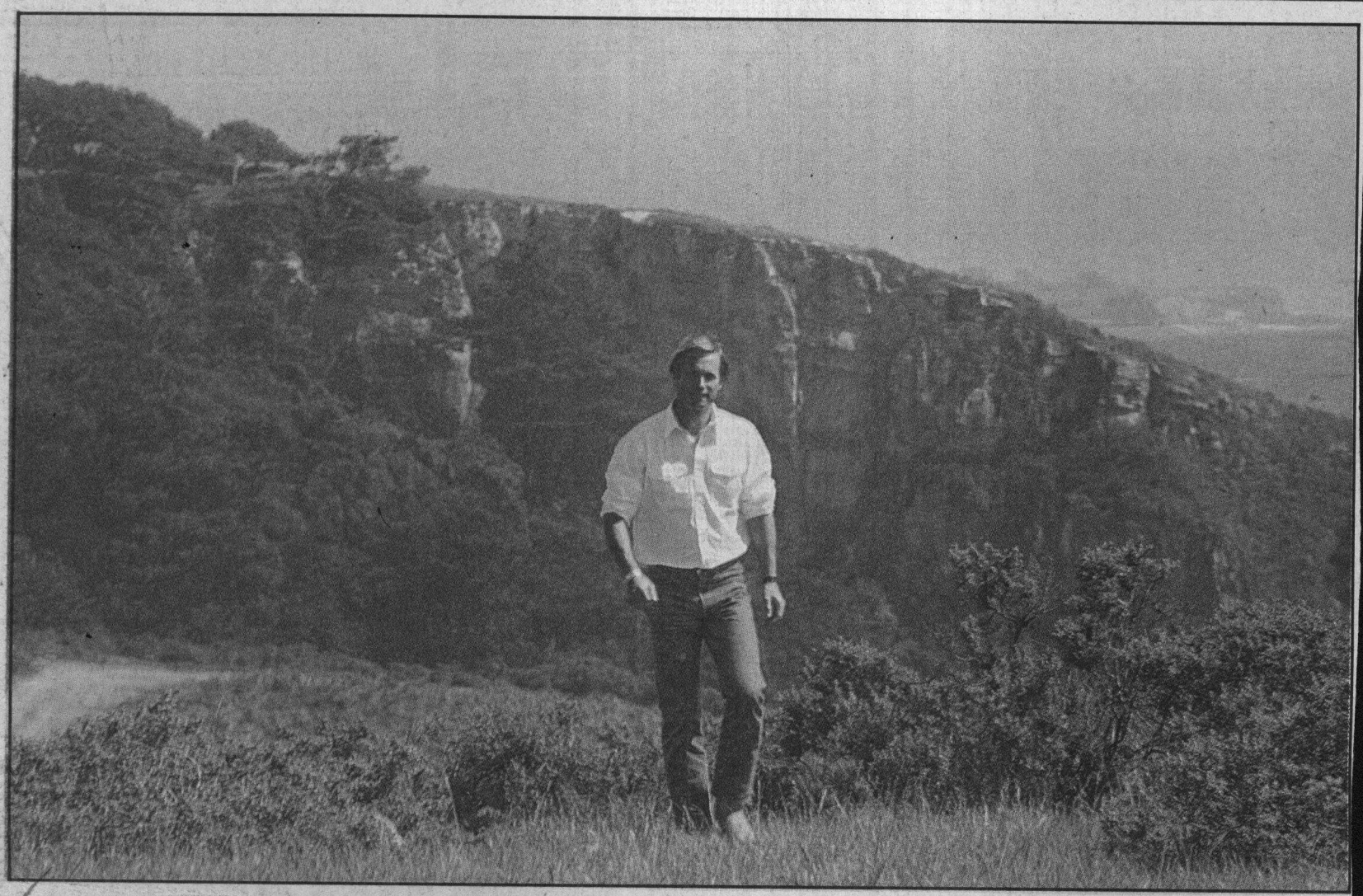
Geology

Health/science



Dan Coyro/Sentinel

Geologic upliftings result in the terraces along the north coast seen behind Professor Gary Griggs.

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The county's biggest transients

By DONALD MILLER
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SANTA CRUZ — Since it seems that a disproportionate number of people living in Santa Cruz County came here from someplace else, it also seems only appropriate that the physical backbone of the county, the Santa Cruz Mountains, are geologic vagabonds themselves.

To understand how they got here and what the mountains are made of requires taking a rocky road into the past, merely a few hundred million years ago. ...

The Santa Cruz Mountains are both very old and very young, in geologic time, says UCSC Professor of Earth Sciences Gary Griggs.

The mountains' core is made up of granite, says Griggs. This core forms a "basement" of the coastal range, which makes up the eastern boundary of the county. The granite, roughly 70 million to 90 million years old, is actually a chunk of what has become Southern California, and was displaced from what is now the Sierra Nevada.

