Soils of the Central Valley of California

Jerry Davis **Joint Ag/Food & Soils Field Trip**

Overview of Parent Material Environments and Associated Soil Distribution

The Central Valley is dominated by alluvial deposition due to its development as a tectonically subsiding structure. The Sacramento, San Joaquin and other rivers have had little role in creating the valley but do transport and deposit sediments in the valley. Alluvial sediments are found throughout the valley and are of various ages, with older alluvium found in high terraces and more recent deposits closer to present sea level.

Alluvial sediments vary in size from clays to gravels, and patterns of these depositional environments that create these help to explain the distribution of alluvial soils in the valley. Near-channel deposition of **natural levees** and **crevasse splays** at levee breaks tend to deposit the coarsest particles, typically ranging from sands to gravels. **Flood plains** get a variety of sediment types relating to old channel locations as well as overbank flow distribution, so can range in sediment size but are typically finer than near-channel deposits; many are actually low terrace soils, thus have had time to develop a more mature soil profile. **Alluvial fans** extend from tributary valleys on both side of the valley, and are extensive. Alluvial **terrace** soils range from low to high terraces, and tend to be the most developed soils, indicated by argillic horizons. Backwater **basin** areas get deposits of fine silts and clays as turbid floodwaters carry finer materials far from the river. The west side of the valley gets more alkaline soils, while the east side of the valley has extensive duripans.

Typical alluvial origin soils developed in these areas include:

- **Fluvents** near the river, typically with cumulic profiles. The ***Columbia*** and ***Holillipah*** series are sandy. The ***Reiff*** series is gravelly. The ***Yolo*** series is silt loam deposits on alluvial fans, and haven't always carried the fluvent classification, perhaps due to the fine texture. **Fluvaquents** occur in the same location as fluvents, but are in water saturated locations, thus having an aquic moisture regime.
- **Alfisols** are found on low to high terraces and alluvial fans, though some are listed as flood plain soils. Most are **xeralfs**, but **aqualfs** are also found. There are many xeralfs in the valley, including haploxeralfs, palexeralfs and durixeralfs:
  - **Haploxeralfs** typify elevated floodplains and low terraces. On the west side of the valley there are series with various defining features such as the mottled ***Marvin***; gravelly ***Arbuckle***; mixed ***Tehama*** (loam texture but particles up to gravels); and Yolo-like ***Zamora***. On the east side of the valley are the **Kilaga**, **Marysville**, and **Snelling** (on granitic derived sand), among others.
  - **Palexeralfs** are characteristic of higher, older terraces where there has been sufficient time for a more distinct argillic horizon to develop (evidenced by more clay increase in the Bt). The ***San Ysidro***, reddish ***Corning*** on mima mounds; ***Hillgate*** are on the west side. On the east side are the ***Kimball***, and granitic ***Cometa*** palexeralfs. Some of the oldest terraces in the area are just to the northeast of Capay Valley, developed in Pleistocene-age conglomerates of the

Red Bluff formation, a rock formation formed in somewhat consolidated and uplifted stream terrace gravels.

- **Durixeralfs** are the duripan soils, primarily along the east side terraces. Lower terraces are characterized by the California State Soil ***San Joaquin*** series. Higher terraces include the extremely gravelly ***Oroville***, gravelly ***Redding***, and the ***Thermalito*** and ***Eastbiggs*** on mima mounds.

- **Inceptisols** occur in less well developed situations on fans and terraces, due to calcareous substrate of aquic moisture regime (aquepts).
- **Mollisols** occur in various locations where grasses have promoted a mollic epipedon to form. Two great groups of the xerolls are distinguished on whether they also have an argillic horizon (argixerolls) or not (haploxerolls).
- **Vertisols** develop in the basin clays, many with an aquic moisture regime. Several extensive vertisols are found in the northern central valley, including ***Capay*** **xererts**, ***Clear Lake*** and ***Willows*** **aquerts**, Willows, and above a hardpan on the east side in Butte County are several **aquerts**.

