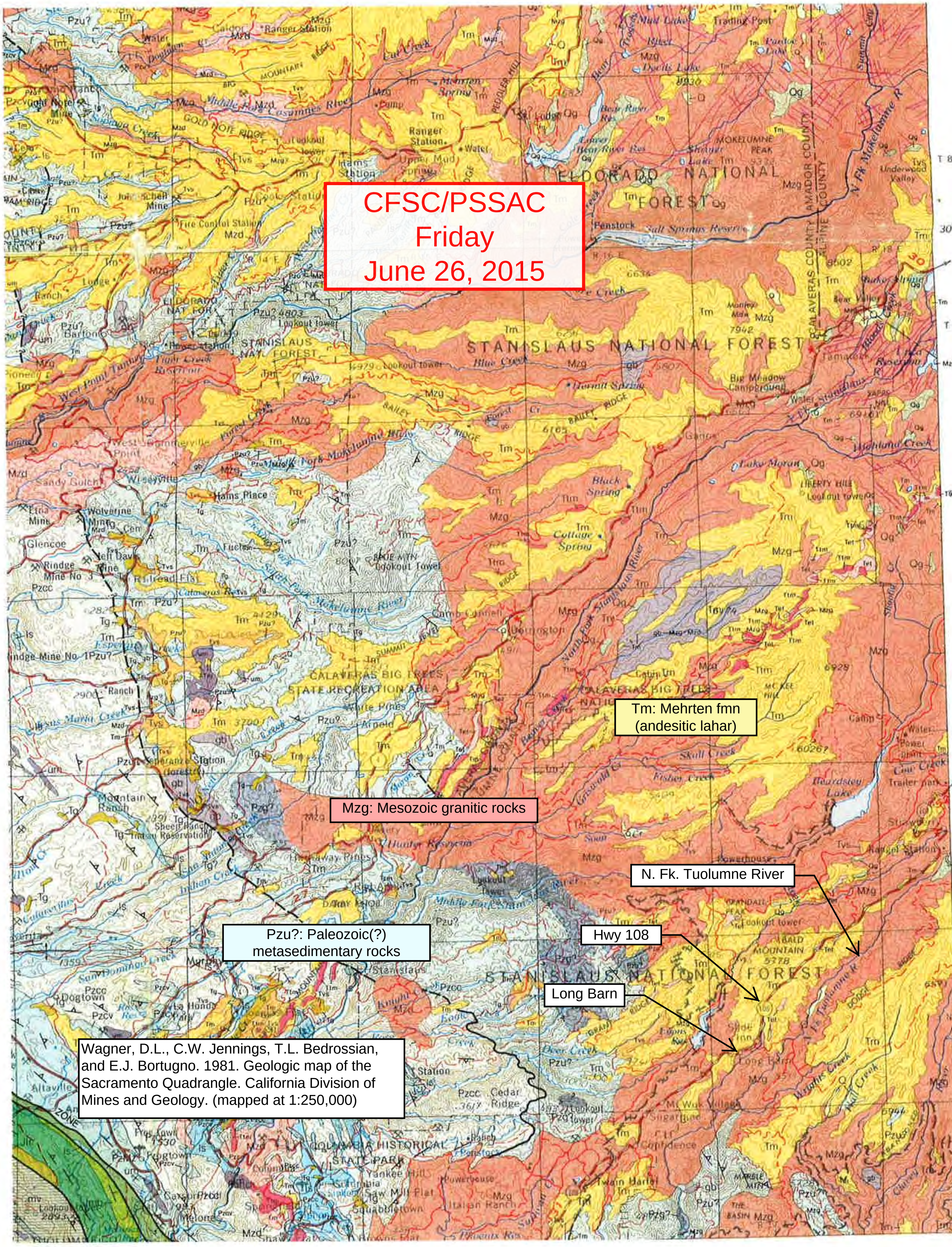
Figure 1. Bowen's Reaction Series and Goldich Weathering Sequence. Minerals along the left branch of the "Y" form a discontinuous sequence (each mineral is a distinct species), whereas minerals along the right branch form a continuous solid solution series of plagioclase, which has varying ratios of calcium to sodium.

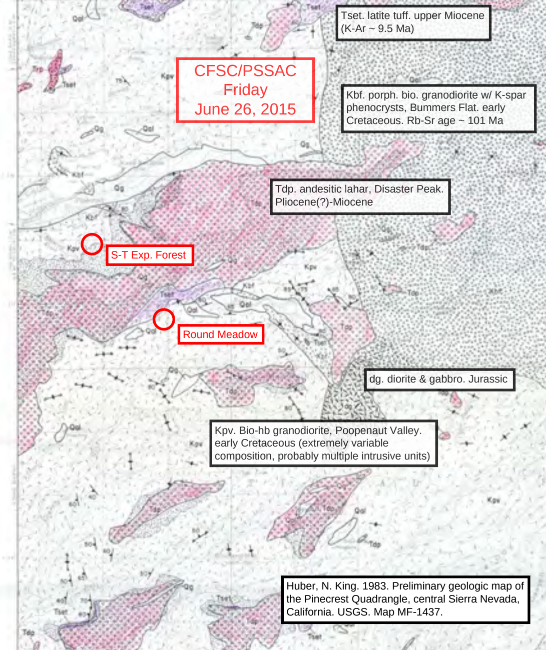
are the best grus formers.

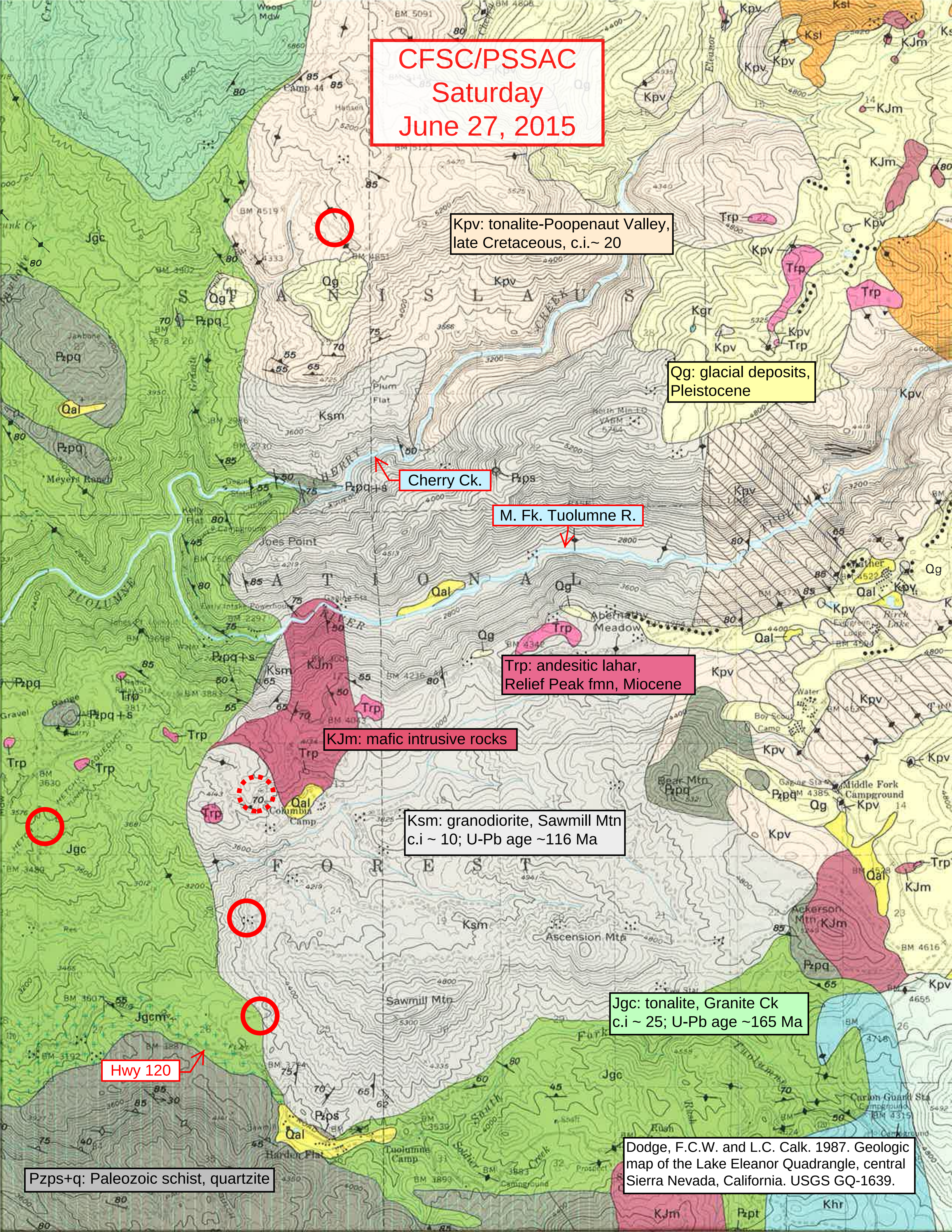
At low to mid elevations, pluton differences are highly significant in landscape evolution and pedogenesis, but at high elevations—above about 2,500 meters in this part of the Sierra—differences in rock chemistry and mineralogy appear to be of little importance in weathering and soil development. A possible explanation for this trend is that many soils at lower elevations appear to be polygenetic, having begun to form by rock weathering during the Eocene or earlier; while those at higher elevations show only one stage of development since being scraped clean by glaciation.

