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John Weber

Grand Valley State University

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Caribbean Tectonics and Adventures

Tectonics is the study of Earth's shifting geologic plates, as well as the earthquake belts, mountain ranges, and faults that develop along their edges. My introduction to the tectonics of the boundary between the Caribbean and South American plates came in the summer of 1990 when Bob Speed, a sophisticated structural geology professor at Northwestern University, where I was working on a Ph.D. in Geosciences, invited me to help him with some work in Trinidad. After a few weeks of intense training sessions working on Trinidadian rock thin-sections and hand specimens at the petrographic microscope, I was off. My "tour of duty" began at the Seismic Research Unit at the University of the West Indies (UWI) in St. Augustine, Trinidad. St. Augustine is a well-manicured, former British colonial village that sits at the southern foot of the Northern Range. Some geologists thought that this sharp boundary was the eastward continuation of Venezuela's famous El Pilar strike-slip ("San Andreas type") fault into Trinidad; Alexander von Humbolt had witnessed and documented large destructive earthquakes on the El Pilar fault in Venezuela as early as the 1800s. There were some problems with this idea—e.g., why had Trinidad not had a single large earthquake since colonization? The primary objective of my trip was to start developing and testing alternative ideas.

The staff at Seismic was warm and welcoming. They immediately made me feel glad to be in their country. Their names sound off like a list of Trinidad's mixed ethnic heritage: Lloyd Lynch, Keith Rowley, and Shirley Bethelmy—descendants of African slaves, some mixed with genes from Scottish and Irish plantation overseers; Kumar Rampersadsingh, Desmond Seepersad, Wilkie Balgobin—descendants of East Indian indentured servants brought to the island to work sugar cane fields after the British abolished slavery (about 50 years before emancipation in the U.S.); Jeffery Chang—a Chinese Trinidadian, whose ancestors arrived through a British-Hong Kong connection; and, Godfrey Almoralez—partly of Venezuelan or "Spanish" descent.

John Weber is Associate Professor of Geology at Grand Valley State University.

Despite the warmth of my coworkers and my interest in learning about their culture, the geology was calling. I couldn't wait to escape from the noisy air conditioners and the frigid Seismic offices and get out into the field. Like most geologists, I enjoy working outdoors in our giant laboratory and exploring the natural history of new places. After a few days of settling in, Bob Speed and I finally drove off into the rain across the Northern Range in the Seismic van (pickup truck). The van had slick tires and no defroster, and I was driving a right-hand drive for the first time in my life. We experienced a few intense but typical rainy-season cloudbursts, and a few slips and slides on the pavement, but before long we were on track, headed toward the north coast, with several hitchhikers (fishermen, gardeners, and one calypsonian) in the back of the van. The views opened up as we approached the coast. The scenery became spectacular—dense tropical vegetation, steep overhung cliffs, and lofty views of the azure-blue Caribbean Sea. Our final destination that day was Maracas Beach, a beautiful long sandy beach with tall, swaying palm trees, brightly painted, wooden and concrete block, cold beer huts and shark-and-bake stands, and spectacular, well-washed outcrops of the same quartz mylonites that we had studied earlier under the microscope back at Northwestern. The rocks were even more spectacular in real life! The Maracas outcrops are full of penetrative ductile structures—boudins, lineations, foliations, and folds—reflecting solid-state flow that was frozen into these rocks about 25 million years ago as these mountains were just being born, cut by late brittle veins and normal faults, reflecting the rocks' more recent journey up to the Earth's surface. Outcrops that record so much Earth history are paradise for a structural geologist. What an introduction to Caribbean tectonics!

Over the next couple of weeks my fieldwork progressed well. I was seeing great geology and mastering the art of outcrop-scale fabric analysis—piecing together the history of a mountain range by deciphering the relative ages of structures, measuring their geometry with a compass, plotting and mapping these orientations, and building a library of field sketches and ideas. In addition, every day that I worked in the field I met more and more of Trinidad's warm and interesting

people. Personal experiences like this are paradise for a cultural fanatic like myself.

Ray Russo, a fellow Northwestern graduate student; Ken Foland, a geochronologist from Ohio State; Bob Speed, and I later met up at a special meeting of the Geological Society of Trinidad and Tobago organized by Keith Rowley. Keith was my first supervisor at Seismic. He is now a high-powered politician and a Minister in Trinidad's government but remains a close friend. We decided to organize a geology expedition from Blanchisseuse to Matelot along the north coast after the meeting. These two small fishing villages mark the ends of the two roads that cross the range—the only way between them is by boat or by foot. The scientific purpose of the hike was to test whether the structural style and metamorphic grade in the range changed gradually or abruptly from west to east, but we were also thirsty for adventure. John Saunders, an adventuresome British micropaleontologist who was part of Hans Kugler's legendary team of field geologists who first mapped the geology of Trinidad in the 1950s, had done this hike a number of years earlier. Our appetite for this adventure was whetted by hearing John's jungle stories at the meeting.

After a terrible sleep on bare foam mattresses, and a cold, greasy breakfast in Las Cuevas, a small, drug-infested, fishing village on the north coast, we set out at daybreak, drove to Blanchisseuse, and started the walk. We left with minimal supplies—just some water and Crix crackers—thinking that we'd be in Matelot before nightfall. Immediately, great scenery and geology opened up before us. I now understand that we were walking through an exhumed brittle-ductile transition, literally rocks with a mix of both ductile and brittle styles of deformation, that form at the boundary between Earth's upper- and middle-crust and were carried up to Earth's surface. This part of the range is covered by relatively pristine rain forest with just a few primitive hiking trails cutting through it. We marveled at the many skyscraper-tall trees with Cadillac-fin roots and Tarzan vines, fresh mountain streams and waterfalls, and unspoiled, isolated beaches. We also enjoyed many rations of bush food along the trail that day; there is nothing quite like the taste of a freshly picked mango.

