

# Elements

An International Magazine of Mineralogy, Geochemistry, and Petrology

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 Proofreader: MARTHA EVONUUK  
 Printer: ALLEN PRESS

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## THE SIREN CALL OF CASCADIA

DOI: 10.2138/gselements.18.4.215



Becky Lange

National parks are surely one of the best ideas of the civilized world, right up there with the invention of writing and public education. Although the United States was the first country to create a national park (Yellowstone in 1872), it is far from having the largest

number with its current count at 62. According to the International Union for Conservation of Nature's registered list, Australia leads the pack (685), followed by Thailand (147) and India (116) for the top three.

We urgently need these preserves now more than ever, not only to protect the biodiversity within them, but for our own sanity and well-being. Not surprisingly, the Cascadia subduction zone (the captivating subject of this issue of *Elements*) has more than its share of national parks per square kilometer. There are nine from north to south: the Pacific Rim and Gulf Island national parks in British Columbia (Canada); the Mt Rainier, Olympic, and North Cascades national parks in Washington (WA, USA); Crater Lake National Park in Oregon (OR, USA); and Lassen National Park in California (CA, USA). This list expands by five when national monuments are included: San Juan Islands and Mt. St. Helens (WA), Newberry and Cascade-Siskiyou (OR), and Lava Beds (CA). It is perhaps not surprising that nearly half of these national parks and monuments include volcanic features.

For those of us of a certain age, mention of the Mt. St. Helens National Monument evokes stirring memories of its 1980 eruption. The astonishingly vivid photographic images (courtesy of Gary Rosenquist) of the massive failure of the northern side of the volcano, immediately followed by an exploding blast of magma, captured the imagination not only of volcanologists around the world, but also of the public at large. It awakened everyone to the hazards of living along the flanks of these spectacular volcanic edifices.

As discussed in chapter six of this issue of *Elements*, it is not only the spectacle of volcanic eruptions that has awakened the public, but also the tragedy associated with major earthquakes. Earth scientists were late in grasping the true magnitude and scale of the earthquake hazard in Cascadia, owing to its seismic quietude compared with other subduction zones around the world. In part, this reflected the hubris of only consulting the written record over the last 150 years, while ignoring the oral histories of local Indigenous tribes that reach far deeper into time.

We now have clear sedimentological evidence, both onshore and offshore, that the Cascadia subduction zone has produced numerous large,

Satake K, Shimazaki K, Tsuji Y, Ueda K (1996) Time and size of a giant earthquake in Cascadia inferred from Japanese tsunami records of January 1700. *Nature* 379: 246-249, doi: 10.1038/379246a0



Photograph of Mt. St. Helens—a U.S. national monument—two years after the 1980 eruption. (PHOTO COURTESY OF THE UNITED STATES GEOLOGICAL SURVEY)

devastating earthquakes over the last several thousand years. However, it was the detective work on the tsunami record in Japan that gave us an exact time and date for the most recent Cascadia megareupture (magnitude  $\geq 9$ ). Learning that this catastrophic event occurred precisely at ~9:00 p.m. on January 26, 1700 (Satake et al. 1996) rendered the severe seismic hazard along the Cascadia coastline far more real to the public than any sedimentary rock record ever could. Less than a decade later, the 2004 Indonesian earthquake (magnitude  $\geq 9.1$ ) and resulting tsunami, which took the lives of >225,000 people, underscored the harsh impacts that await those living along the coastline from Vancouver Island (Canada) down to northern California (USA), although perhaps not for another few hundred years or so from now.

It is our relatively short lives, and even shorter memories, compared to the frequency interval of catastrophic volcanic and earthquake events in Cascadia, that tempt communities to postpone mitigation measures, especially if they require upfront costs. But now there is the new, emerging natural disaster of mega-sized wildfires, which are occurring far more frequently than any volcanic eruption or seismic event, and they are beginning to take an ever-increasing toll on the health and wealth of those living in the Cascadia subduction zone.

The elevated Cascade Range has long drawn moisture out of air masses traveling eastward off the Pacific Ocean, supporting a substantial coniferous forest. However, global warming and persistent drought conditions have greatly increased the number and size of wildfires within these forests. As recently (and late in the season) as October 20, 2022, the city of Seattle held the unwanted record for the worst air pollution in the world on that date. The hazardous, smoky air is derived from the raging wildfires that now plague the entire Cascade Range on an annual basis, and they likely pose the gravest immediate threat to its national parks and monuments.

Despite all these dangers, the varied and majestic landscape of the Cascadia subduction zone continues to draw visitors (>100 million per year according to state tourism statistics). I, for one, am eagerly planning a field trip to the Cascade Range for students at the University of Michigan (USA), most of them native Midwesterners. The trip is already "over-subscribed" as the volcanic features of Crater Lake, Mount St. Helens, and Mt. Rainier emit a siren song that few can resist!

**Becky Lange**