Title

The University of California Natural Reserve System and the Homestake Mining Company: Common Ground at the Donald and Sylvia McLaughlin Reserve

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Publication Date

2003-07-01

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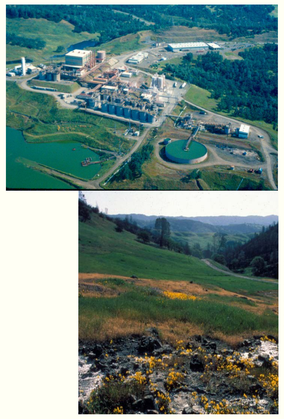
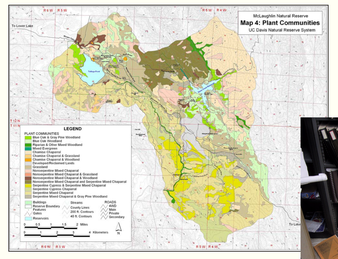


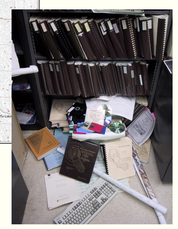
Hardhats and Birkenstocks - a Short History

The idea of creating a reserve on McLaughlin Mine property originated with Homestake's visionary environmental manager, Ray Krauss. In 1985, when the mine had just begun operation, Ray approached UC about the possibility of creating a reserve to be incorporated into the UC Natural Reserve System. In 1992, the first steps were taken to create a 300-acre reserve in this complex and intriguing serpentine landscape. Through 2002, students, researchers and miners respectfully coexisted on the reserve.

In 2003, with the last ounce of gold poured, Homestake and the University signed an agreement expanding the reserve to 6800 acres, with the Land Trust of Napa County holding a conservation easement on the property. Homestake (now a subsidiary of Barrick Gold) will have an obvious continued presence as they conduct post-mine monitoring and reclamation.

The McLaughlin Mine has been widely recognized by both environmental and mining organizations for its rigorous environmental monitoring and its innovative restoration and land management. The Donald and Sylvia McLaughlin Natural Reserve will continue the tradition of exemplary stewardship on this unique landscape.



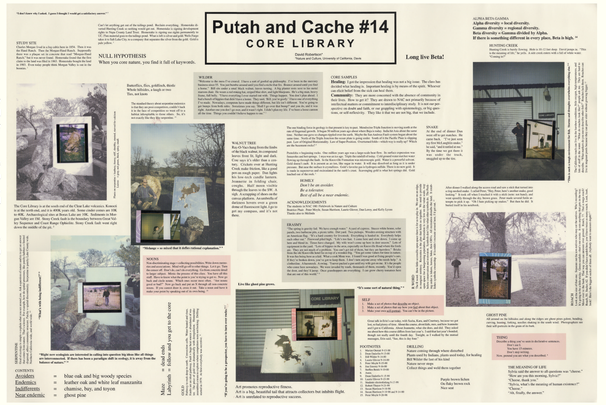


From Rocks to Air Quality - Baseline Data

As part of the permitting process, the mine collected baseline data on an broad array of environmental variables - air, water, soil and deep rock cores. The data, collected over a period of 20 years provide an invaluable resource for researchers from many disciplines.

Data on meteorology, air and water quality, and terrestrial and aquatic ecology were collected before and during operation of the mine, and UC will continue collection of many of them. Surveys of plants, including sensitive species, plant communities, soils, geology and archeological sites were done before mining began, and maps and data are available for research use.

The most unusual, and certainly the largest, data set is a permanent record of the stratigraphy of the mine pit - halved rock cores catalogued by exact location in the ore deposit. This incredible resource, known as the Core Library, has been the inspiration for reserve art as well as geology!