We hope to have considerable discussion on these topics during our tour!

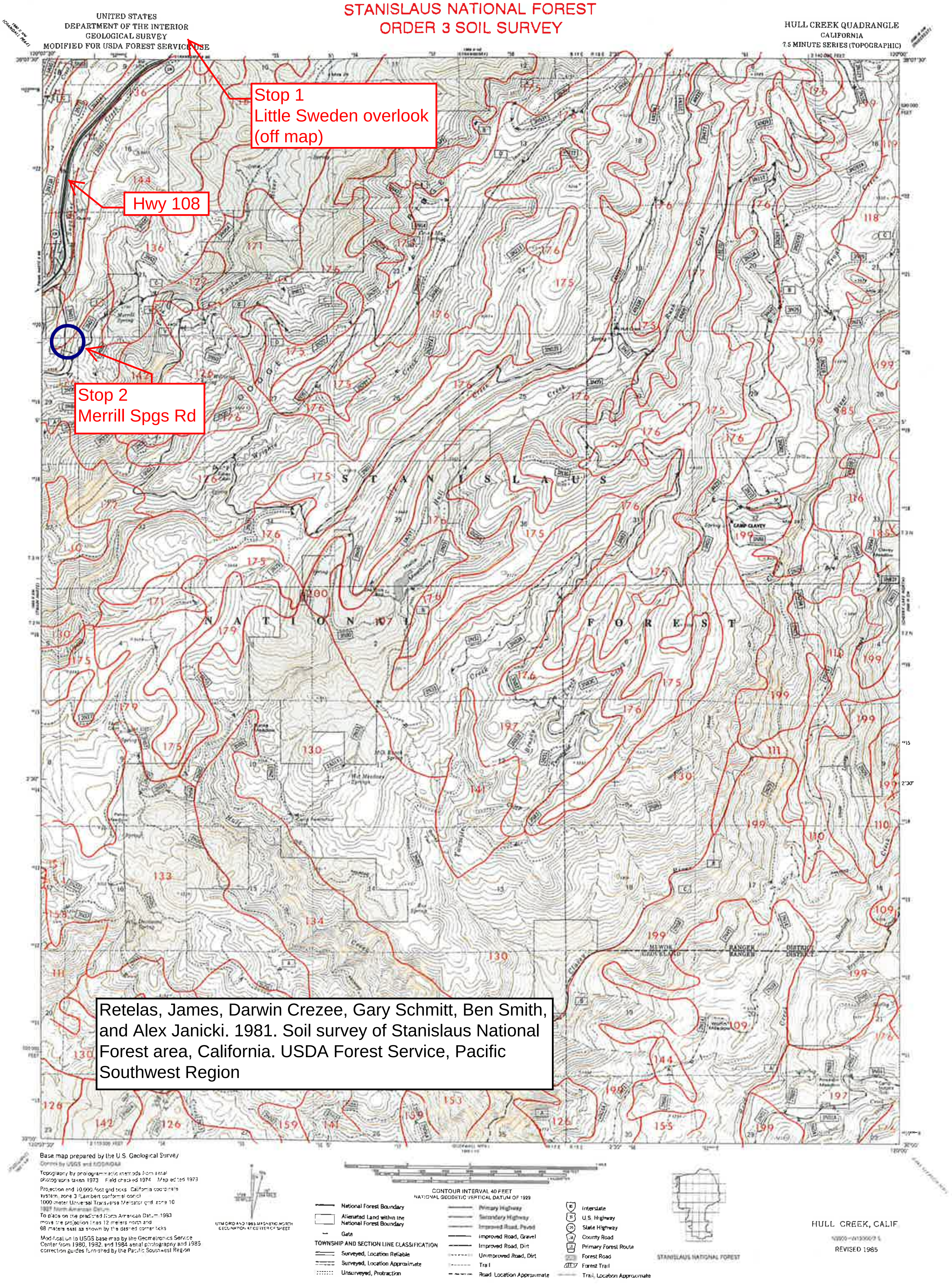
<table>
<tr><th colspan="9">Table 3.2-8. CLASSIFICATION OF IGNEOUS ROCKS</th></tr>
<tr><td colspan="2"></td><td colspan="7">Mineral Composition</td></tr>
<tr><td colspan="2" rowspan="4">Essential Minerals</td><td>K-spar > 2/3 total feldspar</td><td>K-spar 1/3– 2/3 total feldspar</td><td colspan="4">plagioclase > 2/3 total feldspar</td><td>feldspar absent</td></tr>
<tr><td rowspan="3">quartz > 10 %</td><td rowspan="3">quartz > 10 %</td><td rowspan="3">K-spar > 10 %
quartz > 10 %</td><td colspan="3">K-spar < 10 % total feldspar</td><td>pyroxene</td></tr>
<tr><td colspan="2">Na-plagioclase</td><td>Ca-plagioclase</td><td></td></tr>
<tr><td>quartz > 10 %</td><td colspan="2">quartz < 10 %</td><td></td></tr>
<tr><td colspan="2">Accessory Minerals</td><td>5-20 % mafics muscovite, biotite, ± hornblende</td><td>10-45 % mafics biotite, muscovite, ± hornblende</td><td>15-45 % mafics biotite, ± hornblende</td><td>20-45 % mafics hb, ± biotite</td><td>25-50 % mafics hb, ± biotite, ± augite</td><td>35-65 % mafics augite, ± olivine, ± hb</td><td>80-100 % mafics pyroxene</td></tr>
<tr><td rowspan="5">Rock Texture</td><td>phaneritic, equigranular</td><td>granite</td><td>quartz monzonite</td><td>granodiorite</td><td>quartz diorite</td><td>diorite</td><td>gabbro</td><td>peridotite</td></tr>
<tr><td>porphyritic, phaneritic groundmass</td><td>porphyritic granite</td><td>porphyritic quartz monzonite</td><td>porphyritic granodiorite</td><td>porphyritic quartz diorite</td><td>porphyritic diorite</td><td>porphyritic gabbro</td><td>porphyritic peridotite</td></tr>
<tr><td>porphyritic, aphanitic groundmass</td><td>porphyritic rhyolite</td><td>porphyritic quartz latite</td><td colspan="2">porphyritic dacite</td><td>porphyritic andesite</td><td>porphyritic basalt</td><td rowspan="3"></td></tr>
<tr><td>aphanitic</td><td>rhyolite</td><td>quartz latite</td><td colspan="2">dacite</td><td>andesite</td><td>basalt</td></tr>
<tr><td>glassy</td><td colspan="4">obsidian, pumice</td><td colspan="2">scoria</td></tr>
<tr><td colspan="9">adapted from Tennissen, Anthony C. 1983. Nature of earth materials. 2nd ed. Prentice-Hall, Inc.
Note: Feldspathoid-bearing rocks (e.g., syenite, trachyte, monzonite, latite) and a few others (e.g., dunite) have been omitted for simplification. Also, pyroclastic rocks (e.g., ignimbrite) are not included.</td></tr>
</table>


