OUR OCEAN BACKYARD

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ON THE RIM OF A VOLCANO

I am writing from a totally different ocean backyard this week, actually from a white-washed Greek village on the rim of the 32-square mile, 1,300-foot-deep caldera or crater of a volcano that erupted catastrophically 3,650 years ago in the eastern Mediterranean. Santorini, to most geologists, is the most interesting of all of the Greek islands, of which there are many, and it has a totally different geologic origin.

We are coming to the end of a nearly three-week adventure through Greece, with good friend and co-author of The Edge, Kim Steinhardt and his wife Madelyn. Never mind that temperatures have been in the 90s every day an­d that we picked the month when the greatest number of northern Europeans typically head south to the Mediterranean for their vacations, it has still been a great adventure, just a hot and often crowded one.

The eastern Mediterranean has had a nearly ten thousand year-long history of civilization with violence and conquests, invasions and battles, and changing ownership. But the geologic violence, including plate collisions and subduction with their associated earthquakes and volcanic eruptions, has gone on for over a hundred million years and continues to this day, although intermittently. A hike into Samaria Gorge on the south coast of Crete a few days ago was cancelled due to a rock fall from an earthquake, which injured at least one hiker.

Santorini, like Stromboli, Etna and Vesuvius in Italy, is the result of the collision and subduction of the African Plate beneath the Eurasian Plate. The very early Mediterranean (early in geologic time) was known as the Tethys Sea and extended eastward to where the Pacific Ocean now lies. Landmasses were arranged quite differently at this time, but about 200 million years ago the plates began to break up and new edges and land masses were formed.

As the African Plate moved northward and collided with the Eurasian Plate, it scraped off much of the seafloor sediment that had accumulated in the vast shallow and fertile Tethys Sea. These sediments were dominated by calcium carbonate, which is the stuff most marine organisms make their shells of, from corals to clams, as well as some very abundant microscopic plankton such as foraminifera and coccoliths.

It was this calcium carbonate mud from these microplankton that had been accumulating on the seafloor for millions of years, which over time, was consolidated into limestone and then with increased pressure and temperature was metamorphosed or converted to marble. Interestingly, this is exactly the process and the planktonic organisms that created the marble underlying parts of the county that was the source of the lime and cement industry in Santa Cruz County in the mid- to late-1800s and 1900s.

The Mediterranean limestone and marble was pushed upward by this collision of the two plates and now makes up parts of the Atlas Mountains in Morocco, the Alps of France and Italy and most of the Greek Islands. This is the marble that Michelangelo carved, and that the early Greeks built their temples and sculptures with.

However, to get back to Santorini where this all started, it is a volcanic island, like Etna, Vesuvius and Stromboli in Italy. There is a depression or trench running roughly east-west through the Mediterranean Sea, and this was where the African Plate is being forced down or subducted. As this plate descends deeper into the mantle of the Earth, it gets hotter and the fluids produced by this melting rise into the crust and erupt intermittently at the Earth’s surface, forming volcanoes.

This process is what is taking place today almost completely around the rim of the Pacific Basin and what has produced what is sometimes called the Ring of Fire or the circum-Pacific volcanoes. The Peru-Chile Trench, the Middle America Trench, the Cascadia Subduction Zone, the Aleutian Trench and then down the western side of the basin, are all places where the Pacific Plate is being forced down beneath the edges of the continents.

On the landward side of each of these trenches are lines of volcanoes. Perhaps best known to us are the Cascades, the southernmost being Mt. Lassen, then proceeding northward through northern California, Oregon, Washington and into British Columbia. Mt. Shasta, Mt. Mazama (Crater Lake), Mt. Hood, Mt. Saint Helens, Mt. Baker and Mt. Rainier being among the most prominent.

Santorini lies in a nearly identical geological setting and, in fact, has a similar history to Mt. Mazama, now filled with Crater Lake, which erupted catastrophically about 7,700 years ago, much like Santorini. One filled with rainwater and the other with seawater, and both now have islands in their calderas, formed by subsequent eruptions, with the last in Santorini having occurred in 1950. The small crater still steams from time to time, and is monitored for any pending eruptions. All seemed safe as we took a sunset cruise through the now flooded caldera.