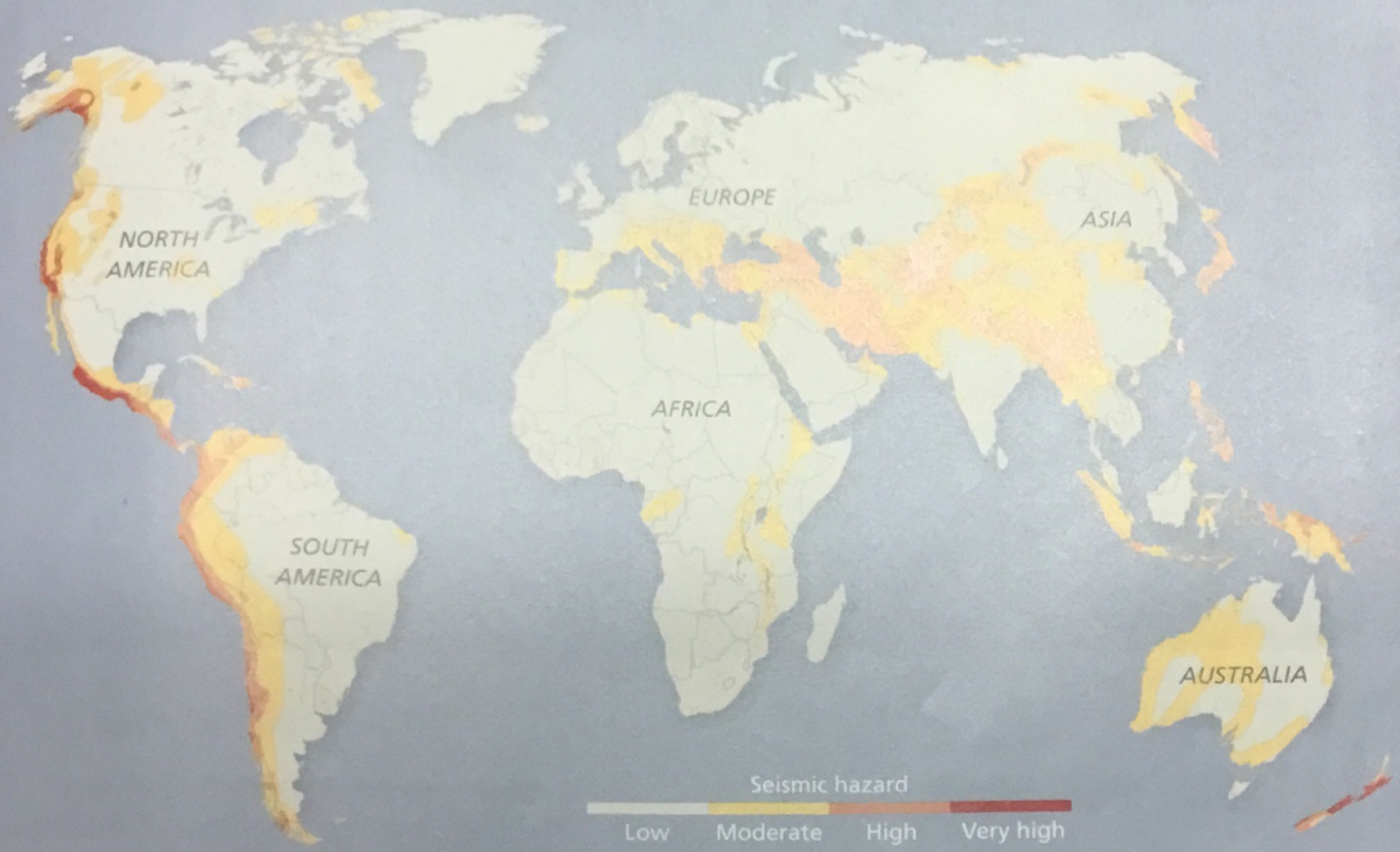
4B

EARTHQUAKE ZONES



Before You Read

A. True or False. The map above shows the areas that are most at risk of disastrous earthquakes. Read the sentences below (1–3), and circle **T** (True) or **F** (False).

1. Southern Europe and Central Asia have many serious earthquakes. **T** **F**
2. People living along the east coasts of North and South America are often affected by earthquakes. **T** **F**
3. Australia has a low or moderate probability of earthquake. **T** **F**

B. Scan. Quickly scan the reading on pages 66–67 to answer this question: Does the author of this passage think that predicting earthquakes is possible? Then read the passage to check your answer.

The waves of an earthquake come in two forms. P-waves (yellow) arrive fastest and compress and punch the rock. S-waves (red) are slower but more destructive. They move from side to side to shake and destroy buildings. The building features in blue, such as deep foundations, can protect a building from earthquakes.

Is Prediction Possible?

Never before have so many people packed into cities—places such as Los Angeles, Istanbul, Tokyo, and Lima—that are regularly affected by earthquakes. Located near the edge of Earth's huge, shifting plates, these cities face the risk of death and economic disaster from large quakes—and from the tsunamis, fires, and other destruction they often cause.

We understand earthquakes better than we did a century ago. Now, scientists would like to predict them, but is this possible? Today, some of the simplest questions about earthquakes are still difficult to answer: Why do they start? What makes them stop? Perhaps the most important question scientists need to answer is this: Are there clear patterns in earthquakes, or are they basically **random** and impossible to predict?

