



Koke'e State Park and Waimea Canyon Kauai, Hawaii

For science-savvy hikers, the rugged canyons of Hawaii's oldest island offer a glimpse into the mysterious behavior of Earth's magnetic field.

KAUAI IS OFTEN CALLED Hawaii's Garden Isle because of its lush tropical forests: Unlike the two active volcanoes on the Big Island, the volcano that birthed Kauai sputtered out 2 million years ago, letting the trees grow unmolested. For Occidental College geologist Scott Bogue, that long-dead volcano is Kauai's biggest draw. The island is one of the best places to peer

into the history of the Earth's magnetic field because its fluctuations are recorded in the ancient volcanic rock. Measure that field, Bogue knows, and you can deduce the inner workings of our planet, more than 1,800 miles below.

Some 4 to 5 million years ago, when Kauai was active, recurring eruptions coated the island in lava. While the lava was still hot, Earth's ambient field

magnetized the minerals inside it. As the molten rock solidified, the minerals preserved a record of Earth's polarity, the direction its north and south magnetic poles pointed at the time.

Over millennia, rivers and streams cut into the island, Bogue says, and exposed "tremendous stacks of lava flows that are just inviting someone to come study them." In the summer of 1977, as a 25-year-old graduate student at the University of California, Santa Cruz, Bogue did just that, heading to the sweeping cliffs of Nu'ualolo Valley with his adviser, Robert Coe.

Scientists had recently discovered that every 200,000 years, on average, churning in the hot liquid metal of Earth's outer core causes the planet's whole magnetic field to flip. Bogue and Coe wanted to learn how the field behaves during the change, and so were looking for a geological record of the

exact time when the planet's poles had switched places.

The bottom of the Nu'ualolo lava stack formed when Earth's field was upside-down, with the north magnetic pole in Antarctica. The top of the stack formed when conditions were as they are today. Somewhere in between, there must have been a transition, and Bogue and Coe set out to find it.

The geologists clambered up the valley walls, stopping every few dozen feet to measure the rocks' polarity with a handheld magnetometer. As the day wore on, the slopes became steeper and more slippery. "It was pretty scary," Bogue recalls. "You went around a corner and there was nothing below you except a thousand feet."

More casual visitors can look down over the lush Nu'ualolo Valley and the coast beyond it from the terminus of a steep, three-mile hiking trail in surround-



ing Koke'e State Park. Other trails take you to scenic ridges, through forests of twisting koa trees, and up to one of Bogue's favorite spots: the Alakai Swamp, where rare native birds like the scythe-beaked Hawaiian honeycreeper flit around above shallow bogs. "It's a very exotic environment up there," Bogue says.

BOGUE AND COE DIDN'T uncover a field reversal in Nu'alolo, but a few days later they did find one nearby in the yawning chasm of Waimea Canyon. The mile-wide canyon splits the island for 14 miles, offering spectacular panoramas of starkly layered rock. The Kukui hiking trail runs from the rim to the bottom of the canyon, so the geologists could reach every geologic layer by foot—no rock climbing necessary. You can trek into the canyon the same way or, for a more leisurely view, try the

lookout points that fork off the main highway above.

As you hike in, "you're descending through hundreds of lava flows as you go down the trail," Bogue explains. Many of the ancient flows are just three to six feet thick. You can identify volcanic basalt from its tiny pockmarks, formed by bubbles of escaping gas that froze in place when hot magma hit the cool air. "The bubbly layer is probably the top of a lava flow, and if it's more solid, that is the interior," he says. Sweep a compass along the rock face and you may pick up the minute perturbations that mark a changing magnetic field. If your compass needle goes bonkers, you've found a rock that's been hit by lightning and intensely remagnetized. Bogue found records of two polarity reversals in these flows, giving him his first glimpse into the magnetic field's complex contortions during its flips, which he is

Waimea Canyon's volcanic rocks have turned brilliant red from intense weathering.

still studying today.

Kauai's ancient rocks can reveal other pieces of planetary history, as well. Many geologists now believe that the giant oceanside cliff faces on the north shore, long assumed to be the result of gradual wave erosion alone, are actually scars from a catastrophic landslide. "You'll see lots of horizontal lines on the faces of the cliffs," Bogue says. "I see lava flow after lava flow after lava flow. It's just paradise."

MARA GRUNBAUM

THE TOUR GUIDE

Occidental College geologist Scott Bogue has spent more than 30 years studying magnetic field reversals—periods when Earth's north and south poles trade places—in Hawaii, Nevada, and Washington.

NEIGHBORING SCIENCE HOT SPOTS

Within a 90-minute drive from Koke'e State Park are ample opportunities to explore the unique geology, wildlife, and scenic beaches of Hawaii's northernmost major island.



POIPU BEACH, on Kauai's southern shore, has been called the best beach in America because of its soft white sands, turquoise waters, and rocky coral reefs. Monk seals sunbathe on the shore, humpback whales breach off the coast, and snorkelers there may spot the Hawaiian state fish, the humuhumunukunua'ua. poipubeach.org

THE KAUAI MUSEUM, in Lihue, built out of lava rocks, has exhibits on the geology of the Hawaiian Islands, the life of early natives, and the adventures of Captain James Cook, who first landed on Kauai in 1778. kauaimuseum.org

WAILUA RIVER wends for 20 miles along the east side of the island, accessible by kayak, canoe, or tour boat. It passes waterfalls, a lava cave, and Nounou Mountain, nicknamed the Sleeping Giant, which looks like a reclining human figure from afar. wailuariverguides.com M.G.