Other major features of the central valley are various **volcanic** deposits, including extensive lahar and lava flows on higher terraces on the east side of the valley, and materials surrounding Sutter Buttes. Typical soils are **xeralfs**, either haploxeralfs, palexeralfs, but also including **rhodoxeralfs** on mafic materials such as basalt flows, where the abundance of iron in the parent material makes the soils more intensely red, especially in the Bt. More rocky soils in adjacent volcanic uplands may be limited to inceptisols with frequent outcrops. Plateau surfaces may have **mollisols**, **alfisols** or **ultisols** depending on rock structure, depth of weathering, and plant communities.

Adjacent upland foothills areas are dominated by residual alfisols, but also include inceptisols in less stable sites. Some of these areas include the volcanic materials just mentioned, with significant series including ***Sobrante*** and ***Argonaut*** **haploxeralfs**, and ***Timbuctoo*** **rhodoxeralfs**. The coast range foothills have many fine marine sedimentary layers forming impure sandstones and shales, and the shales especially tend to form **vertisols** as the clays weather out and shrink-swell processes disrupt horizons – the ***Diablo*** and ***Altamont*** vertisols are good examples.

Finally, delta soils include many **histosols** on thick accumulations of peat. Many delta islands have subsided due to drainage for cultivation and the resulting rapid oxidation of the organic matter.

Soils along the Field Trip

Solano County, from Marine World E on 80, over the hill to I-680 turnoff:

Three residual soils developed on sandstone and shale:
Dibble Fine, smectitic, thermic Typic Haplo**xeralfs**. Moderately deep, well drained residual soils on undulating gentle to very steep uplands, formed in material weathered from shale and sandstone.
Los Osos Fine, smectitic, thermic Typic **Argixerolls**. Mollic epipedon.
Altamont Fine, smectitic, thermic Aridic **Haploxererts**. Residual from shales. Slickensides.
Millsholm Loamy, mixed, superactive, thermic Lithic Haplo**xerepts**. Thin, minimal Bt.

On old volcanic flows, typically on plateaus, e.g. late-Pliocene Sonoma Volcanics near Cordelia:
Toomes Loamy, mixed, superactive, thermic Lithic Haplo**xerepts**. Very shallow and shallow, well to somewhat excessively drained soils formed in material weathered from tuff breccia, basalt and andesite. On ridges and plateaus.
Hambright Loamy-skeletal, mixed, superactive, thermic Lithic Haplo**xerolls**. On plateau basaltic lava flows.

Section of central valley alluvial soils around Fairfield and Lagoon Valley:

Brentwood Fine, smectitic, thermic Typic Haplo**xerepts**. grayish brown, moderately alkaline, clay loam A horizons; brown, moderately alkaline, heavy clay loam B2 horizons; and yellowish brown, moderately alkaline, silty clay loam C horizons that are calcareous. On nearly level to gently sloping fans and formed in valley fill.
Sycamore Fine-silty, mixed, superactive, nonacid, thermic Mollic Endo**aquepts**. In alluvium, on nearly level flood plains.
San Ysidro Fine, smectitic, thermic Typic **Palexeralfs**. Formed in alluvium on old, low terraces.
Yolo Fine-silty, mixed, superactive, nonacid, thermic Mollic Xero**fluvents**. Developed on alluvial fans.

Near lake in middle of valley:
Capay Fine, smectitic, thermic Typic Haploxererts, near lake, on clay-rich alluvium. Capay soils are on alluvial fans, alluvial flats, interfan basins and basin rims. Have slickensides.
Clear Lake clays Fine, smectitic, thermic Xeric Endo**aquerts**. Also at I-505 turn.

I-505 South to North, Yolo County

In this stretch, the highway traverses a variety of alluvial environments, including flood plain soils, terraces, alluvial fans, and basins.

Yolo Fine-silty, mixed, superactive, nonacid, thermic Mollic Xero**fluvents**. Developed on alluvial fans. We cross it on the flood plain to either side of Cache Creek.

Brentwood Fine, smectitic, thermic Typic Haplo**xerepts**. Have grayish brown, moderately alkaline, clay loam A horizons; brown, moderately alkaline, heavy clay loam B2 horizons; and yellowish brown, moderately alkaline, silty clay loam C horizons that are calcareous. On alluvial fans. We cross it just outside of Yolo soils near Cache Creek.

