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ENVIRONMENTAL GEOLOGIC MONITORING ON ACTIVE TERRANE MARGINS - EXAMPLES FROM CALIFORNIA

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When energy, mineral and waste disposal applications of geology impact resources such as groundwater, environmental geologic investigations determine the magnitude of potential threats. Since many geologic resources are associated with terrane and plate boundaries, including active faults, understanding the hydrogeologic regimes of active fault zones and boundaries between contrasting lithologic materials is essential to determining contamination of water supplies.

The crustal geology of California includes a number of older accreted and autocthonous terranes (Blake et al, 1982). Tectonic motions associated with the interaction of the Pacific and North American plates provide an example of how terranes are translated along the Pacific Rim. This has produced various instances in which potential sources of groundwater contamination are located atop active faults and geologic contrasts, due either to the location of geologic resources, or topography resulting from tectonics. Two case studies of hydrogeologic investigations in active faulting regimes are presented.

Case 1). A cement plant on the SE slopes of the Tehachapi Range is located at the intersection of the Garlock fault zone and structural features parallel to the San Andreas fault zone, 8 km east of the intersection of the main fault traces (Figure 1). The San Andreas fault is the surface boundary between the Pacific plate, comprised of various small terranes, and the North America plate. At upper mantle depth, Hadley & Kanamori (1976) sugggest that the boundary is to the east, beneath the Mojave Desert, so this area represents active terrane formation by crustal dismemberment.

Cement kiln dust (CKD), a byproduct of the Portland cement process, is disposed in a mining waste pile over a graben btween two Garlock zone faults, the Range Front fault and the Pinyon Hill fault (Figure 2). Due to high pH (>12.5), CKD may be considered hazardous waste. Groundwater contaminated by high pH would be easily detected, so pH is a good indicator parameter for monitoring.

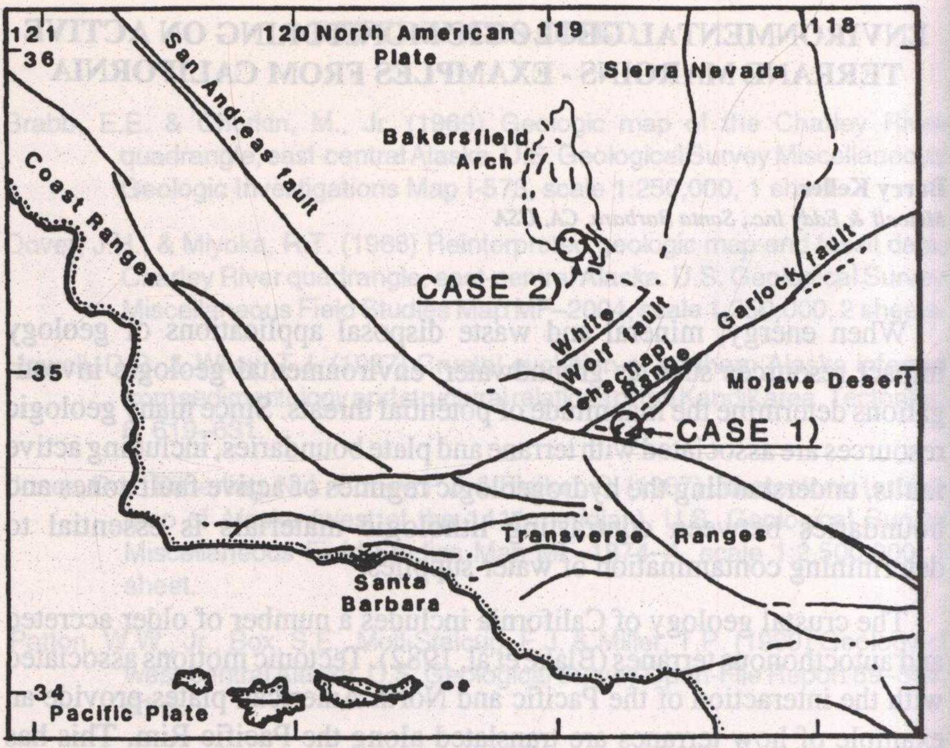

Figure 1. Locations of study areas in California. Also shown are major faults and physiographic provinces.

