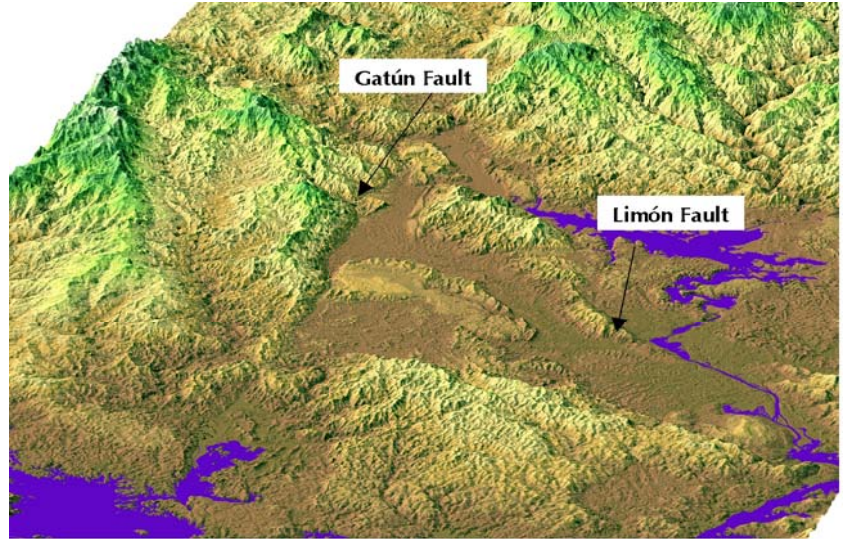




# PALEOSEISMIC HAZARDS EVALUATION of the Gatún and Limón Faults Panama Canal, Panama

## PROJECT DESCRIPTION

When the Panama Canal was constructed, little attention was paid to seismic design inputs. As the Panama Canal Authority (ACP) embarked on a program of seismic risk assessment and mitigation for the Canal's structural components, it became clear that the faults of central Panama needed to be better defined in the seismic hazard model. Fault-specific data on slip rate, recurrence intervals, and past earthquake magnitudes were needed. In order to generate these data, a detailed geomorphic, geologic, and paleoseismic investigation was developed to look at two of the most prominent faults, the Gatún and Limón faults. The project began with DEM imagery analysis and stereoscopic aerial photographic mapping, followed by geomorphic mapping and field reconnaissance, and concluded with 2-D and 3-D paleoseismic trenching of both faults. The field work was done in close cooperation with the ACP geological staff.



The geomorphology of central Panama, as illustrated in this DEM image, exhibits the appearance of 20 km of left-lateral extension across the Gatún fault and several secondary accommodation faults. Gatún Lake and dam (lower left) are a major part of the Canal waterway, while Lake Madden and dam (upper right) form a major water supply reservoir.

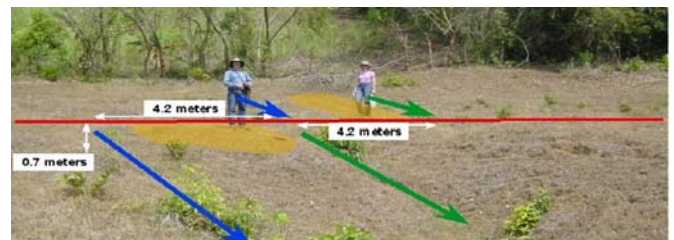
## SOLUTION

The geomorphic mapping indicated a high probability that the two faults pose an active seismic hazard to the Canal facilities. Locations were identified on each fault for paleoseismic trenching to better quantify the seismic hazard. A total of ten trenches were excavated, geologically analyzed and photo-logged, and 26 charcoal samples and five optically stimulated luminescence dating samples were collected and processed for stratigraphic age control. Based on the results of the logging and testing, we concluded that both faults have experienced multiple earthquakes in the past 2,000 years, including at least two that must have been felt in Panama City since it was occupied in the 1500s. The Gatún fault is a left-lateral strike-slip fault with a minimum slip rate of 6-8 mm/yr. The Limón fault is a right-lateral strike-slip fault with an estimated slip rate of 3 mm/yr. Both faults are capable of, and have generated earthquakes between M6.8 and M7.2. Both faults will generate ground shaking at the Canal facilities well in excess of current design levels. The findings were presented to ACP staff and to their Seismic Advisory Board.



3-D trenching of a feeder channel across the Gatún fault to measure slip per event and timing of past events.

2-D and 3-D trenching of the Gatún fault to measure fault displacement of a 2500-3000 ka channel margin.



4.2 m offset of two parallel drainage channels along the Limón fault.

