Rocks of Shepherd Canyon

A guided walk for Friends of Sausal Creek, July 1, 2017

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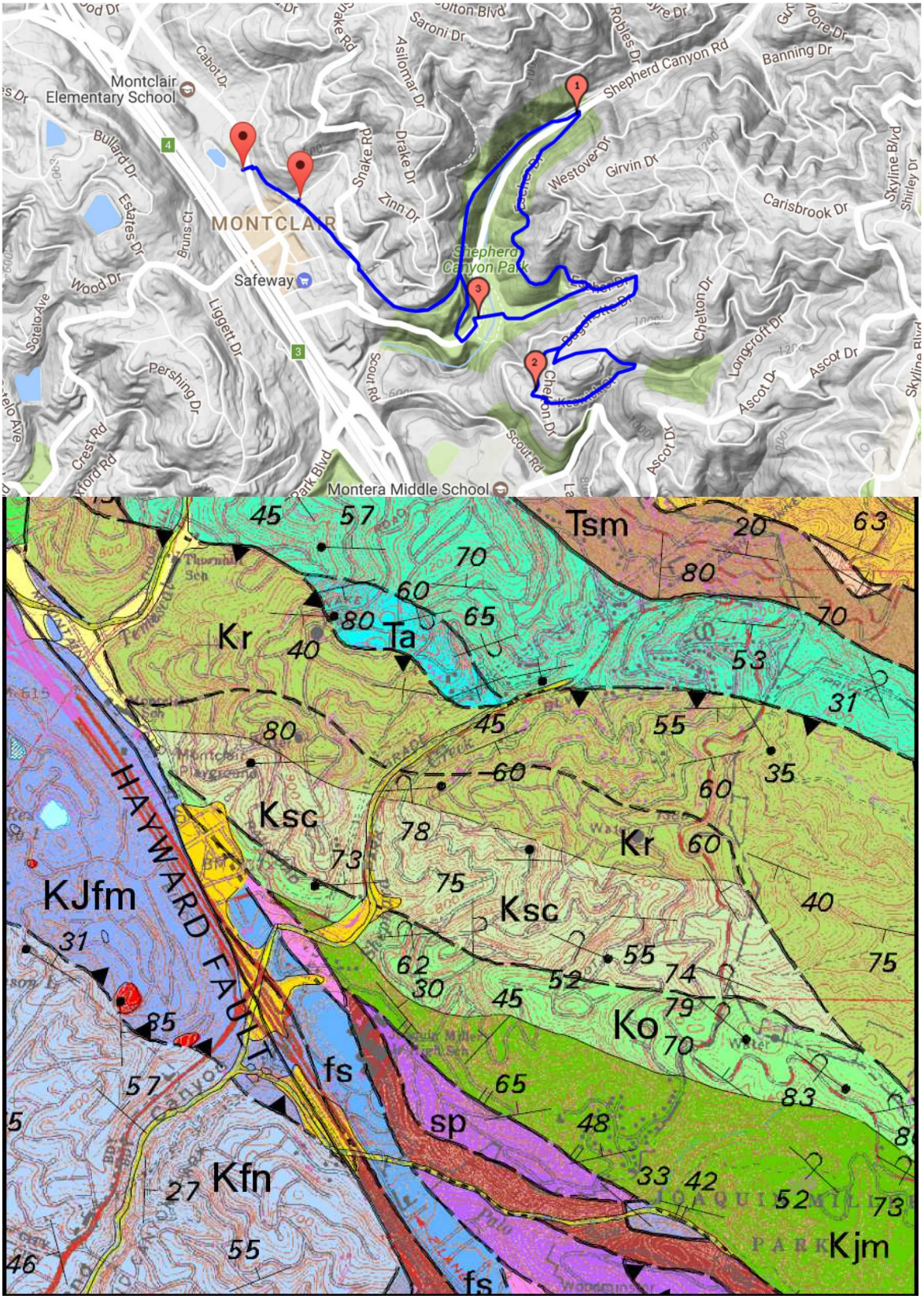
The city of Oakland boasts the Bay area's widest selection of rocks, representing a range of ages from about 165 million years to the late Pleistocene glaciation. The lower valley of Shephard Creek, in Shepherd Canyon, exposes a distinctive set of sedimentary rocks dating from the Late Cretaceous Epoch, in the middle of this age span. They are the westernmost outcrops of the Great Valley Sequence.

The Oakland Conglomerate, Shephard Creek Formation and Redwood Canyon Formation were mapped by Jim Case for his UC Berkeley Ph.D., then formally named by him in a 1968 U.S. Geological Survey paper (Bulletin 1251-J). Andrew Lawson of UC Berkeley had previously mapped them in 1914 as part of the Chico Formation, a name that is now abandoned. Case took the names for these units from localities in and near Shepherd Canyon where they were best exposed. Russ Graymer of the USGS, along with Davy Jones and Earl Brabb, examined these rocks in detail for his 2000 geologic map of the Oakland metropolitan area (map MF-2342) and other Bay area county geologic maps.