Using the Mine to Understand Invasion Biology and Restoration

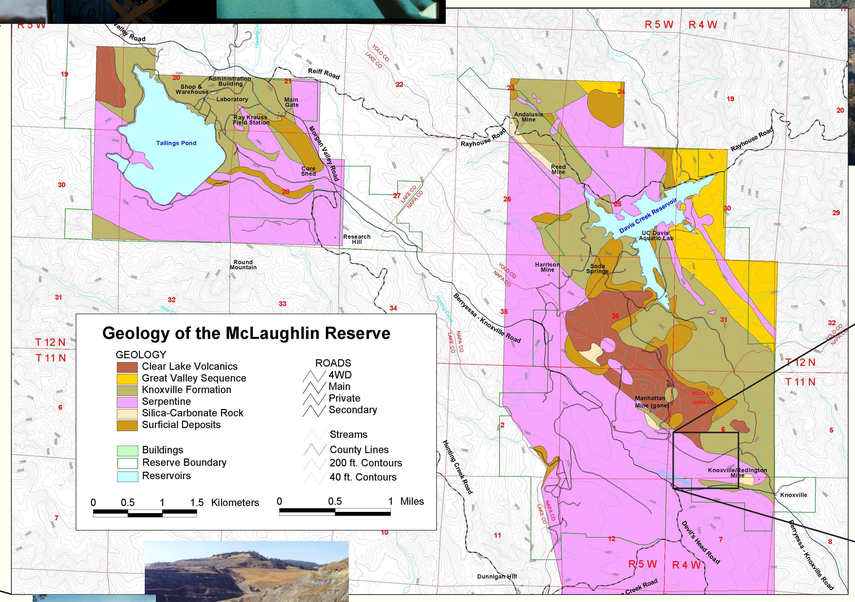
During mining operations, millions of cubic yards of rock and soil were moved to reach the gold ore. Graduate students in the NSF Biological Invasions Integrative Graduate Education and Research Traineeship (IGERT) are using these mountains of transplanted soil as an experimental site to test the role of propagule supply (numbers of seeds and numbers of times they are introduced) in determining the success of invasions by common weeds such as European mustard. There are also plans to use the mine's revegetation program as an opportunity to study various aspects of restoration ecology, such as the importance of species diversity and local adaptation.

Mercury Studies in Davis Creek Reservoir

Mercury deposits occur throughout the area near the McLaughlin Reserve, and mercury mining occurred on the reserve from the mid-nineteenth century until Homestake began operations in the early 1980s. Elemental mercury, both naturally occurring and at elevated levels caused by historic mining, is present in the local creeks. Mercury poses little threat to humans or wildlife in this form - only when it becomes methylated by bacteria in anaerobic sediments can it enter the food chain.

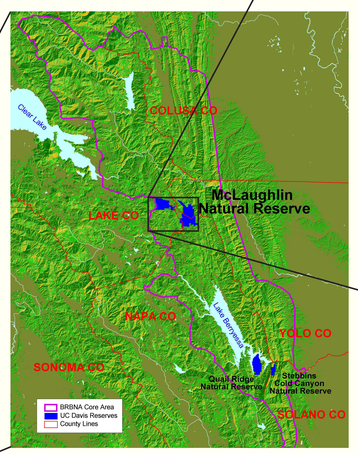
Researchers in Charles Goldman's lab at UC Davis found that the newly inundated sediments in the Davis Creek Reservoir, which was created by Homestake to provide water for its processing plant, contained high levels of organic matter that enhanced the microbial methylation of mercury. This, in turn, produced a spike in mercury levels in fish in the reservoir. A seasonal component to mercury uptake, which peaks during the fall breakdown of thermal stratification in the water, was also discovered by the researchers during subsequent years of study.

The Davis Creek Reservoir studies are among the longest running mercury studies in California, and they continue today.



The University of California Natural Reserve System

The mission of the Natural Reserve System is to contribute to the understanding and wise management of the Earth and its natural systems by supporting university-level teaching, research, and public service at protected natural areas throughout California.