Rincon Fine, smectitic, thermic Mollic Haplo**xeralfs**. Developed on old alluvial fans and stream terraces. Argillic horizon. We'll cross it around the 505/5 interchange.

Corning Fine, mixed, active, thermic Typic **Palexeralfs**. Developed on high terraces with mound, intermound microrelief. Redder than Rincon. We cross it just south of Dunnigan Hills.

Marvin Fine, smectitic, thermic Aquic Haplo**xeralfs**. On flood plains. Mottled.

Capay Fine, smectitic, thermic Typic Haplo**xererts**. Developed on fine textured alluvium derived from mostly sandstone and shale. Capay soils are on alluvial fans, alluvial flats, interfan basins and basin rims. We cross it several places south of Cache Creek. Have slickensides.

Dunnigan Hills:

The Dunnigan Hills are a brief return to bedrock, primarily shales and impure sandstones of late Pliocene age (Tehama Formation, dated to 3.3 Ma, around the time of the formation of Sutter Buttes as a volcanic dome), developing to vertisols or (at "younger" locations) inceptisols.

Sehorn Fine, smectitic, thermic Aridic Haploxererts. Well-drained soils in foothills, moist foot-slope sites. Olive-gray color (5Y 5/2). Developed in residuum weathered from calcareous sandstone and shale. Slickensides.

Balcom Fine-loamy, mixed, superactive, thermic Typic Calcixerepts. Moderately deep, well drained soils that formed in material that weathered from soft, calcareous shale and sandstone. Bk horizon.

North of Dunnigan Hills on I-5. Return to Rincon, Corning on high terraces,

Tehama Fine-silty, mixed, superactive, thermic Typic Haploxeralfs. Developed in mixed alluvium on terraces and fans.

Hillgate Fine, smectitic, thermic Typic Palexeralfs. On old terraces, alluvium from mixed sources [at Dunnigan Rest Stop].

Zamora Fine-silty, mixed, superactive, thermic Mollic Haploxeralfs.

Reiff gravelly loam. Coarse-loamy, mixed, superactive, nonacid, thermic Mollic Xerofluvents. Very deep, well drained soils formed in coarse to medium textured alluvium. On alluvial fans in this area, near stream channels, such as Buckeye Creek near the county line.

Arbuckle Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs. Here also appears to be developed on alluvial fan terraces near Buckeye Creek, in gravelly alluvial materials from mainly conglomerate and metasedimentary rocks.

Colusa County: I-5 north to Williams

In Colusa County to near Williams, we cross several alluvial fans, with ***Arbuckle*** (past Petroleum Creek) haploxeralfs, ***Hillgate*** palexeralfs and other fan terrace soils developed.

Westfan Fine-loamy, mixed, superactive, thermic Pachic Haplo**xerolls**. Alluvium on relict alluvial fans. Effervescent with carbonate layers.

Mallard Fine, mixed, superactive, thermic Pachic **Argixerolls**. On lower alluvial fan positions. Clay loam, somewhat poorly drained, Bt horizon.

Increasing ***Capay*** clays in basin positions past Hahn Creek. Note rice cultivation, laser leveling. Brief return to Alfisols and Mollisols around Williams, then,

Stop #2, Hwy 20:

Willows clay Fine, smectitic, thermic Sodic Endo**aquerts**. "Endo" is just another catch-all "other" category used with aquic suborders. Basin soils. Lower chroma than Capay, 0 or 1 in A horizon.

Hwy 20 to Colusa:

Stays in Willows clay, even at sloughs.

Scribner Fine-loamy, mixed, superactive, thermic Cumulic Endo**aquolls**. In mixed alluvium, on the edges of backswamps on the flood plain of the Sacramento River.

Moonbend silt loam. Fine-silty, mixed, superactive, thermic Pachic Haplo**xerolls**. Very deep, moderately well drained soils that formed in alluvium on high flood plains. Cambic horizon

Hwy 45 to Princeton & Glenn County Line:

Moonbend mostly – presumably road travels along the high flood plain. Also **Vina** haploxerolls, with a thicker mollic epipedon and no B horizon.