CFSC/PSSAC
Friday
June 26, 2015
Tm: Mehrten fmn
(andesitic lahar)
Mzg: Mesozoic granitic rocks
N. Fk. Tuolumne River
Hwy 108
Pzu?: Paleozoic(?)
metasedimentary rocks
Long Barn
Wagner, D.L., C.W. Jennings, T.L. Bedrossian, and E.J. Bortugno. 1981. Geologic map of the Sacramento Quadrangle. California Division of Mines and Geology. (mapped at 1:250,000)


CFSC/PSSAC
Friday
June 26, 2015
Tset. latite tuff. upper Miocene (K-Ar ~ 9.5 Ma)
Kbf. porph. bio. granodiorite w/ K-spar phenocrysts, Bummers Flat. early Cretaceous. Rb-Sr age ~ 101 Ma
Tdp. andesitic lahar, Disaster Peak. Pliocene(?)-Miocene
S-T Exp. Forest
Round Meadow
dg. diorite & gabbro. Jurassic
Kpv. Bio-hb granodiorite, Poopenaut Valley. early Cretaceous (extremely variable composition, probably multiple intrusive units)
Huber, N. King. 1983. Preliminary geologic map of the Pinecrest Quadrangle, central Sierra Nevada, California. USGS. Map MF-1437.


CFSC/PSSAC
Saturday
June 27, 2015
Kpv: tonalite-Poopenaut Valley, late Cretaceous, c.i.~ 20
Qg: glacial deposits, Pleistocene
Cherry Ck.
M. Fk. Tuolumne R.
Trp: andesitic lahar, Relief Peak fmn, Miocene
KJm: mafic intrusive rocks
Ksm: granodiorite, Sawmill Mtn c.i ~ 10; U-Pb age ~116 Ma
Jgc: tonalite, Granite Ck c.i ~ 25; U-Pb age ~165 Ma
Hwy 120
Pzps+q: Paleozoic schist, quartzite
Dodge, F.C.W. and L.C. Calk. 1987. Geologic map of the Lake Eleanor Quadrangle, central Sierra Nevada, California. USGS GQ-1639.

STANISLAUS NATIONAL FOREST
ORDER 3 SOIL SURVEY

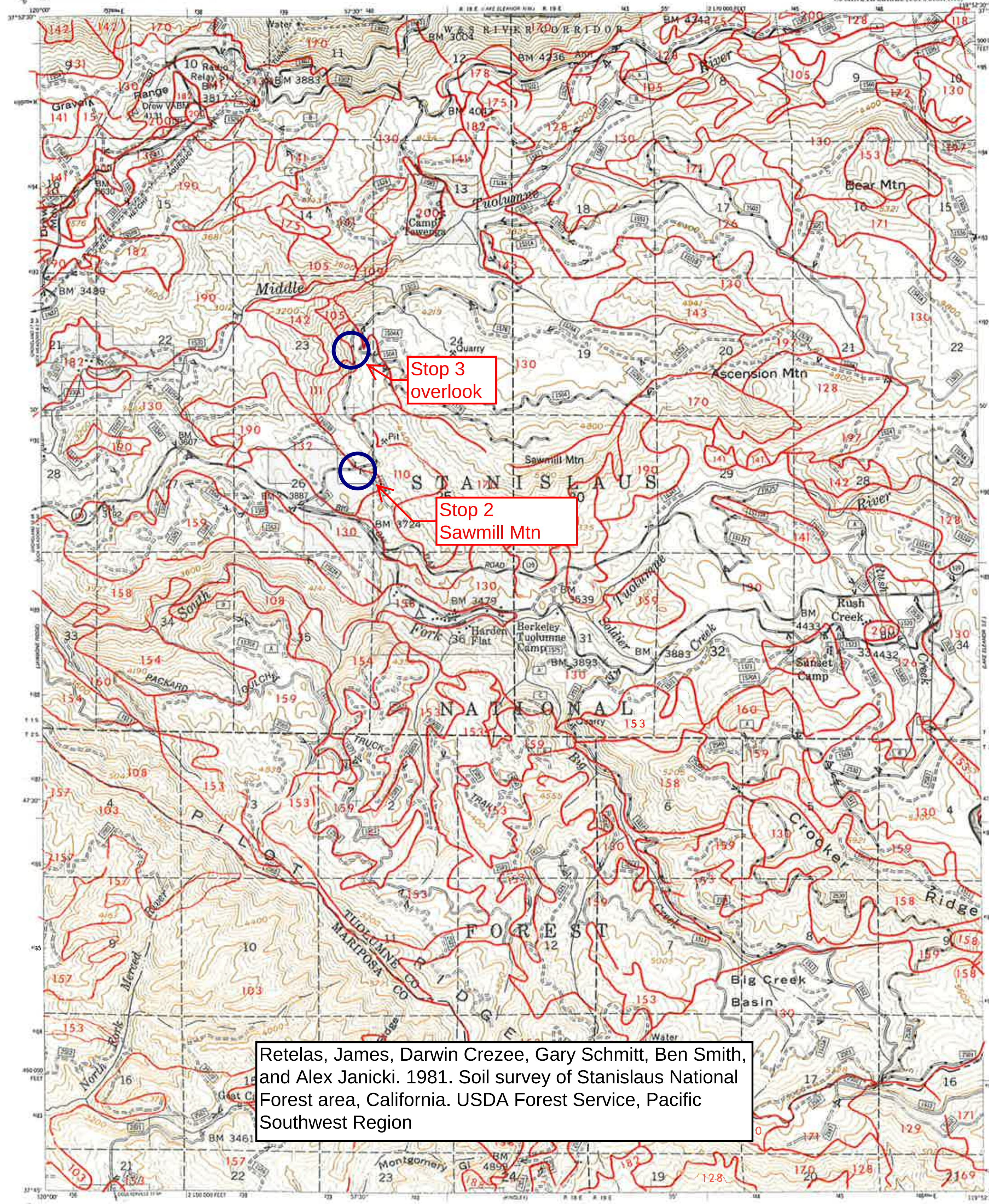


474-4

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE

STANISLAUS NATIONAL FOREST
ORDER 3 SOIL SURVEY

LAKE ELEANOR SW QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



Retelas, James, Darwin Crezee, Gary Schmitt, Ben Smith, and Alex Janicki. 1981. Soil survey of Stanislaus National Forest area, California. USDA Forest Service, Pacific Southwest Region

Base map prepared by the U.S. Geological Survey
Control by USGS and USC&GS
Topography from aerial photographs by photogrammetric methods
Aerial photographs taken 1955. Advance field check 1956
Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 3
1000-meter Universal Transverse Mercator grid ticks, zone 11, shown in blue
Modification to USGS base map by the Geometronics Service Center from 1980, 1982, and 1984 aerial photography and 1985 correction guides furnished by the Pacific Southwest Region
Landnet revised according to additional Forest Service evidence
INTERIM EDITION

CONTOUR INTERVAL 80 FEET
DATUM IS MEAN SEA LEVEL

National Forest Boundary
Alienated Land within the National Forest Boundary
Gate
TOWNSHIP AND SECTION LINE CLASSIFICATION
Surveyed, Location Reliable
Surveyed, Location Approximate
Unsurveyed, Protraction

Primary Highway
Secondary Highway
Improved Road, Paved
Improved Road, Gravel
Improved Road, Dirt
Unimproved Road, Dirt
Trail
Road, Location Approximate

Interstate
U.S. Highway
State Highway
County Road
Primary Forest Route
Forest Road
Forest Trail
Trail, Location Approximate

