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A GENERAL LOCATION GUIDE FOR ULTRAMAFIC ROCKS IN CALIFORNIA - AREAS MORE LIKELY TO CONTAIN NATURALLY OCCURRING ASBESTOS

August, 2000

DEPARTMENT OF CONSERVATION
Division of Mines and Geology

STATE OF CALIFORNIA
GRAY DAVIS
GOVERNOR

THE RESOURCES AGENCY
MARY D. NICHOLS
SECRETARY FOR RESOURCES

DEPARTMENT OF CONSERVATION
DARRYL YOUNG
DIRECTOR

A General Location Guide for Ultramafic Rocks in California - Areas More Likely to Contain Naturally Occurring Asbestos

Compiled By
Ronald K. Churchill and Robert L. Hill
August 2000

MAP PURPOSE

This map shows the areas more likely to contain natural occurrences of asbestos in California. Its purpose is to inform government agencies, private industry and the public of the areas in the State where natural occurrences of asbestos may be an issue. In these areas, consideration of the implications of the presence or absence of asbestos through examination of more detailed maps and site-specific investigations could be warranted as part of public or private decision making. Natural occurrences of asbestos are more likely to be encountered in, and immediately adjacent to, areas of ultramafic rocks. The general location of these rocks is noted on this map. While geologic conditions are more likely for asbestos formation in or near these areas, its presence is not certain. The only way to establish the presence or absence of asbestos at a specific location is through a detailed site examination by a qualified geologist.

EXPLANATION OF ULTRAMAFIC ROCK UNIT

Ultramafic rocks are dunite, peridotite, pyroxenite, and less common in California, hornblendite (IUGS classification of ultramafic rocks, in Philpotts, 1990*). These igneous rocks contain 90 percent or more of the dark colored iron-magnesium-silicate minerals olivine, augite, hypersthene, or less commonly hornblende. Ultramafic rocks form in high temperature environments well below the surface of the earth. By the time they are exposed at the surface by uplift and erosion, ultramafic rocks may be partially to completely altered to serpentinite, a type of metamorphic rock. Sometimes the metamorphic conditions are right for the formation of chrysotile asbestos or tremolite-actinolite asbestos in bodies of ultramafic rock or along their boundaries.
Note--occurrences of non-ultramafic rock types, such as gabbro or diabase, may be included within some of the ultramafic rock areas shown on this map. Asbestos is much less likely to be associated with these non-ultramafic rock types.

INFORMATION SOURCES

The ultramafic rock areas shown on this map are adapted from Jennings, C.W., 1977, Geologic Map of California, California Department of Conservation, Division of Mines and Geology, Geologic Data Map No. 2, scale 1:750,000.

*Philpotts, A.R., 1990, Principles of igneous and metamorphic petrology, Figure 6-3, IUGS (International Union of Geological Sciences) classification of ultramafic rocks: Prentice Hall, Englewood Cliffs, New Jersey, page 96.

This map may be viewed on the California Department of Conservation website at http://www.consrv.ca.gov, which includes links to other sites with asbestos information.

MAP USAGE AND LIMITATIONS

The small scale of this map (1:1,000,000) precludes showing detailed boundaries of ultramafic rock units and small occurrences of ultramafic rocks. It should be used only as a general guide to the presence of ultramafic rocks that may contain asbestos. This map is derived from the Geologic Map of California (1:750,000 scale - one inch equals about 12 miles), Jennings (1977). No ultramafic rocks are shown in Solano and Madera counties on this map. However, ultramafic rocks are shown as present in these counties on available more detailed maps at scales of 1:250,000 (one inch equals about 4 miles) and larger. In addition to association with ultramafic rock and serpentinite, asbestos minerals are also known to occur in association with some faults in particular geologic settings, certain non-ultramafic related metamorphic rock types, and magnesium-rich carbonate rocks such as dolomite. These asbestos occurrences are much less common and their locations less well known than for ultramafic rocks. Consequently, such occurrences are not shown on this map.

This map should not be used to determine whether bedrock or soil on a particular parcel of land in or adjacent to areas identified as ultramafic rocks contains asbestos. A site-specific investigation would be required to make such a determination.

Definitions

Asbestos -- Asbestos is the generic term for the naturally occurring fibrous (asbestiform) varieties of six silicate minerals. These minerals are: chrysotile, tremolite (when fibrous), actinolite (when fibrous), crocidolite (fibrous riebeckite), anthophyllite (when fibrous), and amosite (fibrous cummingonite-grunerite). Chrysotile is the most common asbestos mineral in California and belongs to the serpentine mineral group. The remaining asbestos minerals belong to the amphibole mineral group. Asbestos also refers to an industrial product obtained by mining and processing deposits of the asbestiform minerals listed above.

