Serpentinites and the High Incidence of Breast Cancer in Marin County, CA - Pilot Study

Authors: Janice Barlow, Scott Fendorf, Christopher Oze
Institutions: Marin Breast Cancer Watch, Stanford University, Dartmouth College

Background
Extensive deposits of serpentinites (metamorphosed ultramafic rocks) are present in Marin County and western California as discontinuous outcrops due to ocean crust emplacement and transform movement along the San Andreas Fault. Serpentinites contain elevated concentrations of toxic and carcinogenic elements including Cr, Ni, Fe, Mg, Mn, Co, Cd, V and Hg and weather (undergo chemical and physical alteration) to produce groundwater, soils (referred to as serpentine soils), sediments and dust also containing elevated levels of these elements. Concentration of these elements in Marin rocks and soil exceed carcinogen regulations set forth by OSHA, IARC, and CGIH. In Marin County as well as other serpentinite localities around the world, the extent of exposure through inhalation, digestion, and dermal contact with water and dust and the role of these carcinogenic elements in breast cancer etiology have never been explored.

Hypothesis
In this study, we hypothesize that the increased prevalence of breast cancer in Marin County is due in part to exposures in areas with serpentinite rock, soils formed from these rocks, and related waters due to the abundance and availability of toxic and carcinogenic elements (Cr, Ni, Fe, Mg, Mn, Co, Cd, V, and Hg) inherent of these rocks, soils, and waters.

Objectives/Aims
The long-term aim is to address the community’s concern whether the increased prevalence of breast cancer in Marin County is due in part to exposure to areas with serpentinites and related materials (solids and solutions). The objectives to be completed in this pilot study include:

1. Obtaining geologic and chemical data for Marin and creating a modifiable GIS database
2. Assessing the concentration, geochemical availability, and pathways of elemental exposure and uptake of Cr, Ni, Fe, Mg, Mn, Co, Cd, V, and Hg related to serpentinites, related sediments, serpentinite soils, dust, and related water
3. Initiating the collection of breast cancer incidence and mortality databases with Marin specific, individual-level breast cancer risk factor data and residency information.

Methods
This project is at the scientific forefront of examining the potential role of non-anthropogenic carcinogenic elements in the initiation of breast cancer. A combination of field and laboratory studies as well as community involvement will begin to provide the foundation for evaluating the nature of these carcinogens and their potential association with breast cancer in Marin County. Mineralogical and geochemical analyses including optical microscopy, whole rock compositions, electron microprobe mineral compositions, and Raman spectroscopy will be performed on the collected samples in order to identify the specific minerals and phases contributing the noted carcinogenic elements. Whole rock/soil chemical analyses, chemical extraction experiments, and water and dust analyses will be completed at Stanford and Dartmouth and will be integrated into a GIS format to examine the spatial distribution and the potential pathways of bioaccumulation. This geologic and chemical data set will then be used in a future CRC proposal to examine potential correlations in breast cancer incidence (data collection initiated in this study) in Marin County.

Impact on Breast Cancer
Ultimately this study will begin to unravel whether certain carcinogenic elements derived from serpentinites and related material are potential factors that should be considered in future ecologic and etiology studies of breast cancer in Marin County as well as other geographic areas in the world having seemingly unexplainable high incidences and mortality rates of breast cancer. Additionally, this study might provide insight for epidemiological and biospecimen evaluation with regards to a specific element which might be highly concentrated, bioavailable, and breast cancer specific. If serpentinite-related elements do pose a potential hazard, the synergy created between Marin Breast Cancer Watch, scientists, and the community will be able to work collaboratively to formulate remediation strategies and government involvement.