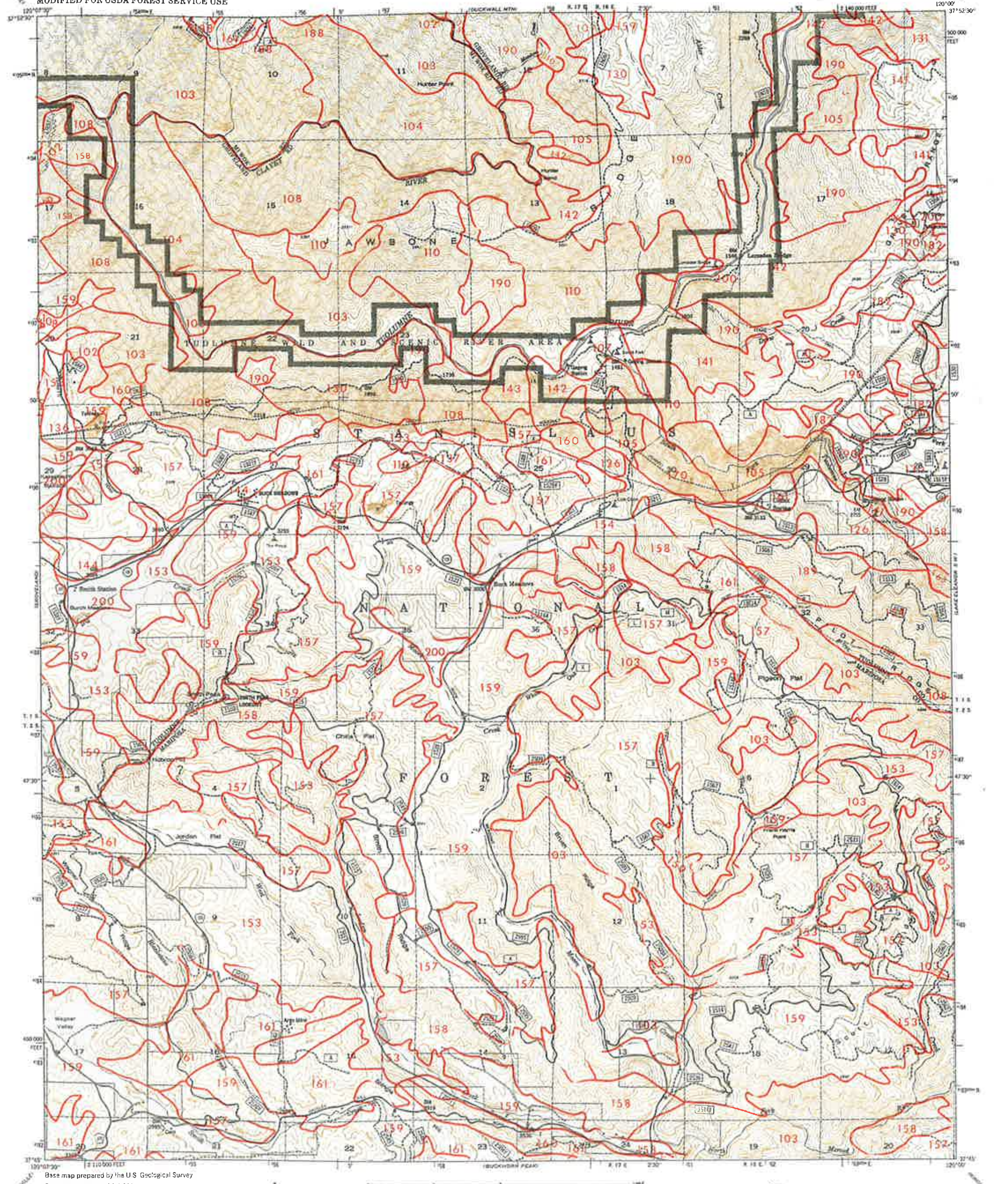
STANISLAUS NATIONAL FOREST

LAKE ELEANOR SW, CALIF
N3745-W11952.5/7.5
1956
REVISED 1985

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
MODIFIED FOR USDA FOREST SERVICE USE

STANISLAUS NATIONAL FOREST
ORDER 3 SOIL SURVEY

JAWBONE RIDGE QUADRANGLE
CALIFORNIA
7.5 MINUTE SERIES (TOPOGRAPHIC)



Base map prepared by the U.S. Geological Survey

Control by USGS and NOS/NOAA

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1945. Field check 1947

Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 3
1000 meter Universal Transverse Mercator grid ticks,
zone 10, shown in blue

Modification to USGS base map by the Geometronics Service Center from 1980, 1982, and 1984 aerial photography and 1985 correction guides furnished by the Pacific Southwest Region

CONTOUR INTERVAL 50 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

- National Forest Boundary
- Alienated Land within the National Forest Boundary
- Gate

TOWNSHIP AND SECTION LINE CLASSIFICATION

- Surveyed, Location Reliable
- Surveyed, Location Approximate
- Unsurveyed, Protraction
- Primary Highway
- Secondary Highway
- Improved Road, Paved
- Improved Road, Gravel
- Improved Road, Dirt
- Unimproved Road, Dirt
- Trail
- Road, Location Approximate
- Interstate
- U.S. Highway
- State Highway
- County Road
- Primary Forest Route
- Forest Road
- Forest Trail
- Trail, Location Approximate

STANISLAUS NATIONAL FOREST

JAWBONE RIDGE, CALIF.
N3745—W12000/7.5
1947
REVISED 1985

457-4

R. Taskey

United States
Department of
Agriculture

Forest Service

Pacific
Southwest
Region

In cooperation with:

U.S.D.A. Soil
Conservation Service

Regents of the
University of California
(Agricultural Experiment
Station)

Soil Survey

Stanislaus National Forest Area California

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183 Rock outcrop 99
184 Rock outcrop - Entic Cryumbrepts complex, 10 to 50 percent slopes 100
185 Rock outcrop - Fiddletown family, moderately deep complex, 35 to 70 percent slopes 101
186 Rock outcrop - Gerle family, bouldery complex, 5 to 35 percent slopes 102
187 Rock outcrop - Gerle family, bouldery complex, 35 to 50 percent slopes 103
188 Sites family, deep, 5 to 35 percent slopes 104
189 Sites family, moderately deep - deep complex, 5 to 35 percent slopes 105
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192 Wilder - Ovall families complex, 35 to 50 percent slopes 108
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195 Windy family, moderately deep - deep complex, 5 to 35 percent slopes 111
196 Windy family, moderately deep - deep complex, 35 to 60 percent slopes 112
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JOSEPHINE FAMILY

The soils of the Josephine family are moderately deep to very deep and formed in material weathered from metasedimentary rock. These soils are on mountainsides and rolling hills. Slope is 5 to 80 percent. Elevation is 2000 to 5000 feet and the annual precipitation is 30 to 55 inches.

Taxonomic Class: Fine-loamy, mixed, mesic Typic Haploxerults.

Reference Pedon: The representative profile for this soil is on a northeast facing mountainside under mixed conifers and hardwoods at an elevation of 3800 feet. Slope is 40 percent. (Colors are for dry soil unless otherwise noted).

A– 0 to 7 inches; brown (7.5YR 5/4) gravelly loam, dark reddish brown (5YR 3/4) moist; strong fine granular structure; soft, friable; many fine roots; many very fine pores; 15 percent pebbles; slightly acid (pH 6.5); clear smooth boundary.

BAt1– 7 to 14 inches; yellowish red (5YR 5/6) gravelly loam, yellowish red (5YR 4/6) moist; moderate fine granular structure; soft, friable, slightly sticky and slightly plastic; many fine roots; many very fine pores; few thin clay films; 20 percent pebbles; slightly acid (pH 6.5); clear smooth boundary.

BAt2– 14 to 22 inches; yellowish red (5YR 5/6) gravelly clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; few fine and coarse roots; many very fine pores; few thin clay films; 20 percent pebbles; slightly acid (pH 6.3); gradual smooth boundary.

Bt1– 22 to 31 inches; yellowish red (5YR 5/6) clay loam, yellowish red (5YR 4/6) moist; moderate fine subangular blocky structure; slightly hard, friable, sticky and plastic; few roots, many very fine pores; common thin clay films; moderately acid (pH 6.0); gradual smooth boundary.

