Duck and cover? The art of earthquake prediction

By Mark Wheeler / Hi-Desert Star *Friday, July 30, 2004 11:07 PM PDT*

Vladimir Keilis-Borok is a Russian geophysicist, professor in residence at UCLA's Institute of Geophysics and Planetary Physics, and much quoted authority on seismology. Earthquakes are what seismology is all about, and the quotes attributed to Keilis-Borok are all earthquake related. Take the latest one, for example, a version of it here reproduced from a United States Geological Survey report.

"The prediction is for a magnitude 6.4 or greater earthquake to occur between January 5 and September 5, 2004, within a 12,440 square miles area of southern California that includes portions of the eastern Mojave Desert, Coachella Valley, Imperial Valley (San Bernardino, Riverside and Imperial Counties) and eastern San Diego County."

Although the USGS statement of the Keilis-Borok prediction describes a large geographic area, the prediction's implicit target is the southernmost portion of the San Andreas Fault, right where it runs through the Coachella Valley.

This is most certainly an ominous forecast, but as earthquake-country residents have learned by now, earthquake forecasts typically don't score high on the reliability scale. More than a few scientists have, in fact, gone on record calling the idea of accurate earthquake prediction an "impossibility." That's what makes the Keilis-Borok predictions so unnerving to many. He and his team have made some uncannily accurate and near-accurate forecasts, and their record seems to improve with practice.

Track record

In 1986, the Keilis-Borok team predicted a quake would hit an area containing Loma Prieta within five years. In 1989, a 7.1 magnitude shaker at that location fulfilled the prophesy. The 1994 Northridge quake of 6.8 magnitude took place only 21 days after an 18 month prediction window the Keilis-Borok team had identified closed. Although they were only close with the date, their magnitude prediction of 6.6 or greater was right on.

During 2003, the team's accuracy score made a quantum leap. Announcing in July of that year a 7+ magnitude earthquake would hit Japan by Dec. 28, the team was proven correct when an 8.1 magnitude disaster struck that city on September 25.

Closer to home, San Simeon's 6.5 event confirmed a June announcement, warning that a 6.4-plus magnitude quake would strike within nine months in a 310 mile region of

Central California containing San Simeon. That quake occurred on Dec. 22.

Criticism and insults

Many authorities dispute Keilis-Borok's predictions. For instance, scientist-in-charge of the USGS Southern California Hazards Team Lucy Jones states flatly: "Predicting earthquakes is impossible." In defense of her view, Jones argues that far too many variables are involved in a large seismic event to account for them all in a practical way.

Rather a bit more insulting in his statement on the subject of earthquake prediction, developer of the famous Richter Scale, Charles Richter, put it this way. "Prediction provides a happy hunting ground for amateurs, cranks, and outright publicity-seeking fakers."

Despite the rebukes and remonstrances, serious scientists continue looking for the key to foretelling seismic events, and hard-science institutions and governments continue to fund their research. The reason for this seeming contradiction is spelled out by another USGS Hazards Team geophysicist Ross S. Stein. In a January 2003 Scientific American article he wrote, "scientists have plenty of reason to keep pursuing this dream," and he counted those reasons in the hundreds of millions of people who "live and work along the world's most active fault zones."

Some of those millions live and work along California's San Andreas Fault, one of the world's great research faults, and one of its most fearsome.

Not if, but when

No seismologist, including Lucy Jones, disagrees that the southern San Andreas Fault is overdue for a quake, and will probably cut loose with a 7+ magnitude bone-shaker sometime within the next 30 years. What the experts debate is whether the quake's epicenter can be accurately identified in advance, and whether the date for its massive slip can be foretold with enough precision to make evacuation and other tactical actions practical.

Clearly, Keilis-Borok and his team think they're closing in on the magic formula. Their method relies heavily on mathematical analysis and is, therefore, not unlike many other prediction models. However, it does differ in its scope and in the way it interprets the data.

"Four symptoms" raise the red flag for Keilis-Borok's team. Enumerated in a UCLA bulletin, they are: small earthquakes increasing in an area, not necessarily on the same fault line; earthquakes clustered in time and in location; simultaneous earthquakes occurring over large distances in a seismic region; an increase in the ratio of medium-magnitude earthquakes to smaller ones.

What the forecasters saw in the southern San Andreas Fault data last fall was a pattern of small quakes they could identify as a precursor condition for a big one. According to their model, this opened a nine month window of strain intensity they expect should close with an earthen bang sometime before September 5.

No time for response

That a southern San Andreas Fault quake will be a big one is almost universally assumed. Study after study has confirmed the history of the fault in this region is one of large magnitude events, as announced once again just this month by Cal Tech in a news release stating it bluntly: "Earthquakes along the San Andreas, though infrequent, tend to be very large."

The last big one in this area occurred in 1857, a shaker north of Los Angeles at Fort Tejon estimated at 7.9 magnitude. It left a 220 mile scar. Trench studies show events like this one in the southern San Andreas Fault happen every 130 years or so. At present, the sleeping giant is 17 years overdue.

If local, short term earthquake prediction ever becomes a reality, it will be a monumental achievement for science. It will move us closer to taming one of nature's most awesome and potentially deadly phenomena. Consider the might and brute force of a famous San Andreas quake that occurred near its northern extremity.

At 5:12 a.m., April 18, 1906, San Francisco shook with the violence of a 7.7 to 7.9 magnitude quake. Much of that seismic disaster's property damage and human tragedy has been preserved in historic accounts and retold many times. Little, however, is ever mentioned about the dynamics of the quake itself.

Starting on the Pacific Plate deep in the ocean, the quake hit land 90 miles north of San Francisco and sped south. It traveled 270 miles, from Mendocino County to San Juan Bautista in less than four minutes. That's about 4,000 miles per hour. During the event, visible displacement along the fault reached 21 feet.

Science continues to pursue earthquake prediction because when this kind of stupendous force is released, it's too late to do anything but hang on for dear life. Only two people were reported killed in the last southern San Andreas Fault tantrum at Fort Tejon. The region was only sparsely populated in those days. Nine million now live and work in the zone of prediction identified by the Keilis-Borok team.