Sutter Buttes to the East: Volcanic rocks and deposits : ***Palls*** and ***Stohlman*** **xeralfs** on andesite and andesitic mudflows. ***Ocraig*** **orthents** (A/C).

Clarks Farm Stop

Three main types of soil are relevant to agricultural uses here:

Marvin & ***Zamora*** xeralfs on upper floodplains and terraces, used for a variety of crops.

Willows clay vertisols to the west, used for rice.

Columbia xerofluvents inside the levees near the river, used for orchards.

Leaving Clarks, going along Hwy 162, we go through ***Marvin*** xeralfs on floodplains and ***Zamora*** xeralfs on alluvial fans. Past Campbell Slough, we move onto Landlow mollisols on basin clays, used for rice. Stockton Clay vertisols are just before Butte County (but are probably similar to what we'll find on the other side.)

Butte County, Hwy 162 to Midway, then to Lundberg Family Farm

Crossing Butte Creek into Butte County, we are in Lofgren-Blavo complex of Aquerts developed in flood basins on duripan, with Blavo a bit more of a duripan. Developed in flood plain basins. Very limited drainage with duripan – a precursor to the durixeralfs we'll see along the east side

of the valley. Both used for rice. After we leave Lundberg's, we'll head for Oroville, along the way passing through more aquerts on duripans in the Esquon-Neerdobe complex.

Lofgren Very-fine, smectitic, thermic Xeric Epi**aquerts**

Blavo Very-fine, smectitic, thermic Xeric **Duraquerts**.

Esquon Fine, smectitic, thermic Xeric Epi**aquerts**

Neerdobe Fine, smectitic, thermic Xeric **Duraquerts**

Past Thermalito Reservoir, we'll go onto gravelly terrace **durixeralfs** (the first of many to follow as we explore terraces down the east side of the valley), and these continue south of Oroville:

Oroville **Durixeralfs** are in swales on intermediate terraces, and characterized by extremely gravelly indurated duripan.

Thermalito **Durixeralfs** soils are on mounds on intermediate terraces.

Eastbiggs loam **Durixeralfs** soils are on mounds on low terraces. Not gravelly – loam.

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Oroville Table Mountain may be visible to the north. On this mountain and its side slopes are various soils formed on its basaltic lava flows:
Thermalrocks, Elsey and ***Beatsonhollow*** **humults** on the plateau surface. Acidic subsoils with argillic horizons and umbric epipedons.
Campbellhills, ***Coalcanyon***, and ***Coonhollow*** **mollisols**
Cherotable **alfisols**.

As we start to run out of Butte County, near the Feather River we encounter fluvents near the river and alfisols developed on the Lower Modesto formation.

Gianella Coarse-loamy, mixed, superactive, nonacid, thermic Typic Xerofluvents. Very deep and stratified., on flood plains, primarily within the active meander belts of the Feather River.

Boga and ***Loemstone*** Fine-loamy, mixed, superactive, thermic Typic Haploxeralfs. On Feather River terraces. These soils formed in alluvium of the Lower Modesto formation deposited over unrelated root restrictive sediments.

Yuba County coming south from Oroville.

Kilaga Fine, mixed, active, thermic Mollic Haplo**xeralf**s. In alluvium on terraces.
Conejo Fine-loamy, mixed, superactive, thermic Pachic Haplo**xerolls**. On alluvial fans and terraces, alluvium from basic igneous and sedimentary rock. Cambic horizon.
Marysville Fine-silty, mixed, active, thermic Mollic Haplo**xeralfs** . In alluvium from mixed rock sources over unrelated siltstone.

Woodruff Road:
Kimball Fine, mixed, active, thermic Mollic **Palexeralfs**. Very deep, well drained soils formed in alluvium from mixed sources. Kimball soils are on low terraces.
Hollenbeck Fine, smectitic, thermic Chromic Haplo**xererts**. Deep to duripan, moderately well drained soils that formed in alluvium from mixed rock sources. Hollenbeck soils are on basin rims and interfan basins. Subsoil strongly effervescent.
San Joaquin Fine, mixed, active, thermic Abruptic **Durixeralfs**. State soil with duripan, developed on alluvium from granitic sources. On low terraces.