Bt2– 31 to 41 inches; yellowish red (5YR 4/6) clay loam, moderate fine subangular blocky structure; slightly hard, friable sticky and plastic; very few roots; many very fine pores; many thin clay films; moderately acid (pH 5.7), clear smooth boundary.

Bt3– 41 to 65 inches; yellowish red (5YR 4/6) cobbly clay loam; weak fine subangular blocky structure; hard, friable, sticky and plastic; very few medium roots; very fine pores; moderately thick clay films; 20 percent cobbles; strongly acid (pH 5.5); clear wavy boundary.

R– 65 inches; fractured metasedimentary bedrock with soil material in the cracks.

Location: About 1/2 mile south from Forest Service Road #1N01 toward Gravevine Creek, along the access road and about 200 feet south (uphill) of the road. In the center of NW/14 of Section 29, T.1N., R.17E. Tuolumne Quadrangle (457-2C).

Range in Characteristics: Depth to a lithic or paralithic contact is 20 to over 60 inches. The mean annual soil temperature at 20 inches is 47 to 59°F. The soil moisture control section is estimated to be dry in all parts from mid July to mid October and moist in some or all parts the rest of the year. The profile contains 10 to 30 percent rock fragments.

The A horizon dry color is 10YR 5/4, 4/4, 7.5YR 5/4, 5/2, 4/6, 5YR 6/4, 6/3, or 5/3; moist color is 10YR 4/2, 3/3, 7.5YR, 4/4, 4/2, 3/2, 5YR 4/4, 4/3, or 3/4. It is fine sandy loam or loam. Reaction is moderately to slightly acid (pH 5.6 to 6.5).

The Bt horizon dry color is 7.5 YR 5/6, 5/4, 4/6, 5YR 6/6, 5/6, 5/4 or 4/6; moist color is 7.5YR 5/2, 4/4, 4/2, 5YR, 5/4, or 4/6. It is loam, sandy clay loam or clay loam. Reaction is strongly to moderately acid (pH 5.1 to 6.0).

Remarks: This taxonomic unit consists of a moderately deep phase (20 to 40 inches to weathered bedrock) and a deep to very deep phase (greater than 40 inches).

The soils of the Holland family are moderately deep to very deep and formed in material weathered from granitic or volcanic rocks. These soils are on mountainsides. Slope is 5 to 60 percent. Elevation is 2000 to 7000 feet and the annual precipitation is 30 to 60 inches.

Taxonomic Class: Fine-loamy, mixed, mesic Ultic Haploxeralfs.

Reference Pedon: The representative profile for this soil is on a mountainside under mixed conifer at an elevation of 5000 feet. Slope is 30 percent. (Colors are for dry soil unless otherwise noted).

Oi– 2 inches to 0; weakly to moderately matted needles and duff.

A– 0 to 3 inches; light brown (7.5YR 6/4) loam, dark reddish brown (5YR 2/2) moist; moderate fine granular structure; soft, friable, slightly sticky, slightly plastic; moderately acid (pH 6.0); abrupt smooth boundary.

BAt– 3 to 17 inches; reddish yellow (7.5YR 6/6) clay loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, friable, sticky, plastic; common moderately thick clay films on ped faces; slightly acid (pH 6.5); gradual wavy boundary.

Bt1– 17 to 31 inches; reddish yellow (7.5YR 7/6) clay loam, light yellowish brown (10YR 6/4) moist; moderate medium subangular blocky structure; hard, firm, very sticky, plastic; many thick clay films on ped faces; moderately acid (pH 6.0), gradual wavy boundary.

Bt2– 31 to 60 inches; brownish yellow (10YR 6/6) clay loam, reddish yellow (7.5YR 6/6) moist; moderate medium subangular blocky structure; hard, firm, sticky, plastic; many thick clay films on ped faces; strongly acid (pH 5.5).

Location: About 200 feet from the junction of Forest Service Roads 2N11 and 3N07 in the west cutbank (vicinity of Willow Meadow) SW1/4SE1/4 of Section 28, T.2N., R.17E. Duckwall Mountain Quadrangle (457-1C).

Range of Characteristics: Depth to a lithic or paralithic contact is 20 to over 60 inches. The mean annual soil temperature at 20 inches is 47 to 59°F. The soil moisture control section is estimated to be dry in all parts from mid July to mid October and moist in some or all parts of the rest of the year. Reaction is strongly to slightly acid. Rock fragment content is 0 to 20 percent.

The A horizon dry color is 10YR 6/4, 6/3, 5/3, 7.5YR 6/4, 5/4, 5/2, 5YR 6/4, 6/3, 5/4 or 5/3; moist color is 10YR 5/3, 4/3, 3/3, 7.5YR 4/4, 4/2, 3/4, 3/3, 3/2, 2/2, 5YR 4/3, 4/2, 3/3 or 2/2. It is fine sandy loam or loam.

The Bt horizon dry color is 10YR 7/6, 6/8, 6/6, 6/4, 5/8, 5/6, 7.5YR 8/6, 7/8, 7/6, 7/8, 6/6, 6/4, 5/8, 5/6, 5YR 6/8, 6/6, 6/4, 2.5YR 5/8 or 5/6; moist color is 10YR 5/6, 5/4, 6/4, 7.5YR 6/6, 5/6, 5/4, 4/4, 4/2, 5YR 5/4, 5/3, 4/4, 4/3, 2.5YR 4/6 or 4/4. It is sandy clay loam or clay loam.

Remarks: Several phases exist for this family. The moderately deep phases are 20 to 40 inches to weathered bedrock. The dark surface phases are formed in residuum weathered from volcanic rocks and have darker surface colors than the soils formed over granitc rocks. The sandy subsoil phase has a weak argillic horizon which is sandy clay loam; it is very deep.

McCARTHY FAMILY

The soils of the McCarthy family are moderately deep to deep and formed in material weathered from andesitic tuff breccia and similar volcanic rocks. These soils are on rounded ridges and mountainsides. Slope is 5 to 60 percent. Elevation is 3000 to 7000 feet and the annual precipitation is 35 to 60 inches.

Taxonomic Class: Medial-skeletal, mesic Andic Xerumbrepts.

Reference Pedon: The representative profile for this soil is under Mixed Conifer - Fir at an elevation of 5,600 feet. Slope is 30 percent. (Colors are for dry soil unless otherwise noted).

A– 0 to 11 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 3/3) moist; weak very fine granular structure; soft, very friable; many fine and medium roots; 15 percent pebbles and cobbles; slightly acid (pH 6.5); clear smooth boundary.

Bw1– 11 to 28 inches; brown (7.5YR 5/4) very cobbly sandy loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky; many fine roots; 35 percent pebbles and cobbles; slightly acid (pH 6.5); gradual wavy boundary.

Bw2– 28 to 50 inches; light brown (7.5YR 6/4) very cobbly sandy loam, dark brown (7.5YR 4/4) moist; weak fine and medium subangular blocky structure; soft, very friable, slightly sticky, common fine roots; 50 percent pebbles and cobbles; moderately acid (pH 6.0).

R– 50 inches; fractured, slightly weathered andesitic tuff.

Location: Along Forest road 3N10, about 3/4 mile east of junction with road 3N01, on the northwest cutbank. In the NE1/4NW1/4 of Section 32, T.3N., R.18E. Hull Creek Quadrangle (474-4C).

Range of Characteristics: Depth to a lithic or paralithic contact is 20 to 60 or more inches. The mean annual soil temperature at 20 inches is 47 to 59°F. The soil moisture control section is estimated to be dry in all parts from mid July to mid October and moist in some or all parts of the rest of the year. Rock fragment content is 35 to 60 percent. Reaction is strongly to slightly acid (pH 5.1 to 6.5).

The A horizon dry color is 10YR 5/3, 5/2, 4/3, 7.5YR 5/4, 5/2, or 4/4; moist color is 10YR 3/3, 2/2, 7.5YR 3/3, 3/2 or 2/2. It is sandy loam, fine sandy loam, or loam.