The granite, which dominates Ben Lomond Mountain and much of the Empire Grade area, is part of a *batholith*, says Griggs — a big, igneous body of rock that moved along the geologic plate we see today as the San Andreas Fault.

The granite also is a cash crop of sorts — because it is so old and thus weathered, quarries such as Felton and Olive Springs ship it off as a paving material.

CHUNKS of marble can be found along the granite deposits, says Griggs. Local lime kilns and Davenport's cement plant live off the weathered marble deposits.

Much of the UCSC campus sits above the limestone, which is more than 90 million years old.

Another type of rock is found under UCSC, says Griggs — schist, which weathers into a reddish soil with shiny areas that often reflect sunlight. The schist probably started as limestone or siltstone, says Griggs, and is even older than the granite and marble - approximately 150 million to 200 million years old.

It is so old, says Griggs, that geologists cannot truly know how old it is, since fossil evidence and other dating material is long gone. "We just know it's older than the granite," he says.

That takes care of the first 200 or so million years. It is the last million that have added finishing touches to the mountains' ancient outline.

SITTING on top of all the igneous rock is sedimentary rock. This rock makes up the county's lowlands.

There are a multitude of sedimentary formations, all of which have abundant fossil evidence of their geologic past, and which give particular county areas their distinctive topography.

Griggs outlined four such formations, listing them in order of age, youngest first:

- The Purisma Formation — dominates mid-county, Soquel and Aptos. The formation is characterized by fossilized whalebones and seashells.
- Santa Cruz Mudstone — makes up the sea cliffs, with their characteristic terraces, from Natural Bridges to Ano Nuevo at the county's northern border.
- Santa Margarita Sandstone — another economic boon for some county residents. The clean, white sand that is quarried out of Scotts Valley — and delivered by truck by way of Highway 17 — comes from this formation. It is very old, beach sand, says Griggs, with sharks' teeth and sand dollar fossils.
- The next oldest formation is Monterey Shale — which yields petroleum along much of the Central California coast. It can be seen along Ano Nuevo.

Fossils of sea life, incidentally, can be seen way above Scotts Valley. Griggs explains that the earth's crust is relatively thin, and is redistributed almost at geologic will. Seashell fossils have been found on the top of the Himalayas, he says.

THE FOUR sedimentary formations show that the lowlands have been covered by advancing and retreating water, with cycles of shallow and deep water.

All of downtown Santa Cruz has been covered with sedimentary rocks and then covered with water, as has all of mid-county, says Griggs, "from a few meters to hundreds of meters below sea level, over hundreds of millions of years," he says.

The sedimentary formations also promoted the growth of the mountains' redwood forests.

The trees — what kind and where they are found — can offer stark evidence of the different kinds of sedimentary rock in the Santa Cruz Mountains. On Graham Hill Road, driving toward Felton, the prevailing Santa Maragarita Sandstone provides a foothold for pines and oaks. A bit farther up the road, the redwood forest begins, when the soil changes and can hold moisture.

The Empire Grade area sits on granite, which allows only pines and scrubby brush and small trees to take root.

The most recent geologic activity in the mountains has occurred along the coast, which has been uplifted into "benches," or terraces. This uplifting begins around the intersection of Mission Street and Highway 1 and continues up to Davenport. There have been at least five such upliftings in the past 500,000 or so years.

Each time the sea level has dropped, a terrace is preserved.

These terraces can be easily seen. Griggs can see several near his home along the north coast. Three different terraces are apparent on the UCSC campus around the barn area and near the new student housing.

THE Santa Cruz Mountains also are home to numerous earthquake faults — "a whole stack of them," says Griggs.

The two of most concern are the San Andreas and the San Gregorio.

The malevolent San Andreas comes into the county after making a bend at San Juan Bautista, around Chittenden Pass (Highway 152), then passes behind Watsonville, through the Holy City area of the mountains on the Santa Clara County side and then along the county line-Skyline Boulevard area toward Pacifica and Daly City.

"These mountains are part of a block of land that is displaced between the San Andreas and the ocean now," says Griggs.

The San Gregorio system runs from Bodega above San Francisco, all the way down the coastline, through Half Moon Bay to Ano Nuevo and along the outer edge of Monterey Bay, and down past Diablo Canyon and its nuclear reactor, in San Luis Obispo County.

The rate of movement on a fault — there are several other less consequential faults in the Santa Cruz Mountains — determines its potential for an earthquake, Griggs says. The San Gregorio moves about 1 centimeter year, and the San Andreas about 3.2 centimeters a year.

Because of its greater movement, the San Andreas provides the most worry, says Griggs.

The future? Griggs says Santa Cruz and the Santa Cruz Mountains will continue the process that began hundreds of millions of years ago — moving to the northwest, about 3.5 centimeters a year. This means that if you live 100 years, and are watching, you'll see 10 feet of movement.