The Oakland Conglomerate consists of massive (thick-bedded) wacke (impure sandstone) and conglomerate with a little shale. It's exposed in the East Bay hills from Montclair Village down past Hayward. Here at its northernmost end, the formation consists of about 50 percent conglomerate. Its type locality is along Skyline Boulevard west and northwest of Redwood Peak, but we will see good exposures of it in Shepherd Canyon. It's a few hundred feet thick and appears to have a fault between it and the overlying Shephard Creek Formation. It tends to resist erosion and form ridges. It has no visible fossils: conglomerate never does. The stones in the conglomerate are both granitic and volcanic.

The Shephard Creek Formation consists of mudstone (shale and siltstone) and a little coarser-grained stuff. It's mapped as far south as San Leandro Creek above Chabot Dam and is well exposed in Redwood Canyon and Grass Valley, although it's missing around Redwood Peak. We will be walking through its type locality. It's about 1500 feet thick here and is overlain conformably by the Redwood Canyon Formation (that is, they represent a continuous period of time). It tends to be easily eroded and form valleys. It has only microfossils.

The Redwood Canyon Formation consists of thick-bedded sandstone (massive wacke) with a little shale. It extends from the north side of Temescal Creek down to Castro Valley and surrounds most of Upper San Leandro Reservoir. Its type locality is in Redwood Canyon. A fault runs through it, but we won't be seeing any evidence of that. Even more so than the Oakland Conglomerate, this unit resists erosion and underlies the steepest parts of Shepherd Canyon. A few shelly fossils (the straight ammonite *Baculites* and a "coiled gastropod") have been found near the base of this formation. So keep your eyes peeled!



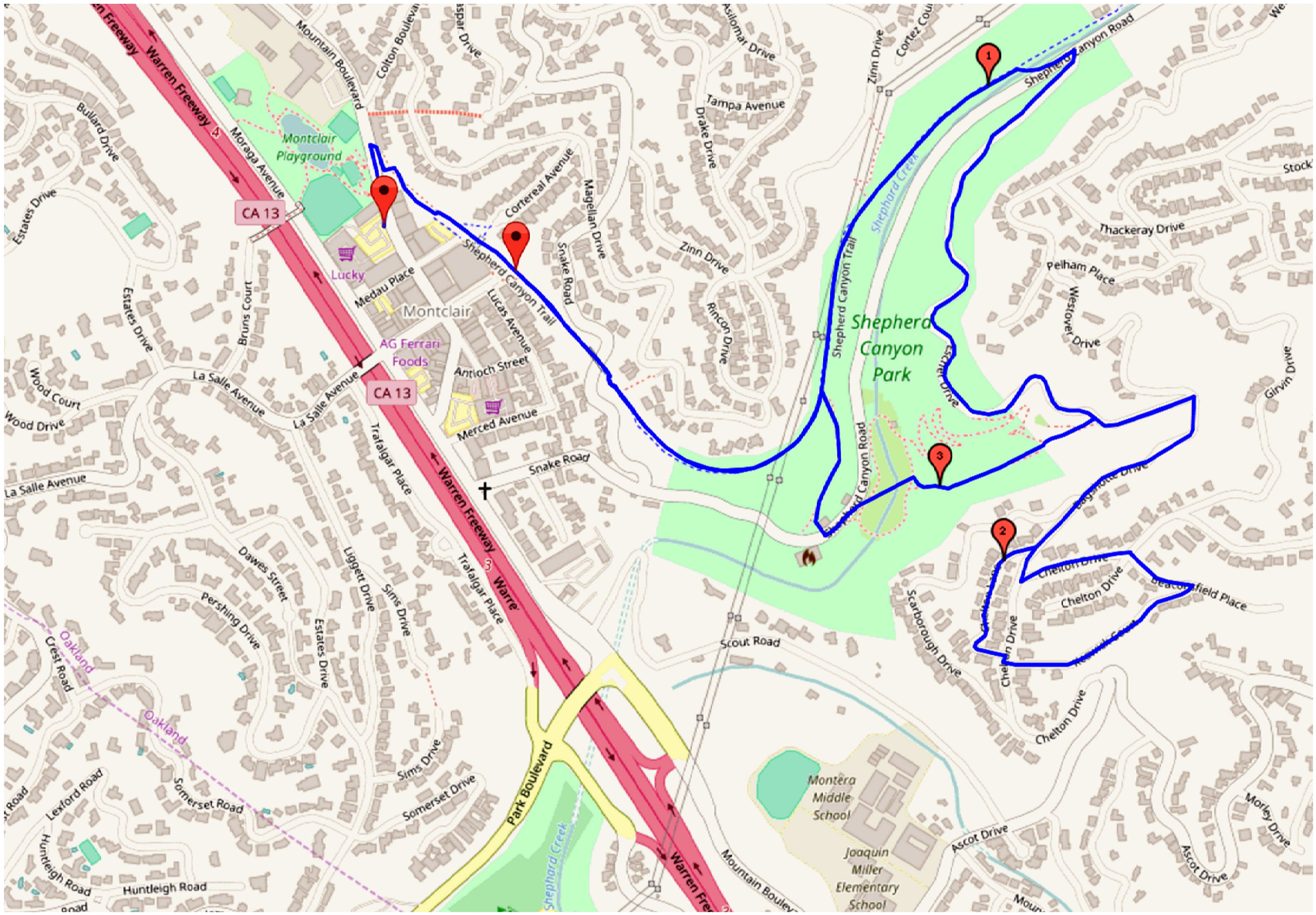
Geologic map and route map. We will visit outcrops of the Oakland Conglomerate (Ko), Shephard Creek Formation (Ksc) and Redwood Canyon Formation (Kr).