The Bw horizon dry color is 10YR 5/3, 5/2, 4/3, 7.5YR 6/4, 5/4, 5/3, or 5/2; moist color is 10YR 4/4, 4/2, 3/3, 3/2, 7.5YR 4/4, 4/3, or 4/2. It is sandy loam or loam.

Remarks: This family consists of two phases, one moderately deep (20 to 40 inches) and the other greater than 40 inches to a paralithic or lithic contact.

Figure 8-1. Soil clay (all horizons, no meadows) related to elevation, YNP.

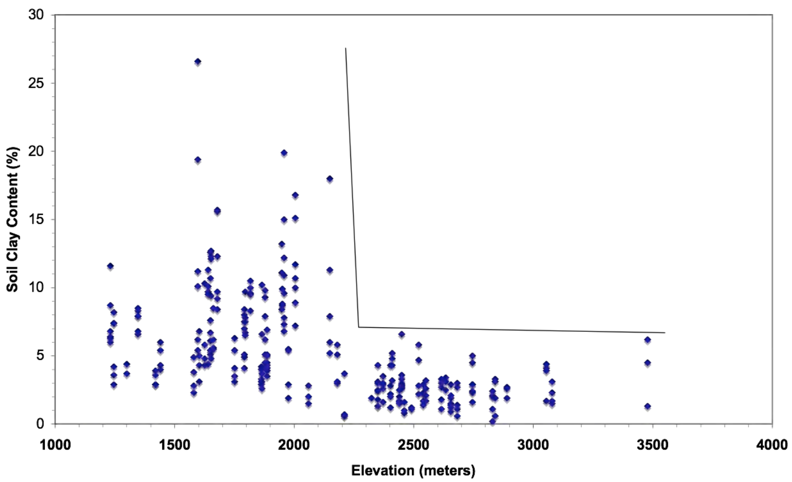


Figure 8-2. Soil carbon (all horizons, no meadows) related to elevation, YNP.

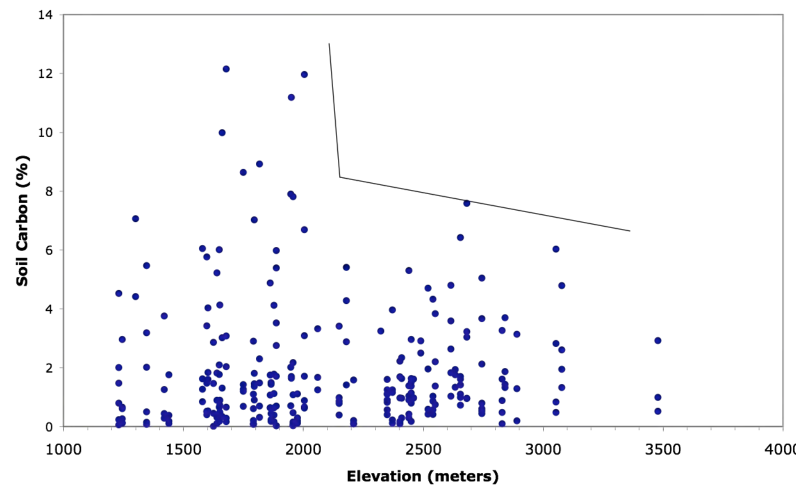


Figure 8-3. Soil pH (all horizons, no meadows) related to elevation, YNP.

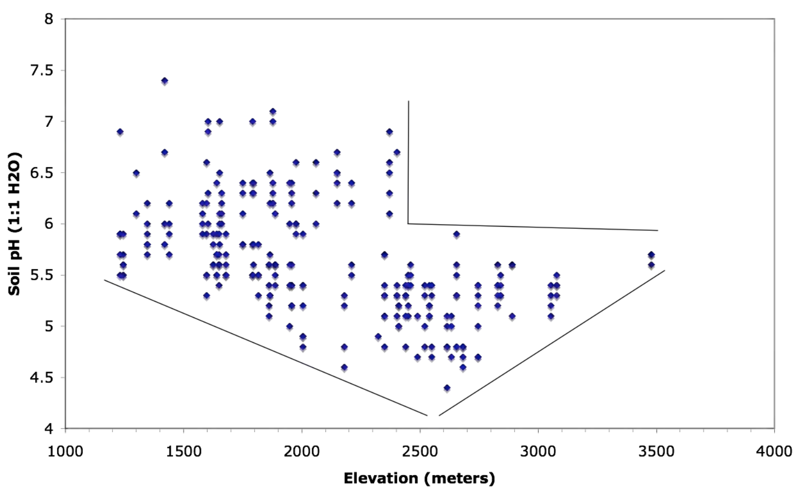


Figure 8-4. Ca (NH4Oac) (all horizons, no meadows) related to elevation, YNP.

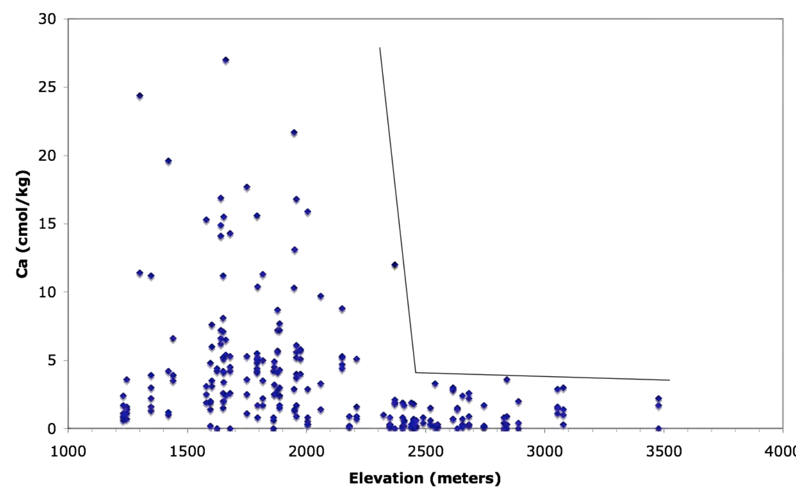


Figure 8-5. Soil base saturation (all horizons, no meadows) related to elevation, YNP

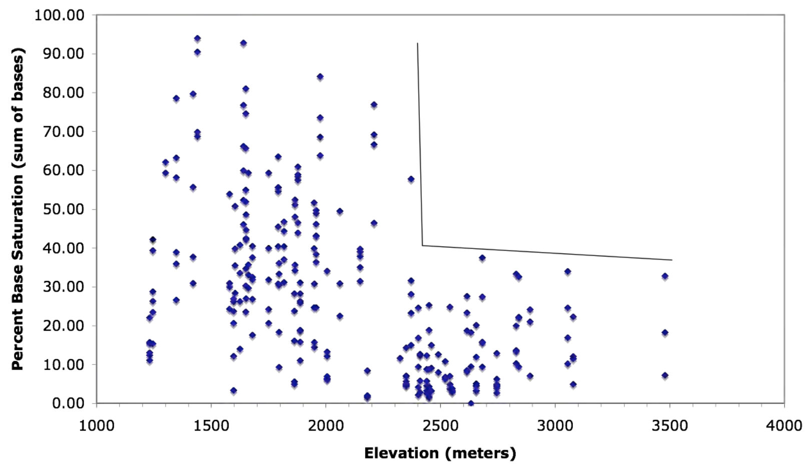


Figure 8-6. Soil CEC (all samples) related to percent carbon, YNP.

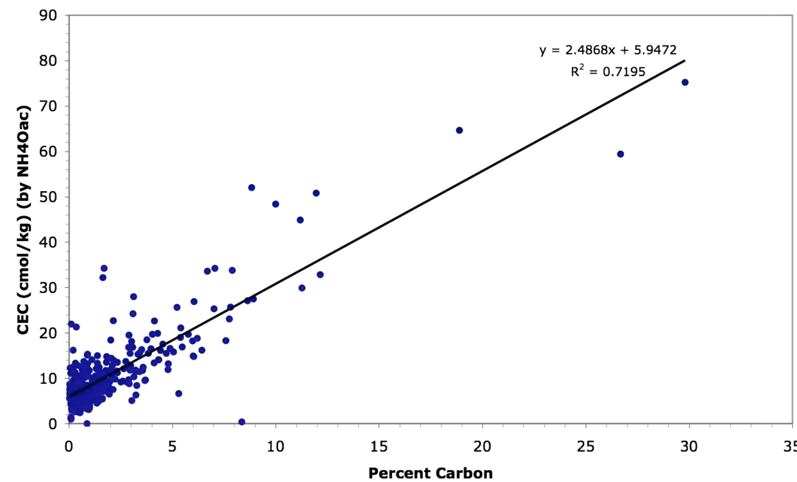


Figure 8-7. CEC (all horizons, w/ meadows) related to clay content, YNP.