Late in the afternoon we realized that we'd made little progress on the way to Matelot. Ray took the lead and set a faster pace: fewer stops to look at rocks, more hiking. However, attempting to cross several deep, gushing streams on rotten, broken stumps of old wooden bridges slowed us down. Poorly-maintained man-made structures decay rapidly in the jungle. With time quickly passing we were still deep in the jungle. Nightfall comes like clockwork in the tropics, with little seasonal difference between "summer" and "winter" sunset times. At around six or seven p.m. it began getting darker and darker. Soon it got too dark to see. I tried to lead using my bare feet to feel the muddy rut marking our path. Finally, we were forced to call it quits and decided to try having a sleep on the jungle floor. It was a challenge for me to fall asleep—my mind was flashing with images from the adventures of the day and full of concerns about the night ahead. How much more adventure might a night in the jungle bring?

The ending to this particular jungle story is happy; I know of several others that have ended tragically. After a few hours the moon was shining so brightly that it woke us. We could see that we had been sleeping right on the trail. We got up and continued walking toward Matelot. After about an hour of walking, we found Ken Foland sleeping in the shuttle car parked on the outskirts of town, waiting for us. Ken had recently had back surgery and opted not take the hike, but instead drove the shuttle. We jumped into the car, and took off, and drove for all of about 5 minutes—only as far as the first Carib beer hut in the

village. There we found a number of local fishermen casually drinking a few late night beers and playing checkers. We were quite thirsty and very happy to see people after a day and night in the bush. Somehow the locals knew our story right away—I guess by our ragged look, the odd hour of our arrival, and our high level of thirst. They quietly accepted our unspoken invitation to celebrate. We proceeded to get acquainted with one another, play checkers (albeit poorly), and down a fair number of beers. As the party wound down, the proprietor led us to a primitive bunkhouse with foam beds and no bed coverings. He would accept no money for using the sleeping quarters—probably because in a single night we injected the local economy with more money from beer sales than it normally sees in weeks! Early the next morning, after a very short sleep, we took off for Port-of-Spain. On the way down the driveway, Bob immediately backed our rental car into a deep concrete drain beside the road. Somehow we were able to lift and rock the car back on to three wheels and get it out, and fortunately, didn't need to wake any of the fisherman or villagers for help.

Another adventure began one night after a month or two of working in Trinidad. During a dinner at my UWI flat on St. John's Road, an Afro-Trinidadian Muslim who calls himself Abu Bakar came on the TV and announced that he and his cadre of Muslimeen had just taken control of the Red House, the seat of Government, as well as most of the TV and radio stations in the country. They proclaimed to be our new leaders. My first coup! The whole country went up for grabs overnight. Over the next couple of days I heard gun shots, saw shops and buildings burning, and saw people walking up my street toting looted couches and refrigerators and pushing shopping carts full of pillaged groceries. My toughest adolescent experiences growing up on Chicago's south side paled in comparison. I felt very green in this volatile situation. The police and military finally regained some control, and we were put under a state of emergency, initially with a 24-hour curfew. Bob, who was in Barbados at the time, was scheduled to fly back into Trinidad for just a day or two on his way back home to the U.S. Because I had no phone in my apartment, the only way we could talk about my getting out of the country was for me to sneak

out under curfew, walk over to Seismic, and call him at the airport hotel. I remember locking the Seismic gate behind me just as a van full of men with machine guns drove past. They had on no uniforms, so I couldn't tell whether they were "good guys" or "bad guys." Either way, the coup was becoming an adventure like none I had ever experienced. I decided to leave the country as soon as I could. On the phone Bob instructed me to get myself to Piarco Airport where we would meet and he would give me his credit card so that I could buy a plane ticket and leave for Barbados. By this time the 24-hour curfew had been lifted so that people could get out and buy food and supplies. Our small, neighborhood grocery, owned by the Rhamudits, a nice East Indian family, was being guarded by the family men standing on the store balcony with shot guns so that their little shop did not get looted like the big ones on the Eastern Main Road, a few blocks away.

William Ambeh, a Cameroonian seismologist colleague and friend from Seismic, drove me to the airport on empty (it was still almost impossible to get gasoline), where I joined the ranks of the disorganized crowd trying to flee the country. It took me two days to buy a ticket and get a flight out. Seven of us, myself, a German couple returning from their honeymoon in the Grenadines, two AA flight attendants (coincidentally also from Chicago), a Swedish backpacker, and a Trinidadian pilot, all formerly unacquainted people, shared a single room in the one and only airport hotel, waiting in shifts in long lines for plane tickets. Quickly we became close friends. Three days later I finally arrived in Barbados, at Bellairs Research Institute on the west coast. After several weeks in Barbados, things in Trinidad cooled down, the government regained control, and I went back for several months to finish my first field season there working under a 12-hour curfew.

By the time I left Trinidad at the end of the summer of 1990 some science was beginning to gel—this was hard to walk away from, despite the coup experience. Although I didn't yet realize it, my heart had also been captured by the people, the geography, and the culture of Trinidad, and I couldn't wait to get back. With the exception of 1996, I have been back at least once a year since. Tectonic processes and problems in the Caribbean-South American plate boundary remain at the

heart of my research. In addition, my calypso and soca CD collection has swelled to several hundred volumes, and my wife and I regularly enjoy cooking and eating Caribbean cuisine using the transplanted ingredients in our well-stocked kitchen.