BERKELEY
1. Angelo Coast Range Reserve
2. Chickering American River Reserve
3. Hastings Natural History Reservation
4. Jenny Pygmy Forest Reserve
DAVIS
5. Bodega Marine Reserve
6. Eagle Lake Field Station
7. Jepson Prairie Reserve
8. McLaughlin Natural Reserve
9. Quail Ridge Reserve
10. Stebbins Cold Canyon Reserve
IRVINE
11. Burns Piñon Ridge Reserve
12. San Joaquin Freshwater Marsh Reserve
LOS ANGELES
13. Stunt Ranch Santa Monica Mountains Reserve
RIVERSIDE
14. Box Springs Reserve
15. Boyd Deep Canyon Desert Research Center
16. Emerson Oaks Reserve
17. James San Jacinto Mountains Reserve
Oasis de los Osos (satellite site)
18. Motte Rimrock Reserve
19. Sweeney Granite Mountains Desert Research Center
Sacramento Mountains (satellite site)
SAN DIEGO
20. Dawson Los Monos Canyon Reserve
21. Elliott Chaparral Reserve
22. Kendall-Frost Mission Bay Marsh Reserve
23. Scripps Coastal Reserve
SANTA BARBARA
24. Coal Oil Point Natural Reserve
25. Carpinteria Salt Marsh Reserve
26. Kenneth S. Norris Rancho Marino Reserve
27. Santa Cruz Island Reserve
28. Sedgwick Reserve
29. Sierra Nevada Aquatic Research Laboratory
30. Valentine Camp
SANTA CRUZ
31. Año Nuevo Island Reserve
32. Fort Ord Natural Reserve
33. Landels-Hill Big Creek Reserve
34. Younger Lagoon Reserve

Wildlands, Working Landscapes and Willing Collaborators - Bioregional Context

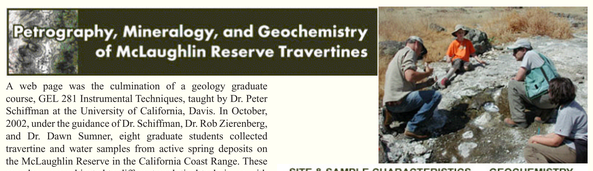
The UC Davis McLaughlin Reserve lies at the center of a wild, natural landscape stretching from Lake and Colusa Counties south to Solano County, centering on a spectacular geologic feature known as Blue Ridge. This region combines extensive areas of wildlands managed by state and federal agencies with privately owned ranches and conserved lands. The reserve itself encompasses about 7000 acres of wildlands straddling the two major watersheds of the area - Putah and Cache Creeks.

Drawn together by their shared desire to maintain its remarkably undeveloped character, the public land managers, private landowners, non-profit conservation groups and environmental scientists of this region have come together to form the Blue Ridge Berryessa Natural Area Conservation Partnership. The partnership works together to meet the shared goal of preserving the natural values of the area. The McLaughlin Reserve is not only the geographic heart of this area, but serves as a focal point of the group's data gathering and dissemination mission.

Miners, Mantle Rock and Native Plants - Geology at McLaughlin

The dramatic and complex geology of the McLaughlin Reserve has attracted both miners and scientists through the years. The Stony Creek Fault, which runs directly through the mine pit, separates the serpentine of the Coast Range Ophiolite from the sediment of the Great Valley Sequence. Liquefied mantle rock formed the ophiolite, carrying gold, silver and mercury for miners, and other metals - magnesium, nickel and chromium that create the harsh soil conditions favoring native and endemic plants - for ecologists.

A variety of forms of serpentinite occur on the reserve, including antigorite, lizardite, chrysotile and detrital serpentine. Patches of gabbro, a more calcium rich but related rock, occur here and there in a matrix of serpentinite, and greenstone overlies both in some areas. Pinnacles of erosion-resistant silica-carbonate, indicators of mercury deposits, dot the landscape. Mudstones, sandstones and siltstones comprise the sedimentary portion of the reserve. In some areas, recent volcanic andesite overlies all of these older rocks. This rich geologic diversity provides a mother lode of prospective research projects for geologists, soil scientists and ecologists.



