

# Soil Science on Vacation...Or Soil Science with a (Minor) Language Barrier

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In January of 2005, while I suffered from one of the worst bouts of flu that I can remember, a colleague emailed me some wonderful soils photos from Hawaii. From this inspiration, my wife, Cindy and I decided that a winter vacation in a warm location was long overdue. Cindy and I have spent 14 years in business together, working long hours and 7-day weeks and have learned to hate field work in the winter. So it was that January of 2006 found us, along with our son Chris, daughter Kelly (a student at University of Delaware majoring in soil science) and her boyfriend Josh, boarding a USAir 757 for Costa Rica.

As none of us spoke Spanish, we anticipated a language barrier. I prepared by listening (half-heartedly) to some Spanish language tapes, buying a phrase book and Spanish-English dictionary, and using Alta Vista's Babel Fish website to pre-translate a few key phrases and put them on note cards. "Usted por favor pararia el coche por un momento. Soy cientifico de la tierra. Doseo examinar el suelo." (Would you please stop the car for a moment. I am an Earth scientist. I want to examine the soil.) "You're going to get us killed," my wife said upon finding my note cards. Upon arrival, we immediately found that the anticipated language barrier was virtually nonexistent. Most Costa Ricans or "Ticos" as they call themselves, speak at least some English. We found that they did, however, appreciate people trying to speak their language, and we all rapidly learned enough Spanish to at least be polite.

I had taken some time to peruse the meager soils, archaeological, and geological information available on the region before we left. Like most of Central America, Costa Rica has no soil survey, and little soils information was readily available. Geological and archaeological information was a little easier to come by. Costa Rica has more than 200 volcanoes, of which four are active and one, Mount Arenal, has been in a steady state of eruption since 1968. The volcanism is due to the active subduction of the Cocos tectonic plate under the Caribbean plate. Costa Rica also has extensive, though poorly studied, small archaeological sites, although none are known to be as massive as the famous ruins of Mexico and South America.

I got my first glimpse of Oxisols from the window of the plane as we crossed into Nicaraguan airspace from the Caribbean Sea. Every road-cut, every excavation showed strikingly bright orange (I estimated colors in the 2.5YR 6/6 range) against the verdant rainforest.

We were picked up at the airport by a driver who took us the three-and-a-half-hour drive over the mountains on roads that ranged from fair to something resembling a very rocky washboard to our first destination, the Lake Arenal region. Lake Arenal was a natural shallow lake, until the Costa Rican Government dammed the outfall at Rio Fortuna and made a deeper lake with a hydroelectric generator that supplies 70% of

the electricity of the country. Costa Rica derives virtually all of its electricity from hydroelectric power, geothermal energy, and wind energy. The lake exists in the shadow of Mount Arenal, an active strato-volcano that was believed to be dormant until it erupted violently in 1968, killing 87 people, 25,000 cattle, and devastating approximately 15 km<sup>2</sup>. It has been erupting steadily ever since. From our hotel, at night when the clouds lift, the lava flows are visible as orange rivers flowing down the slopes of the cinder cone. Unfortunately, we didn't get to see that as we were only there for two nights, but the rumbling of the volcano, like thunder in the distance, was a nearly constant companion.

A hike to the Fortuna waterfall, plunging several hundred feet down a cliff, brought about our first close encounter with Oxisols. Most of Costa Rica appears to be covered by either Oxisols or Andisols. On the steep hike (we soon learned that all hikes in Costa Rica except those along the beach, are steep hikes) down to the waterfall, we encountered Andisols at the top of the hill transitioning into Oxisols as we descended down into the jungle.