In the larger context, the rocks we'll see today are all a detached part of the Great Valley Sequence.

The Great Valley Sequence is one of California's major rock units, forming the western wall of the Central Valley and underlying its entire extent. It's made of mud and gravel that washed off the volcanic Sierra Nevada (a continental arc) into an offshore basin between the North American continent and the subduction zone of the Farallon plate (a forearc basin), a setting much like the southern coast of Java today, or the Pacific Northwest. For more than a hundred million years this forearc basin collected terrestrial material, forming a pile of stratified rocks some 40,000 feet thick. Typically this kind of basin gets a slow, constant input of mud, plus occasional underwater landslides of coarse-grained sand and gravel. The coarse-grained beds therefore interrupt the fine-grained beds and are limited in horizontal extent, with a lens-shaped cross section. The shales produce natural gas, especially in the Sacramento Valley.

Oakland's pieces of the Great Valley Sequence date from three separate parts of geologic time. The bottom part consists of the Knoxville Formation (Late Jurassic to Early Cretaceous, ~150 to ~130? Ma). The middle part consists of the Joaquin Miller Formation and the overlying Oakland Conglomerate (Cenomanian to Turonian, 100 to 90 Ma). The upper part consists of the Shephard Creek and Redwood Canyon Formations and the Pinehurst Shale (Campanian, 84 to 72 Ma). The three packets of strata have been brought together by tectonic movements, like a messy shuffle of a card deck. Cretaceous time was marked by high sea levels, very high CO_2 levels and warm climate.

Around the end of Campanian time, much of the basin filled all the way up to sea level. This means that younger rocks are scarce and scattered. Also, the plates appear to have reorganized themselves such that the subduction became oblique rather than orthogonal. This opened up many small basins, probably like the California Continental Borderland of today, and allowed scraps of the continent to become detached and migrate northward (dextrally) along the subduction margin. In coastal California, the most notable of these scraps is the Salinian block, which forms the Santa Lucia and Gabilan Ranges, Santa Cruz Mountains, Montera Mountain, Point Reyes and Bodega Head. The oblique-subduction regime appears to have taken a break after 50 Ma. The modern San Andreas fault regime started around 25 Ma and continues today. During this time the Great Valley Sequence was folded steeply upward on its west side and partly disassembled, as we'll see this afternoon.


Warren Freeway
CA 13
Mountain Boulevard
Colton Boulevard
Montclair Playground
Moraga Avenue
Bullard Drive
Estates Drive
Lucky
Medau Place
Montclair
AG Ferrari Foods
Antioch Street
Merced Avenue
Cortereal Avenue
Magellan Drive
Snake Road
Shepherd Canyon Trail
Lucas Avenue
Tampa Avenue
Drake Drive
Zinn Drive
Rincon Drive
Shepherd Canyon Road
Shepherd Creek
Shepherd Canyon Park
Thackeray Drive
Pelham Place
Westover Drive
Girvin Drive
Scout Road
Scarborough Drive
Chelton Drive
Beaconsfield Place
Montera Middle School
Joaquin Miller Elementary School
Ascot Drive
Morby Drive
Park Boulevard
Trafalgar Place
Dawes Street
Liggett Drive
Sims Drive
Pershing Drive
Oakland
Crest Road
Lexford Road
Somerset Road
Huntleigh Road
La Salle Avenue
Wood Court
Wood Drive
Bruns Court
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