Islands across a fault

After a magnitude 8.1 earthquake caused a deadly tsunami in the Solomon Islands, Fred Taylor and colleagues rushed to the epicentral area to learn about rupture across a subducting triple junction.

Why did you choose this particular location for fieldwork?
One of us, Fred Taylor, had visited the Solomon Islands eight times previously, and in 2006 we had proposed to install a network of seismograph stations there. The network was not built, but we were excited when we heard about the 1 April 2007 magnitude 8.1 earthquake because it occurred in a familiar area where no large earthquake had happened in historic times. We also knew we could use corals to precisely measure surface deformation. Thanks to a rapid response programme at our university we were able to go to the Solomon Islands on short notice.

What was the objective of the work at the beginning of the project?
When tectonic plates suddenly slip several metres past each other and a large earthquake results, the displacement causes uplift and subsidence on the Earth's surface and on the ocean floor. This movement can also cause a tsunami, and this happened in the Solomon Islands with devastating consequences. Measurements of the vertical movements of the Earth's surface can constrain exactly where and how the fault ruptured. The aftershocks indicated that the rupture straddled the subducting Simbo ridge, which meant that three rather than just two plates were involved: two plates subducting under one overriding plate. Our field observations confirmed that the rupture continued across the triple junction. The earthquake ruptured past the closest pair of trench-spanning islands anywhere in the world: Simbo and Ranongga, which lie only 8 km apart on opposite sides of the trench. This meant that we could make the first measurements of uplift and subsidence on the extreme edges of the downgoing plate and the overriding island arc.

What sort of data and samples were you after?
We determined uplift and subsidence mainly by measuring their effects on corals. Along coastlines in the tropics, corals grow upward to about the mean low-tide level. If they are uplifted then the part above low-tide level dies within a few days. Thus, after an earthquake we can measure the amount of uplift at any coastal site to within a few centimetres. We can also determine subsidence by measuring the depth of the shallowest living underwater corals and then comparing their elevations with predictions from a numeric tide model. In many ways the corals are much better than manmade instruments as you don't need to deploy corals or change their batteries — they just go on measuring uplift and subsidence for you anyhow.

FRED TAYLOR

Alison Papabatu of the Solomon Islands Ministry of Natural Resources standing on a partially emerged *Porites* coral head where uplift was about 0.5 m. The photograph was taken during low tide when the part of the coral head above the water level had died and been colonized by algae.

Does it take any unusual special skills to do this kind of research?
Often, this kind of research is done along remote coasts, so it helps to be familiar with handling small boats and fixing whatever goes wrong. In the Solomon Islands we've always had wonderful hospitality from the locals and we always try to help them out in return. Traumatized people were evacuated into the hills after the tsunami, and village leaders and government officials were trying to coax them to come home where they would have access to proper medical care, food and shelter. The village leaders asked us to explain to the public what we knew about earthquakes and tsunamis and whether it was safe to return.

Did the trip give you any ideas for future research projects?
The earthquake convinced us of the value of our plan to install seismograph and GPS instruments in the Solomon Islands and do a more complete coral study of palaeo-earthquakes and vertical movements. With the islands so near the trench and the underlying seismogenic zone of the underthrusting plates so shallow here, we could get a picture of how tectonic plate subduction relates to earthquake generation and tectonic deformation that is not possible elsewhere. Scientists in Taiwan have agreed to collaborate with us and our Solomon Islands government colleagues if we can obtain our share of the necessary support. Stay tuned.

What particular high points are notable?
The full cooperation of government officials and the citizenry was encouraging. Everyone understood the need to investigate the earthquake and to consider the possibility of future events. For example, our longstanding collaboration with the Department of Energy, Water and Mineral Resources in the Solomon Islands helped us immensely once we were in the field. Danny Kennedy, a former Peace Corps volunteer and now a member of parliament for the province of Ghizo, arranged a guest house for our arrival and the police hauled us up there from the ferry landing in their van. The sad thing was that the most devastated part of Gizo town where many people died was on the shore just below our house. We awakened the first morning overlooking that bleak scene.

This is the Backstory to the work by Fred Taylor and colleagues published on page 253 of this issue.