Another day had us hiking with a nature guide onto a lava flow from 1992 to the closest approach allowed to Mt. Arenal. The mountain remains dangerous. In 2000, two people, a nature guide and a tourist, were killed at the base of Mount Arenal by a pyroclastic flow. In October of 2005, a strombolian eruption threw car-sized lava bombs 340 m out from the crater toward the Tabacon Hot Springs Resort. The volcano rumbled steadily in the background as we hiked and the clouds lifted for about five minutes, enough to allow us to watch lava flowing down the mountainside. We traversed an area impacted by a pyroclastic flow in 1992, where virtually everything in its path was wiped out. Here I was able to briefly examine soil development in the tephra left behind by the flow, amounting to about 1 cm of soil with lichens growing on top. The leaves in the trees of the surrounding forest were coated with a thin layer of volcanic ash from the constant eruptions. At first glance, the lava flow appears more like a boulder field. The lava from Mt. Arenal is andesitic and extremely viscous. Due to its high silicon content, it solidifies rapidly, forming boulders, and rarely flows like the Hawaiian lavas. Here we caught some of our first glimpses of the exotic wildlife of Costa Rica, when we heard and saw howler monkeys in the trees and a troop of white-faced coatis fearlessly ran down the trail past us.

We traveled by boat across Lake Arenal to board a van for Monteverde, just over the Tiluron Cordillera on the Pacific side of the mountains. Landing on the south side of Lake Arenal, shards of pre-Columbian pottery immediately caught my eye, strewn about the landing site and ignored by everyone but me. The three-hour van ride over the Cordillera was another experience in rough steep roads but spectacular scenery.

Monteverde is a small town just within the rain-shadow of the mountains. It has a warm dry Mediterranean climate with clear skies but with a constant light mist falling, though you never get wet from it.

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An anonymous, balding soil scientist examines soil development in the wake of a pyroclastic flow.

Although we weren't able to spend much time examining soil here, we did visit the cloud forest, which exists on the windward side of the Cordillera. This is a unique ecosystem developed under near-constant 100% humidity. It is dominated by plant and animal species adapted to the constantly saturated soil. Due to the "rain-shadow" effect of the mountains, drastically different ecosystems exist within 100 yards of each other depending on which side of the mountain they occupy. The genetic diversity of plants and animals is incredible. It would be interesting to examine the variation in soil across this same gradient.

Diversity is the main theme in Costa Rica, both naturally and culturally. Costa Rica is a country of approximately 51,100 km<sup>2</sup>. With only 4.4% of its land being arable, the nation's economy relies heavily on tourism, which accounts for approximately 63% of the economy. Industry provides 28% of the economic activity, with agriculture trailing at only 9%. It is the only continental nation in this hemisphere with no military, having disbanded it after a period of civil unrest in the late 1940s. Slightly smaller than the state of West Virginia, Costa Rica is home to 14 different climatic zones, six types of rain forest, and an amazing array of biological diversity. Costa Rica currently boasts over 8000 species of vascular plants, which accounts for 4% of the plant species on the planet, almost 500,000 species of insects, 218 of mammals, 850



Daughter Kelly and her boyfriend examine an Oxisol at the base of the Fortuna Waterfall.

of birds, 150 of amphibians, 210 of reptiles, and 130 of freshwater fish, with more being discovered regularly. The people are very proud of this diversity and very knowledgeable. I had in-depth discussions on primatology (my former career before I entered soil science) and plate tectonics with taxi drivers, bartenders, and waiters, among others.

Located on the Pacific coast, Guanacaste Province is in the rain shadow of the cordillera and thus is relatively arid. Still, lush vegetation covers large areas of the landscape. Here we found ample opportunity to examine Oxisols under closed forest canopy, while white-faced capuchin monkeys played overhead. On one occasion, we were lucky enough to accompany a guide on a kayak trip through a mangrove swamp beginning at low tide. As the tide turned we were able to kayak through areas that had earlier been dry and watch the crystal clear Pacific water mingle with the murky river water, flocculating the suspended clays and depositing them among the mangrove roots.

The ten days that we spent in Costa Rica will be forever etched in my memory. The natural diversity, scenic beauty, and friendly people made for both an enjoyable vacation and a serious learning experience. The trip turned out to be a pivotal point in my professional life. The exposure to so much diversity in soils, topography, and geology led me, on my return, to enter a graduate program in geology, but that's another story.

