On the shoulder of a giant: Precursor volcano to the island of O'ahu discovered

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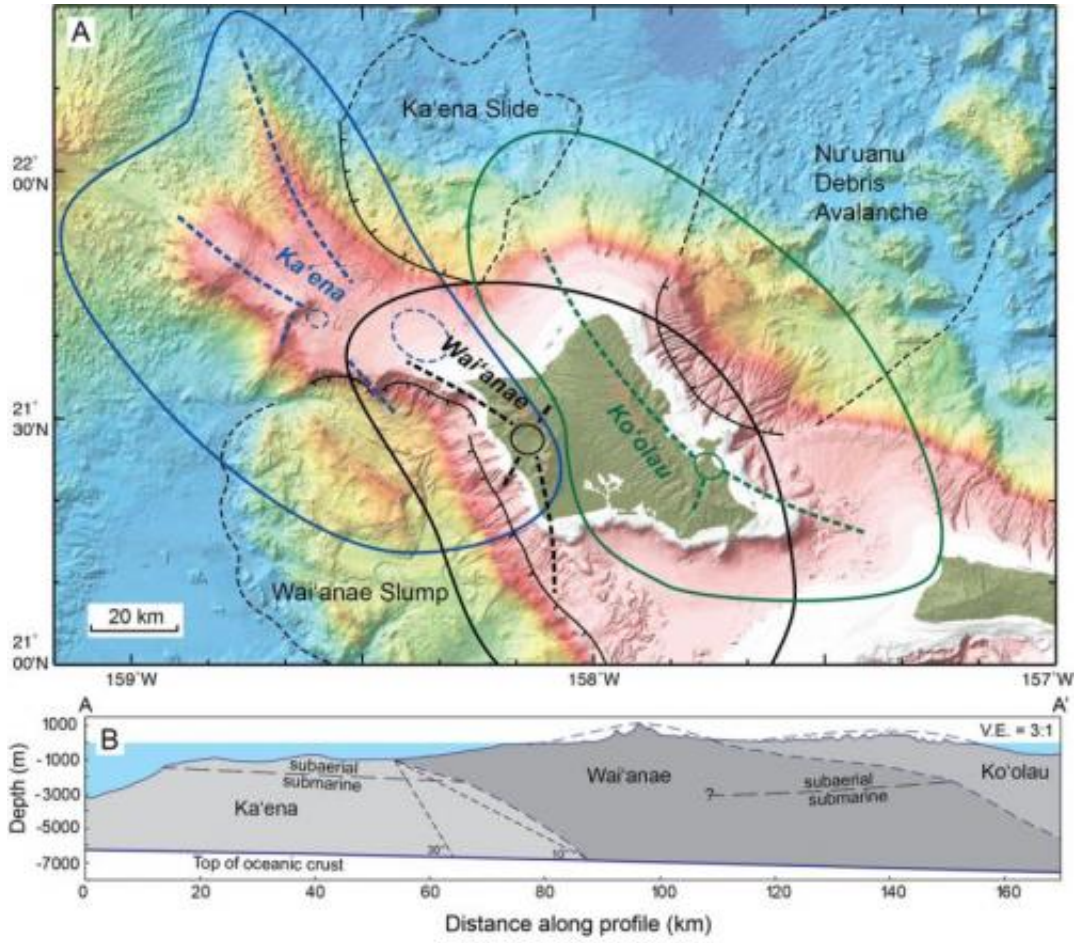

Map showing schematically the distribution of the three volcanoes now thought to have made up the region of O'ahu, Hawai'i. From oldest to youngest these are the Ka'ena, Wai'anae, and Ko'olau Volcanoes. Upper panel: bold dashed lines delineate possible rift zones of the three volcanoes; also shown are the major landslide deposits around O'ahu. The lower panel shows how the three volcanic edifices overlap. Credit: J. Sinton, et al., UH SOEST

Researchers from the University of Hawai'i – Mānoa (UHM), Laboratoire des Sciences du Climat et de L'Environment (France), and Monterey Bay Aquarium Research Institute recently discovered that O'ahu actually consists of three major Hawaiian shield volcanoes, not two, as previously thought. The island of O'ahu, as we know it today, is the remnants of two volcanoes, Wai'anae and Ko'olau. But extending almost 100 km WNW from Ka'ena Point, the western tip of the island of O'ahu, is a large region of shallow bathymetry, called the submarine Ka'ena Ridge. It is that region that has now been recognized to represent a precursor volcano to the island of O'ahu, and on whose flanks the Wai'anae and Ko'olau Volcanoes later formed.

Prior to the recognition of Ka'ena Volcano, Wai'anae Volcano was assumed to have been exceptionally large and to have formed an unusually large distance from its next oldest neighbor - Kaua'i. "Both of these assumptions can now be revised: Wai'anae is not as large as previously thought and Ka'ena Volcano formed in the region between Kauai and Wai'anae," noted John Sinton, lead author of the study and Emeritus Professor of Geology and Geophysics at the UHM School of Ocean and Earth Science and Technology (SOEST).

In 2010 scientists documented enigmatic chemistry of some unusual lavas of Wai'anae. "We previously knew that they formed by partial melting of the crust beneath Wai'anae, but we didn't understand why they have the isotopic composition that they do," said Sinton" Now, we realize that the deep crust that melted under Waianae is actually part of the earlier Ka'ena Volcano."

This new understanding has been a long time in the making. Among the most important developments was the acquisition of high-quality bathymetric data of the seafloor in the region. This mapping was greatly

accelerated after UH acquired the Research Vessel Kilo Moana, equipped with a high-resolution mapping system. The new data showed that Ka'ena Ridge had an unusual morphology, unlike that of submarine rift zone extensions of on-land volcanoes. Researchers then began collecting samples from Ka'ena and Wai'alu submarine Ridges. The geochemical and age data, along with geological observations and geophysical data confirmed that Ka'ena was not part of Waianae, but rather was an earlier volcanic edifice; Wai'anae must have been built on the flanks of Ka'ena.

"What is particularly interesting is that Ka'ena appears to have had an unusually prolonged history as a submarine volcano, only breaching the ocean surface very late in its history," said Sinton. Much of our knowledge of Hawaiian volcanoes is based on those that rise high above sea level, and almost all of those formed on the flanks of earlier ones. Ka'ena represents a chance to study a Hawaiian volcano that formed in isolation on the deep ocean floor.

Despite four different cruises and nearly 100 rock samples from Ka'ena, researchers say they have only begun to observe and sample this massive volcanic edifice. While this article was in press, SOEST scientists visited Ka'ena Ridge again – this time with the UH's newest remotely operated vehicle, ROV Lu'ukai – and collected new rock samples from some of its shallowest peaks. With these new samples Sinton and colleagues hope to constrain the timing of the most recent volcanism on Ka'ena.

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