Serpentine --The serpentine group minerals are hydrous magnesium silicate minerals, of which lizardite, antigorite and chrysotile are the most common. Chrysotile forms crystals that are naturally fibrous. These fibers occur in serpentinite in small veins, where the fibers are oriented perpendicular to the vein walls (cross-fiber veins) or parallel to the vein walls (slip-fiber veins). Chrysotile fibers are one type of asbestos. The other serpentine minerals usually do not occur as fibrous crystals and are not asbestos minerals. Although the term serpentine is commonly used to refer to the rock serpentinite, it is actually the name of the group of minerals that makes up the rock serpentinite.

Serpentinite -- Serpentinite is a rock consisting almost entirely of one or more serpentine minerals. Serpentinite is not identified as a separate rock unit on this map but is likely to be found within areas of ultramafic rock shown on the map. This rock type has a greasy or waxy appearance and may be dark to light green, brown, yellow or white. In addition to serpentine minerals, small amounts of other minerals such as magnetite, chromite, talc, brucite, and tremolite-actinolite may be present. Small amounts of chrysotile asbestos are common in serpentinite because chrysotile is one of the serpentine group minerals. Tremolite-actinolite asbestos (amphibole asbestos) may also occur with serpentinite, but such occurrences are less common than chrysotile asbestos.

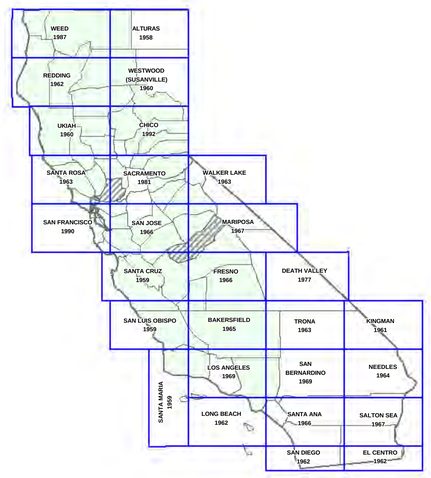
Massive serpentinite, partially to completely serpentinized peridotite (ultramafic rock), with a brown to reddish brown weathered surface due to oxidation of iron.

Sheared serpentinite showing its characteristic variegated green color and greasy luster.

Highly sheared and somewhat weathered light green to white serpentinite.

Cross-fiber chrysotile (asbestos) vein, 3/4 inch wide, in serpentinite.

INDEX TO GEOLOGIC ATLAS SERIES AND REGIONAL GEOLOGIC MAP SERIES MAPS



Counties in solid green contain ultramafic rock areas shown on the adjacent map. These areas are shown in more detail on the Division of Mines and Geology 1:250,000 scale Geologic Atlas and Regional Geologic Map Series maps. Madera and Solano counties, in diagonal pattern, have ultramafic rock areas shown on the Geologic Atlas and Regional Geologic Map Series maps that are too small to show on the adjacent map. Los Angeles County has small ultramafic rock occurrences on Catalina Island and a small occurrence is present in Kern County.

Acknowledgement: Dr. R.G. Coleman, Professor Emeritus, Stanford University reviewed a draft version of this map. Dr. Coleman's suggestions and comments are greatly appreciated.

DISCLAIMER

The State of California and the California Department of Conservation, Division of Mines and Geology make no representations or warranties as to the actual presence or absence of natural asbestos at specific sites within or near the ultramafic rock areas shown on this map. Further, the State and the Department make no representations or warranties regarding the accuracy of the data shown on the map. Neither the State nor the Department shall be liable under any circumstances for any direct, indirect, special, incidental or consequential damages with respect to any claim by any user or any third party on account of or arising from the use of this map.

