Kelly Wiseman collects data near the San Andreas Fault in California.

FINDING FAULT

Geophysicist Kelly Wiseman is keeping a close watch on earthquake activity in one of Earth's danger zones.

By Bobby Oerzen

Kelly Wiseman was only 6 years old in 1989. Still, Oct. 17, 1989, is a day she remembers as if it were yesterday. Late in the afternoon, she and her mom were traveling to their home in San Jose, Calif., after picking up some take-out food. They couldn't wait to watch Game 3 of the World Series on TV. Two California teams, the San Francisco Giants and the Oakland Athletics, were playing.

Suddenly, the pavement started to heave. A magnitude 6.9 earthquake had struck. "Cars started bouncing; streetlamps were swaying," Wiseman recalls. "I couldn't believe it was happening. It was kinda cool.

"That's one of my earliest memories. Since then, I've always had an interest in earthquakes."

In college, Wiseman majored in geophysics and completed a summer internship in which she studied the San Andreas Fault—the fault that caused the quake of '89. Today, Wiseman is a graduate student at the University of California, Berkeley, furthering her interest in earthquakes, this time in one of the planet's shakiest regions.

BROKEN PLATES

Earthquakes are set off by the movement of *tectonic plates*, the enormous slabs of Earth's shell that intersect like pieces of a jigsaw puzzle. Tectonic plates are always in motion; on average, they move between 2.5 and 15 centimeters (1 and 6 inches) per year. Wherever two tectonic plates border each other, they interact in one of three ways: they either pull apart, press together, or slide past each other.

The movements of tectonic plates cause large *faults* (cracks) to appear in the crust near the plate boundaries. The ground normally moves along the two sides of a fault, but that movement isn't always smooth and gradual. The two sides of a fault can get hung up against each other. Stress builds up there until—*snap!*—the fault slips with a jerk. Seismic waves ripple through the ground, and an earthquake happens. Wiseman's work involves monitoring the gradual and abrupt movements of the ground on either side of faults.

WALL OF WATER

Wiseman's main focus is the Mentawai Fault near Sumatra, an island in Indonesia. A nearby fault called the Sunda Megathrust, which runs under the Indian Ocean, caused one of the worst natural disasters in recent memory: a huge *tsunami* that struck the coasts of southern Asia in 2004, killing more than 280,000 people. A tsunami is a huge sea wave or series of waves set off by a submarine earthquake, landslide, or volcanic eruption.

The tsunami started where two tectonic plates—the Indian Plate and the Sundaland Plate—are slowly *converging* (colliding). As the Indian Plate moves under the Sundaland Plate, it sticks in places and pulls the edge of the Sundaland Plate down with it. In 2004, the edge of the Sundaland Plate snapped up, triggering a magnitude 9.2 earthquake. The motion of the snap pushed the water above the Sunda Megathrust upward. At the surface, the water formed a hill that spread, forming the waves of a gigantic tsunami.

"My adviser at Berkeley was interested in studying the great 2004 Megathrust earthquake," she explains. "I expanded the project to include other large earthquakes and faults in the Sumatra region." Wiseman leads a team whose members hail from not only the University of California, but also Nanyang Technological University in Singapore and the Indonesian Institute of Sciences.

Wiseman has never actually visited the Mentawai Fault. She uses the *Global Positioning System* (*GPS*) to observe it instead. The GPS is a network of 31 satellites orbiting the globe that monitors Earth's surface, including its tiniest movements.

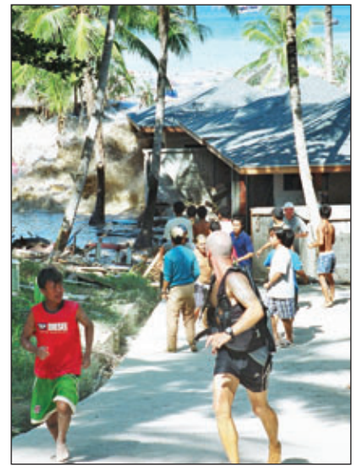
Using GPS data, Wiseman and her team receive real-time updates on the movements of the Mentawai Fault. "We can track everything from the computer," says Wiseman. "We are able to locate a position on Earth's surface within a few millimeters."

STRESSED OUT

Wiseman's research has revealed that the Mentawai Fault is an *active fault*, which means another earthquake is likely to occur there. The project has documented the occurrence of two earthquakes along the Mentawai, one in 2005 and one in 2009.

Those two earthquakes resulted from ruptures along small portions of the Mentawai Fault, so they didn't produce tsunamis. But the size and nature of the fault suggest that a rupture of the whole fault "could trigger a significant tsunami," says Wiseman. Small quakes such as the two she has documented could be signs that the region's crust is close to being "critically stressed."

Wiseman hopes her research will better assess the hazards of earthquakes and tsunamis in the Sumatra region. "Much of what I study," she says, "forecasts the dangers we'll see in this lifetime and our grandchildren's lifetime." **CS**



Top: On an island in Thailand, people flee the tsunami that struck coastal regions of southern Asia in 2004. Bottom: A village in Sumatra that the same tsunami inundated with water

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