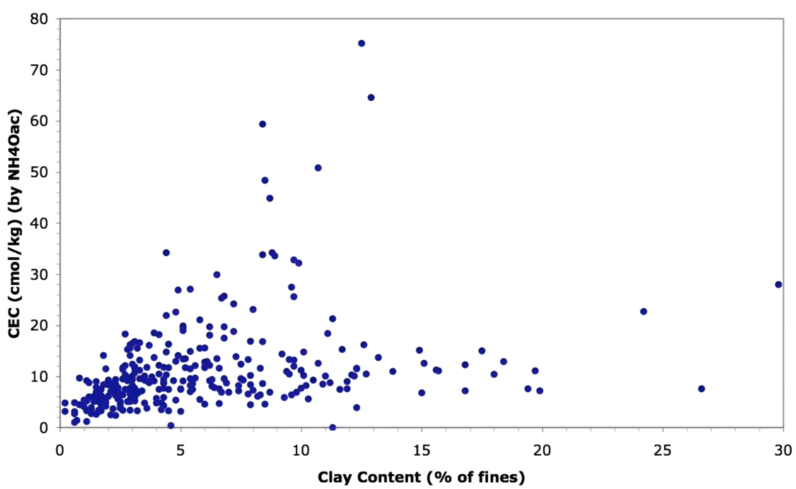
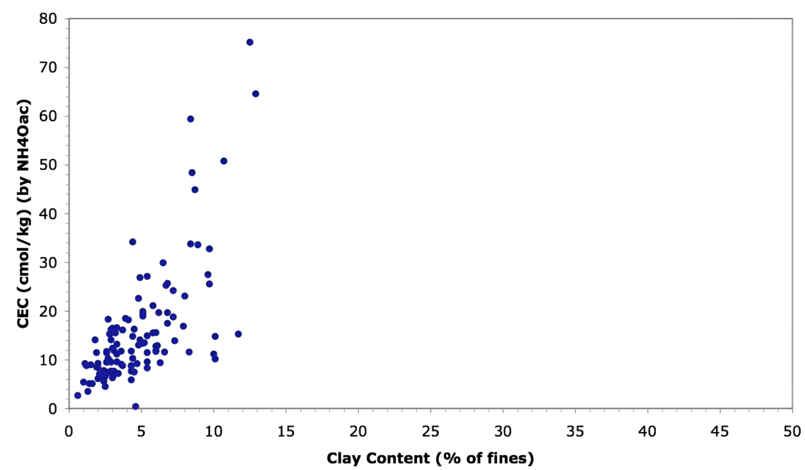


Figure 8-8. CEC (A horizons only, incl. meadows) related to soil clay content, YNP.



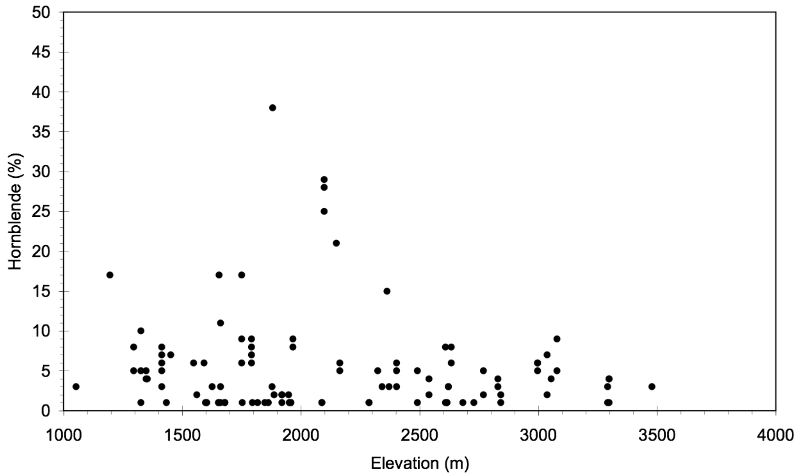


Figure 8-9. Hornblende by Sand Count vs. Elevation, YNP

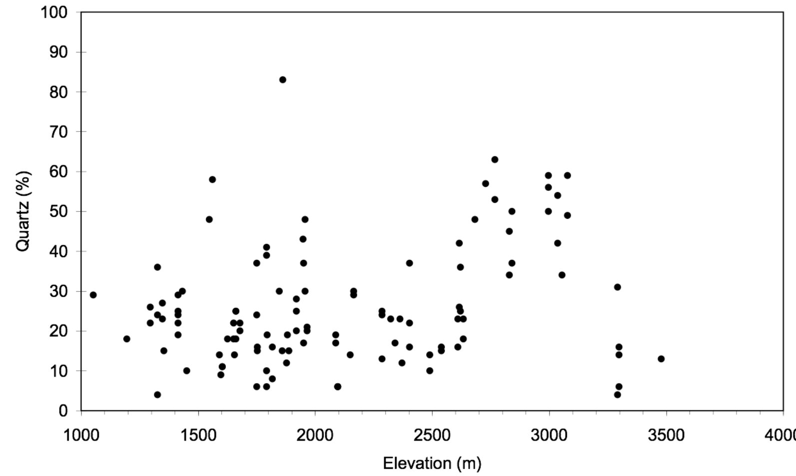


Figure 8-10. Quartz by Sand Count vs. Elevation, YNP

Chemical Data for Soil Grab Samples

collected in preparation for CFSC/PSSAC 2015

Saturday stops

followed by data from Soil Survey of Yosemite National Park

Table 1. pH values and carbon (C) and nitrogen (N) contents of several Stanislaus National Forest, CA soils. Soil pH was determined in a 1:2 soil:solution ratio and percent total carbon and percent total nitrogen were determined by combustion in a CN Autoanalyzer (Elementar). All values are means of 2 or 3 duplicates. (Data compliments of Dr. Chip Appel and Cal Poly students, June 2015. Samples collected by R.D. Taskey in Feb & Mar 2015. These are GRAB samples; interpret accordingly!)

Soil + horizon/depth	$pH_{DI\ H2O}$	$pH_{0.01\ M\ CaCl2}$	% Total Carbon	% Total Nitrogen	C/N
Sawmill Felsic A horiz.	6.42	5.95	2.73	0.12	22.8
Sawmill Felsic C horiz.	5.84	n/a	0.24	0.01	24.0
Sawmill Mafic 0-6 in.	6.29	5.48	1.63	0.08	20.4
Sawmill Mafic 23-34 in.	5.85	n/a	0.25	0.02	12.5
Camp Towanga 0-8 in.	6.45	6.33	4.75	0.22	21.6
Camp Towanga 8-14 in.	6.20	n/a	1.38	0.07	19.7
Spinning Wheel A horiz.	5.55	5.99	3.29	0.18	18.3
Spinning Wheel Bt exposed	5.34	n/a	0.34	0.03	11.3

Table 2. Exchangeable cations, CEC, and Total Acidity determination of several Stanislaus National Forest, CA soils. Exchangeable calcium (Ca^{2+}), magnesium (Mg^{2+}), potassium (K^+), and sodium (Na^+) were determined by neutral 1 *M* ammonium acetate extraction. Exchangeable hydrogen (H^+) and aluminum (Al^{3+}) were determined by 1 *M* potassium chloride extraction. All values are means of 2 or 3 duplicates. (Data compliments of Dr. Chip Appel and Cal Poly students, June 2015. Samples collected by R.D. Taskey in Feb & Mar 2015. These are GRAB samples; interpret accordingly!)