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Miles

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Kilometers

SCALE 1:1,100,000

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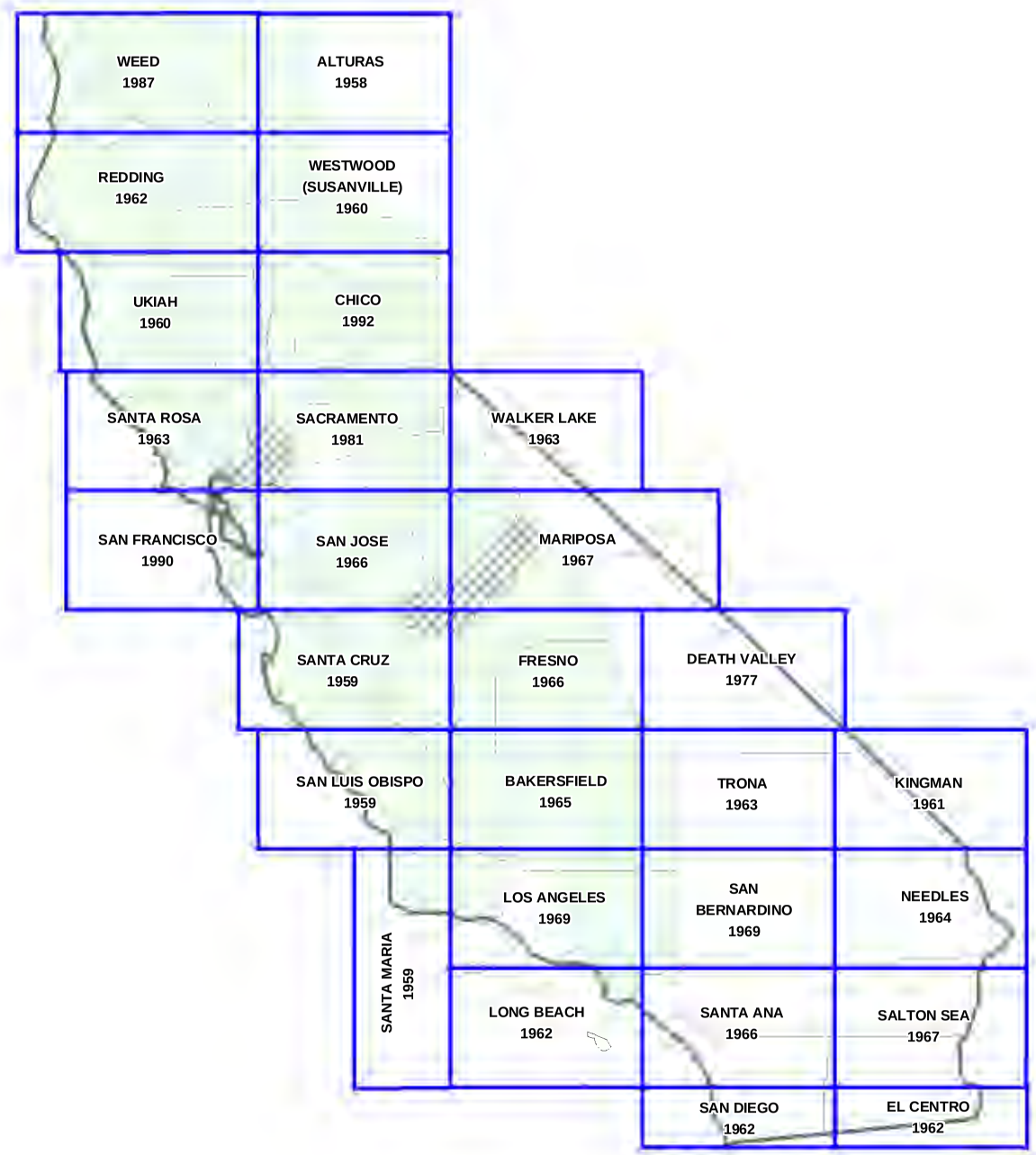

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EXPLANATION TEXT FOR MAP

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VIEWING AND PRINTING TIPS
A General Location Guide for Ultramafic Rocks in California – Areas More Likely to Contain Naturally Occurring Asbestos

Viewing the map

This map opens up in Acrobat Reader in “fit window” view. When you wish to zoom in and look at areas at a higher magnification, there are several ways to do so:

1. Use the magnifying glass icon on the left-hand tool bar and zoom in at preset increments, *or*
2. Click on the **View** pull-down menu for a variety of zoom options, *or*
3. Use the pop-up menu on the lower left toolbar to set exact zoom parameters.
4. To zoom back out with the magnifying glass icon active, press ctrl/alt/spacebar and click the mouse, *or*
5. Go back to **View** pull-down menu and change view, *or*
6. Use pop-up menu on the lower left toolbar to change view.

Printing the map

If you try to print this map, you’ll find that Acrobat Reader will simply print the entire map at your printer’s default page size. The resulting print isn’t very useful if you can only print to an 8.5 x 11 inch page. To print portions of this map at 1:1,100,000 (the original scale of the map) you’ll need Acrobat Reader and a graphics program such as Microsoft Paint, Paint Shop Pro, Corel Draw or Mac Paint. Armed with these tools, do the following:

1. Use Adobe Acrobat Reader to open map file.
2. To select an area, open the document and zoom to 100% at the area of interest. Hold mouse button down (if you have three buttons on your mouse, click on the left one) on the **Text Select** tool button, which will expand to three buttons. Choose the “grab graphics” tool button (last one on the right). Using this tool, select your area of interest..
3. Click on the **Edit** pull-down menu and select **Copy**. This places a copy of the selected area onto your computer’s clipboard. At this point, you can close Adobe Acrobat if your paint program requires the memory to run. If not, you can leave it open.
4. Open your paint program. In Microsoft Paint, make sure that the image area is at least as wide or as tall as the map area that you’ve selected. Choose the **Edit** pull-down menu, and click on **Paste**. In Paint Shop Pro, select **Paste as New Image**. The selected map area will be pasted into the view and can be printed. This “bitmap” image may appear “pixilated” or have jagged edges.

To print the entire map at full-scale requires a large-format color plotter. If you don’t have one, many reproduction firms do, and can plot the file for you.