Hwy 20 heading east:

As cultivated fields give way to grazing land on higher terraces with mima mounds:
Redding gravelly loam Fine, mixed, active, thermic Abruptic **Durixeralfs**. On nearly level or dissected and undulating to hilly high terraces. Microrelief may be hummocky. Gravel and cobbles tend to concentrate in the intermound in hummocky areas. Vernal pools with relief that is greater than the intermound are common in areas with slopes of 0 to 3 percent.

Then into foothills, just past Marysville Road turning off to the left at Brown's Valley. Vegetation changes to oak savanna, oak woodland and foothill pine.
Auburn Loamy, mixed, superactive, thermic Lithic Haplo**xerepts**. Residual soils on schist. Relatively thin yellowish red soils with A/Bw.
Sobrante Fine-loamy, mixed, active, thermic Mollic Haplo**xeralfs**. Residual soils on basic igneous rocks.
Argonaut Fine, mixed, superactive, thermic Mollic Haplo**xeralfs**. Residual moderately deep, well drained soils that formed in materials weathered from meta-andesite. On undulating to hilly broad ridges and slightly concave slopes of 2 to 30 percent. Rock outcrops are common. Elevations are 200 to 2,500 feet.

Peoria Road: road to UC Sierra Field Camp

Peoria Road in Auburn/Sobrante xerepts and xeralfs except along Dry Creek, which contains hydraulic mine tailings. Scott Forbes Road goes through the Sobrante-Timbuctoo mapping unit, which has Sobrante haploxeralfs but also:
Timbuctoo Fine, parasesquic, thermic Typic **Rhodoxeralfs**. On basic metavolcanic rock, like diabase. Just across bridge over Yuba River, around Timbuctoo no less. Red to dark red color: Bt: dry color of 2.5YR 3/6 or 4/6 and moist color of 2.5YR 3/6 or 4/6. A horizon has dry color of 5YR 5/6 or 4/6 and moist color of 5YR 4/6 or 3/4.

Dirt road to Yuba River campsite

Road goes through more xeralfs, but includes some mollisols on stream terrace deposits.

Ricecross loam. Fine-loamy, mixed, superactive, thermic Pachic Ultic **Argixerolls**. On stream terraces.

Campsite area includes residual ***Auburn*** haploxerepts, ***Sobrante*** haploxeralfs, and ***Timbuctoo*** rhodoxeralfs on hillsides, and the Ricecross argixerolls on terraces, with mine tailings and riverwash close to the river.

Hwy 20 to Marysville

Heading west on Hwy 20, return down from the residual **xeralfs** and **xerepts** down through the ***Redding*** and ***San Joaquin*** **durixeralfs** on progressively lower terraces, through the ***Kimball*** **palexeralfs** on the lowest terraces.

South of Marysville on Hwy 70

Immediately upon crossing the levee at the south end of Marysville, we fly over fluvents near the Yuba River: the Holillipah and Columbia series.

Holillipah Sandy, mixed, thermic Typic Xerofluvents. Stratified very deep, somewhat excessively drained soils that formed in alluvium on flood plains and alluvial fans.

Columbia Coarse-loamy, mixed, superactive, nonacid, thermic Oxyaquic Xerofluvents. On floodplains and natural levees. Used for orchards.

Then we return to terrace soils dominated by San Joaquin durixeralfs.

Sutter County on Hwy 70

Just past Bear River, a couple of soils formed in coarse sandy granitic alluvium.

Snelling Haplo**xeralfs** in moderately coarse textured alluvium high in coarse sand and derived from granitic rocks. Typically on terraces.

Cometa **Palexeralfs**. Old alluvium from granitic rock sources. These soils are on gently sloping, slightly dissected older stream terraces.

Marcum **Argixerolls** on low terraces and basin rims, formed in alluvium from mixed sources deposited over unrelated siltstone.

… and several basin clay vertisols: Capay, Clear Lake and others.

Sacramento County on Hwy 70, then to 99.

We'll skip the soils around the metro Sacramento Area. We pick up some San Joaquin durixeralfs on low terraces to the south, then fluvents at the Cosumnes River, then back to durixeralfs south of that.