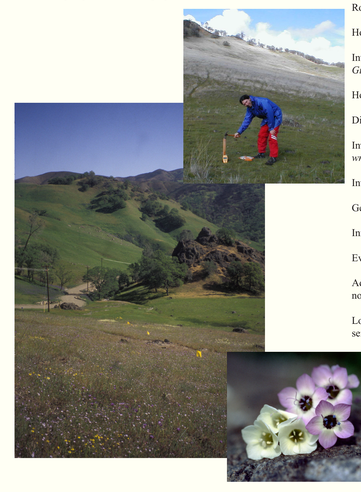
A web page was the culmination of a geology graduate course, GEL 281 Instrumental Techniques, taught by Dr. Peter Schiffman at the University of California, Davis. In October, 2002, under the guidance of Dr. Schiffman, Dr. Rob Zierenberg, and Dr. Dawn Sumner, eight graduate students collected travertine and water samples from active spring deposits on the McLaughlin Reserve in the California Coast Range. These samples were subjected to different analytical techniques with the primary goal of introducing students to different geological techniques and their applications to scientific research. These techniques include petrography and cathodoluminescence, x-ray diffraction, electron microprobe, neutron tomography, magnetics, ICPMS of water and solids, S and C-O-H isotopes, and analysis for microbial organisms. The results and highlights of this project are presented on the web site.

CONCLUSIONS:

The travertine mounds are composed of aragonite with lesser amounts of calcite, dolomite, and sepiolite. This sequence of precipitation is common throughout the samples.

- Low temperature dolomite is precipitating abiotically in these mounds.
- The travertines contain enough magnetite to retain a stable magnetic direction.
- Endolithic coccoidal bacteria have been identified in the samples.
- All of the waters show a $\delta^{18}O$ shift due to water-rock interactions at temperatures considerably greater than ambient surface conditions.
- Fluid composition is consistent with derivation from the Great Valley sequence.
- The composition and mineralogy are controlled by evaporative processes and the presence of serpentinite.

http://www-geology.ucdavis.edu/~GEL281/F02/



Work on the "Grid"

Even to the casual observer, the landscape at the McLaughlin Reserve is a mosaic of multi-colored rock outcrops and spring wildflowers. A team of investigators, from landscape ecologists to molecular geneticists, are exploring plant distribution and its underlying causes in this heterogeneous environment. They selected a hilly site that incorporated three ridges of serpentine separated by varying degrees of nonserpentine soils, grasslands, and chaparral environments, a major section of the Stony Creek Fault and two fossil mineral springs. Over this, they laid a 550- by 600-meter grid and sampled plants and soils in designated areas. Using GIS technology coupled with these plant and soil data, investigators are able to explore patchiness across the landscape at a variety of spatial scales. So far, over a dozen projects are taking place on the grid:

How soil microbes, especially plant growth-promoting rhizobacteria, function in structuring plant communities on heterogeneous soils.

Role of molybdenum deficiency in structuring microbial and plant communities on heterogeneous soils.

How harvester ants (*Messor andrei*) can be a sources of nutrient subsidies to soil microbial and faunal communities.

Interaction of ecological and evolutionary processes to limit the local distributions of plants, focusing on a patchily distributed serpentine annual *Gilia tricolor*.

How habitat patchiness and physical variation at multiple spatial scales structure the plant community found in serpentine seeps.

Differential effects of fire and grazing on plant diversity and community structure on serpentine and non-serpentine soils.

Invasive species impact on the ecology of related native plants: the role of shared herbivory in mediating the interaction between the native *Lotus wrangelianus* and the introduced *Medicago polymorpha*.

Interaction of fire with soil heterogeneity to influence soil nutrient dynamics and the plant community.

Geologic variation (variable degrees of metamorphosis of peridotite into serpentine) in producing variation in serpentine soils and vegetation.

Influences of spatial structure of soil heterogeneity on the role of local adaptation in the spread of invasive goatgrass, *Aegilops triuncialis*.

Evolutionary ecology of wild sunflowers, *Helianthus exilis* and *Helianthus bolanderi*, in patchy serpentine seeps.

Adaptive significance of a flower color polymorphism in *Clarkia purpurea*, which shows contrasting patterns of distribution on serpentine and nonserpentine soils.

Local adaptation to heterogeneous soil gradients in *Collinsia sparsiflora*, an annual plant that appears to be in the early stages of speciating on serpentine and non-serpentine soils.

Poster Design by Shorty Boucher and Shane Waddell

For more information on the Natural Reserve System go to http://nrs.ucop.edu
For more information on the McLaughlin Reserve go to http://nrs.ucdavis.edu/mclaughlin.html
and see the new handbook, *Natural History of the McLaughlin Reserve,* available at UC Davis.