Soil + horizon/depth	Ca^{2+}	Mg^{2+}	Ca/Mg	K^+	Na^+	H^+	Al^{3+}	ECEC†	Total Acidity‡
	---------- cmol$_c$/kg ----------								
Sawmill Felsic A horiz.	5.75	0.70	8.21	0.73	< MDL§	0.08	n/f¶	7.27	15.31
Sawmill Felsic C horiz.	1.77	0.49	3.61	0.56	< MDL	0.48	n/f	3.29	4.00
Sawmill Mafic 0-6 in.	3.23	0.52	6.21	0.59	< MDL	0.30	n/f	4.65	18.69
Sawmill Mafic 23-34 in.	4.38	1.67	2.62	0.25	< MDL	0.13	n/f	6.43	9.32
Camp Towanga 0-8 in.	15.70	1.22	12.87	0.41	< MDL	0.33	n/f	17.66	15.67
Camp Towanga 8-14 in.	3.42	0.89	3.84	0.67	< MDL	0.58	n/f	5.56	14.43
Spinning Wheel A horiz.	8.60	0.56	15.38	0.51	< MDL	0.10	n/f	9.77	15.81
Spinning Wheel Bt exposed	4.28	3.97	1.08	0.18	< MDL	0.43	n/f	8.86	12.46

†Effective CEC = sum of exchangeable Ca^{2+}, Mg^{2+}, K^+, Na^+, H^+, and Al^{3+}.
‡Determined by $BaCl_2$-
§MDL = method detection limit and for Na^+ = 0.16 cmol$_c$/kg.
¶None found.

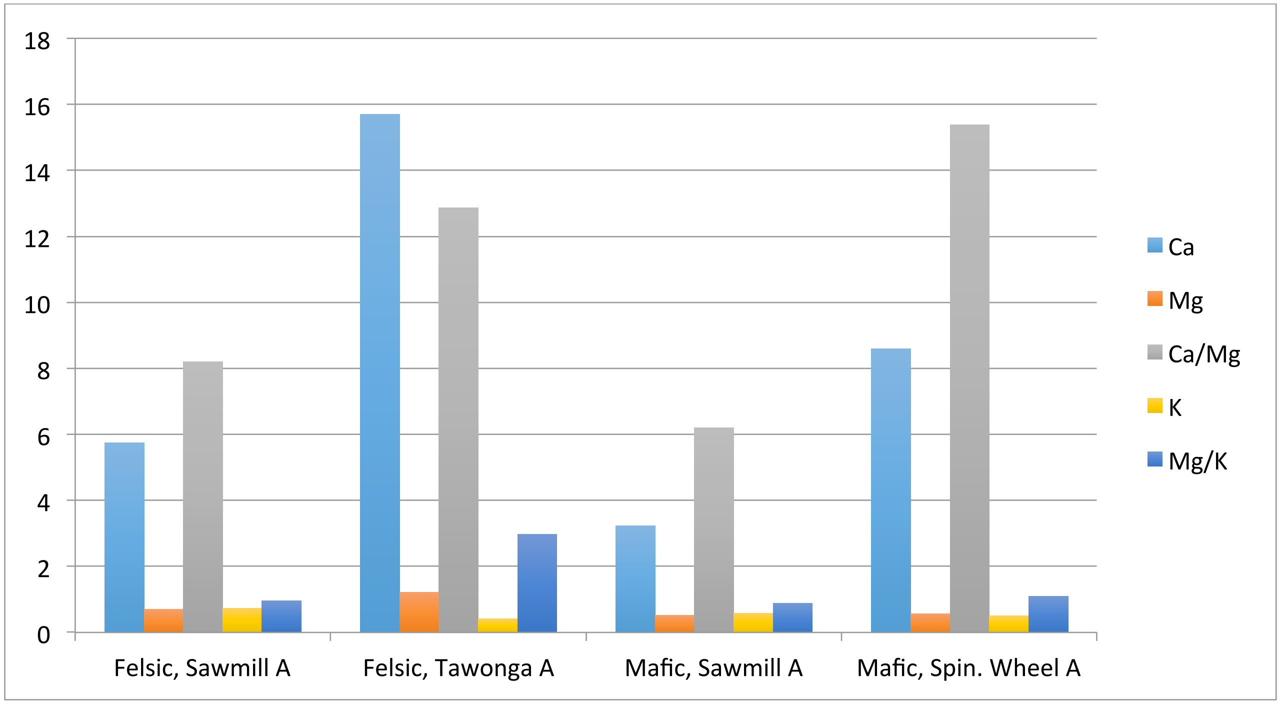


Figure 1. Topsoil values from data in Table 2. Compared with subsurface horizon values, these data presumably are more influenced by nutrient cycling and surficial mechanical processes. The subsurface horizon for the Spinning Wheel site was sampled several meters distant from the location of the surface horizon. Because the data are based merely on grab samples, caution should be exercised in their interpretation.

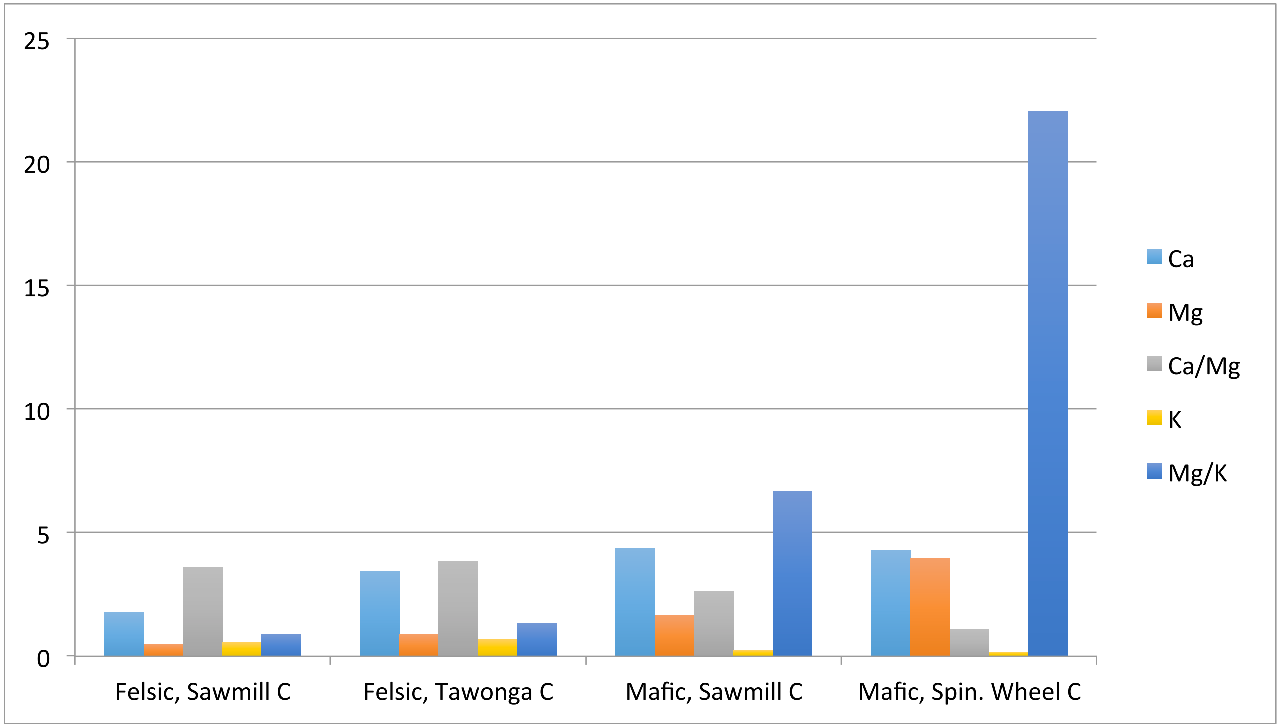


Figure 2. Subsoil values from data in Table 2. Compared with surface horizon values, these data presumably are more reflective of differences among soil parent materials because they are less influenced by nutrient cycling and surficial mechanical processes. The surface horizon had completely eroded from this location at the Spinning Wheel site; topsoil was collected several meters distant.