Groundwater hydrogeology is controlled by the fault zones, with springs and artesian monitoring wells indicative of upward hydraulic gradients. Elevations of groundwater are controlled by permeability variations between fault gouge and sandier material. Monitoring results indicate that the CKD waste pile has not contaminated groundwater.

Case 2). A municipal landfill is located on a structural high of Neogene sedimetary rocks called the Bakersfield Arch (Figure 1). This area had seismic surface rupture in 1952 during a sequence of earthquakes starting with the M 7.2 White Wolf fault earthquake. These earthquakes may represent a NE shift of the locus of plate interaction corresponding to the position of the subducted East Pacific Rise spreading center (Keller, 1981).

An E-W trending fault, named Kern Bluff fault, was projected to underly the landfill site, based on subsurface data from the adjacent Kern Bluff oil field. Trenching revealed the surface fault trace, which offsets modern

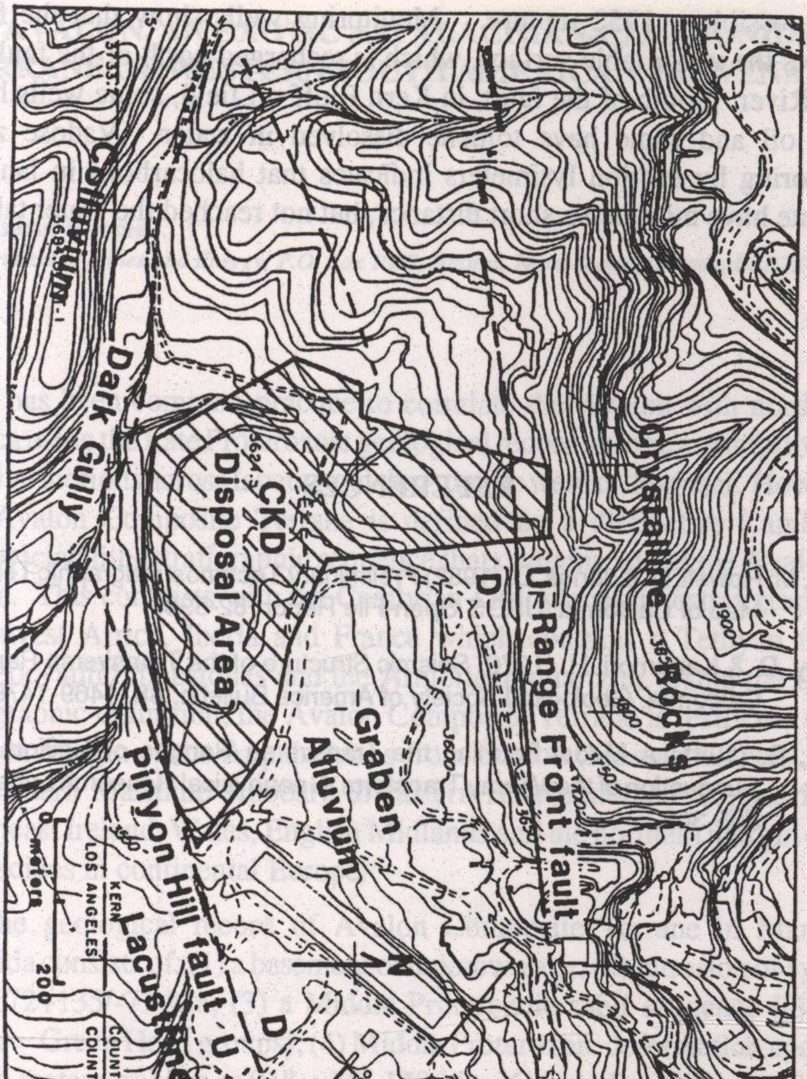

Figure 2. Site specific map of Case 1) area. The CKD disposal area is located on a graben near the intersection of Garlock zone faults with features parallel to the san Andreas fault.

soils, possibly a 1952 rupture. Monitoring wells show that the fault disrupts the water table surface, which is recharged north of the fault by Kern River. South of the fault, in Kern Bluff oil field, some wells have crude oil and some have toluene dissolved in water. Vadose zone monitoring by suction lysimeters indicates that halocarbons in landfill leachate have migrated a short distance, but not reached the water table.

REFERENCES

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