In Japan, government scientists say they have an answer to the question. "We believe that earthquake prediction is possible," says Koshun Yamaoka, a scientist at the Earthquake Research Institute at the University of Tokyo. Earthquakes follow a pattern; they have observable signs, Yamaoka believes. In fact, Japan has already predicted where its next great earthquake will be: Tokai, a region along the Pacific coast about 160 kilometers (100 miles) southwest of Tokyo. Here, two plate boundaries have generated huge earthquakes every 100 to 150 years. And it could be a **massive** quake. The section along Tokai hasn't had a major quake since 1854. The theory is that strain[1] is building up in this region, and that it's time for this **zone** to reduce its stress. Unfortunately, this is more a forecast

1 **Strain** is force or pressure that causes something to break or become damaged.

"We believe that earthquake prediction is possible."

Koshun Yamaoka, Research Scientist

than a prediction. It's one thing to say that an earthquake is likely to happen in a high-risk area. It's another to predict exactly where and when the quake will occur.

The desire for a **precise** prediction of time and place has led to another theory: the idea of "preslip." Naoyuki Kato, a scientist at the Earthquake Research Institute, says his **laboratory** experiments show that before a fault in the Earth's crust finally breaks and causes an earthquake, it slips[2] just a little. If we can **detect** these early slips taking place deep in the Earth's crust, we may be able to predict the next big quake.

Clues in the Desert

Scientists working in Parkfield, California, in the U.S. are also trying to see if predicting earthquakes is possible. They've chosen the town of Parkfield not only because the San Andreas Fault runs through it, but because it's known for having earthquakes quite regularly—approximately every 22 years. In the late 1980s, scientists in Parkfield decided to study the fault to see if there were any warning signs prior to a quake. To do this, they **drilled** deep into the fault and set up equipment to register activity. Then they waited for the quake.

Year after year, nothing happened. When a quake did finally hit on September 28, 2004, it was years off **schedule**, but most disappointing was the lack of warning signs. Scientists reviewed the data but could find no evidence of anything unusual preceding the September 28th quake. It led many to believe that perhaps earthquakes really are random events. Instead of giving up, though, scientists in Parkfield dug deeper into the ground. By late summer 2005, they had reached the fault's final depth of three kilometers (two miles), where they continued collecting **data**, hoping to find a clue.

And then they found something. In an article published in the July 2008 journal *Nature*, the researchers in Parkfield claimed to have detected small changes in the fault shortly before an earthquake hit. What had they noticed? Just before a quake, the cracks in the fault had widened slightly. Scientists registered the first changes ten hours before an earthquake of 3.0 on the Richter scale[3] hit; they identified identical signs two hours before a 1.0 quake—demonstrating that perhaps the "pre-slip" theory is correct. In other words, it may in fact be possible to predict an earthquake.

Although there is still a long way to go, it appears from the research being done all over the world that earthquakes are not entirely random. If this is so, in the future we may be able to **track** the Earth's movements and design early-warning systems that allow us to predict when a quake will happen and, in doing so, prevent the loss of life.

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2 If something **slips**, it slides out of place.

3 The **Richter scale** is a scale used for measuring how severe an earthquake is. Higher numbers are more severe.

Reading Comprehension

Multiple Choice. Choose the best answer for each question.

Gist

1. What is the reading mainly about?
   a. earthquake prediction failures
   b. the Japanese government's work on earthquakes
   c. efforts to predict when an earthquake will happen
   d. the Parkfield investigations

Paraphrase

2. Which of the following is closest in meaning to the reading's first sentence, beginning *Never before have . . .*?
   a. Many people who live in big cities have experienced earthquakes.
   b. Cities crowded with people are more likely to have serious earthquakes.
   c. Some of the biggest cities in the world suffer damage from earthquakes.
   d. More people than ever live in cities that are affected by earthquakes.

Reference

3. In line 61, what does *do this* refer to?
   a. wait for an earthquake
   b. study the fault
   c. predict an earthquake
   d. set up equipment

Vocabulary

4. In line 68, the word *reviewed* could be replaced with _____.
   a. recorded
   b. deleted
   c. saw
   d. studied

Detail

5. Which of the following statements is NOT true?
   a. A major earthquake occurs in Tokai every 100–150 years.
   b. Scientists believe that the "pre-slip" theory could help predict earthquakes.
   c. Data supporting the "pre-slip" theory was found in Parkfield.
   d. There was a major earthquake in Parkfield, in late summer 2005.

Cause and Effect

6. According to Parkfield scientists, how did cracks in the fault change before an earthquake hit?
   a. They became much wider.
   b. They became slightly narrower.
   c. They became slightly wider.
   d. They became much narrower.

Main Idea

7. What is the main idea of the last paragraph (starting line 90)?
   a. Further research will help us avoid loss of life in the future.
   b. Earthquake research has had a long and successful history.
   c. Early-warning systems are being designed to predict earthquakes.
   d. It is unlikely we will ever be able to predict the Earth's movement accurately.

Critical Thinking

Evaluating: In order to prove useful, how long before an earthquake should the early-warning system send a warning to the people?

Discussion: Which type of natural disaster mentioned in this unit concerns you the most? Why?