Seifert Dairy Stop

Lots of ***San Joaquin*** **Durixeralfs**

Continuing west on Collier Road, then south on (old) Sacramento Road, continues in San Joaquin soils, south to Peltier Road. We may see a couple of mollisols developed on granitic origin sediments in low fan terraces, ***Tokay*** and ***Acampo*** haploxerolls and ***Kingdon*** argixerolls, except for the ***Columbia*** fluvents at the Mokelumne River crossing.

Dropping into the delta on Hwy 12

First we cross basin rim aquolls, then at 2.1 miles to the west of Thornton Road, we hit histosols:

Shinkee muck Loamy, mixed, euic, thermic Terric Haplo**saprists**. Very deep, very poorly drained soils formed in material weathered from hydrophytic plant remains over alluvium. Shinkee soils are in fresh water marshes and river channels of the San Joaquin - Sacramento Delta. Slopes are less than 2 percent. They formed in hydrophytic plant remains over mixed mineral alluvium. The organic material is derived from tule and reed fibers. Other saprists are ***Kingile*** (clay-rich) and ***Rindge***.

Near the Mokelumne River are also are a couple of mollisols and fluvaquents.
Near the Sacramento River are some alluvial soils: *Laugenour* fluvaquents, *Valpac* mollisols, and *Sailboat* fluvents.

West of Rio Vista in Solano County.

Past Rio Vista, Hwy 12 crosses some residual upland soils on shale: ***Diablo*** and ***Altamont*** **vertisols**. These continue to the north on Hwy 113, until the road drops onto low terrace soils ***San Ysidro*** and ***Antioch*** xeralfs, and then *Capay* clay basin vertisols and associated fine *Yolo* fluvents. In Yolo County, many basin soils – *Capay* clay starts appearing more frequently. Occasional *Yolo* loam fluvents. Hwy 16 from Woodland into Capay Valley. Lots of *Capay* Clay vertisols near the mouth of Capay Valley.

Some soils of Capay Valley:

Brentwood Fine, smectitic, thermic Typic Haplo**xerepts**. Have grayish brown, moderately alkaline, clay loam A horizons; brown, moderately alkaline, heavy clay loam B2 horizons; and yellowish brown, moderately alkaline, silty clay loam C horizons that are calcareous.

Tehama Fine-silty, mixed, superactive, thermic Typic Haplo**xeralfs**. Developed in mixed alluvium on terraces and fans.

Corning Fine, mixed, active, thermic Typic **Palexeralfs**. Developed on high terraces with mound, intermound microrelief. Redder than Rincon.

Yolo Fine-silty, mixed, superactive, nonacid, thermic Mollic Xero**fluvents**. Developed on alluvial fans.

Soboba sandy xero**fluvents**. Also on alluvial fans.

Zamora Fine-silty, mixed, superactive, thermic Mollic Haplo**xeralfs**.

Full Belly Farm
The farm appears to be primarily on ***Yolo*** loam fluvents, with some ***Soboba*** sandy fluvents closer to the creek at the south, and riverwash close to Cache Creek. Across the highway are ***Hillgate*** palexeralfs on terraces, and just to the north are ***Tehama*** haploxeralfs.

Soils on Old Terrace Deposits.
Uplands to the west of Capay Valley are dissected alluvial fan deposits of late Pliocene age, the Tehama and the overlying Red Bluff Formations, the former dated by a basal volcanic tuff at 3.3 Ma (million years BP), around the same time of the formation of the Sutter Buttes as a local volcanic dome. In the Capay Hills (where we should be standing), ***Balcom*** **silty clay loam Calcixerepts** are developed on steeper slopes eroded from the compacted but uncemented Tehama Formation sediments.

The original gravelly surface of the Red Bluff Formation, Pleistocene in age, is preserved as scattered terrace remnants. Where preserved, soils on this surface are quite old, and have developed prominent Bt horizons. ***Positas*** **gravelly loam Mollic Palexeralfs**, with a yellowish-red (5YR 4/6) Bt horizon and dark red (2.5 YR 3/6) clay films, dominates these old terrace soils. In spite of the gravelly loam texture, permeability is very slow due to the heavy clay Bt.