Developing New Measurement Techniques Both in the Laboratory and the Field. We have previously built ocean going benthic fluid flow meters to look at fluid migration patterns through the surfaces of active tectonic systems and gas hydrate provinces such as those at Costa Rica (see Fig.1, from Brown et al., 2005).

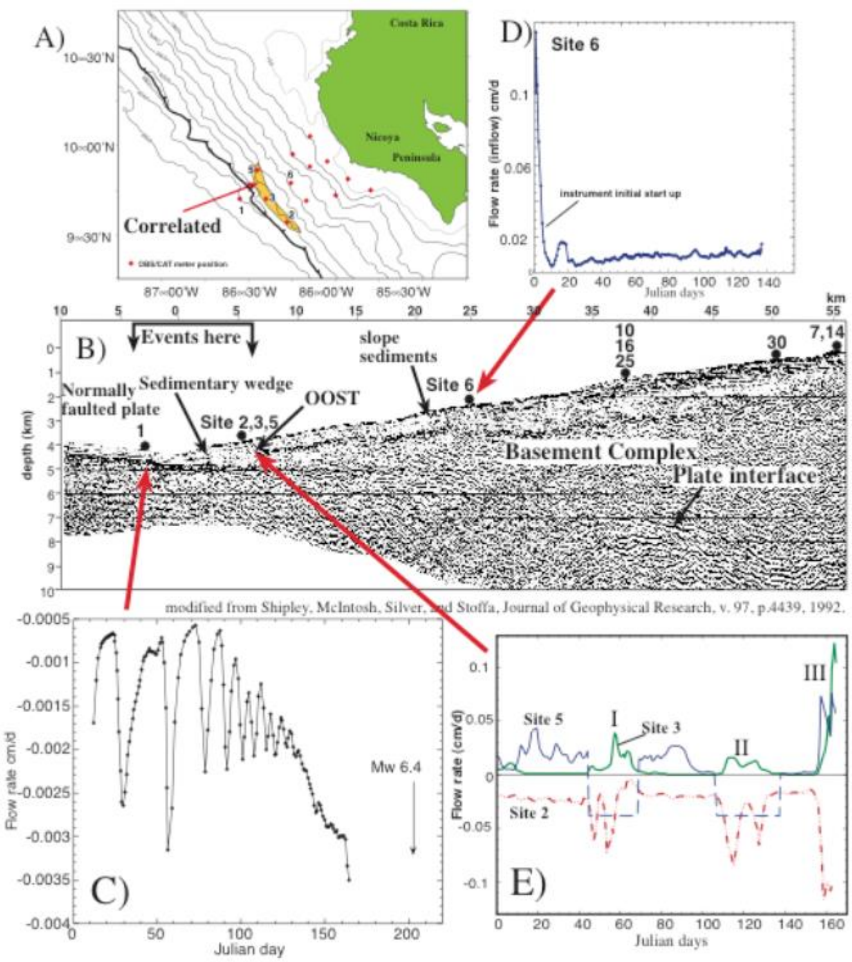

Figure 1: A) Map showing instrument locations of the 1999-2000 deployment. B) Seismic reflection section off the Nicoya peninsular showing the major tectonic elements of the forearc and instrument locations; hydrotectonically active instruments Sites 1, 2, 3 ,5; and non-correlated Site 6. C) Flow record from Site 1 on the incoming plate. D) Flow record from Site 6 up slope above the rigid basement complex. E) Records from site 2, 3, and 5 above the sedimentary wedge and OOST area. Correlated events marked as I, II, and III.

The striking correlation between the instrumentations flow signals and seismic tremor suggested that the pulsing flow thought the surface of the wedge is related to episodic slow-slip (Fig. 2, Brown et al. 2005). This hypothesis was greatly supported by numerical poro-elastic simulations of the expected surface flow system above a propagating slow-rupture Figure 3 (LaBonte et al., 2009).

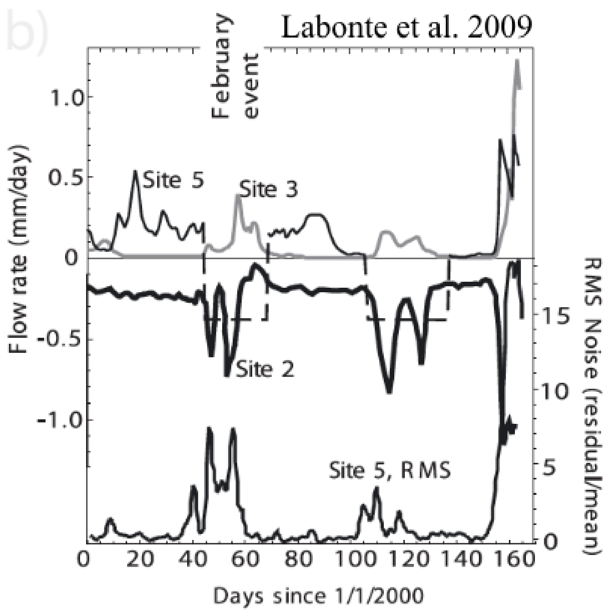

Figure 2 (a) Location of the 14 flowmeters in the Costa Rica (CR) subduction zone during the 2000 CRSEIZE (modified from *Brown et al.* [2005] with permission from Elsevier) plotted with the trace of seismic line CR-20 [*Silver*, 2001]. (b) Three instruments on the prism toe (hexagons) recorded time series with three 2.5- to 3.5-week-long periods of flow rate transience. An instrument malfunction prevented recording of downflow rates at site 5 (dashed line). An ocean bottom seismometer at site 5 recorded high root-mean-square (RMS) noise, a measure for residual vertical accelerations, during the same period (modified from *Brown et al.* [2005] with permission from Elsevier).

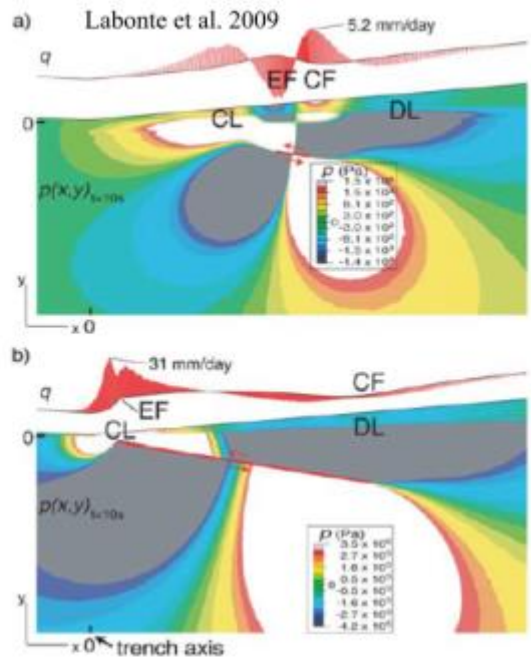

Figure 3 Response to an instantaneous slip thrust event centered at 37 km from the trench axis and 10 km depth with displacement $b = 1.1$ m in Costa Rica layered material geometry (Figure 2 and Table 1) evaluated at $t = 10$ s. Extensional and compressional flexure (EF and CF) of the seafloor (plotted with vertical exaggeration) effect the vertical flow rate, q (vertical red vectors), through the seafloor. Lobes of compression and dilation (CL and DL) extending out from the rupture as seen in the pore pressure field, $p(x,y)$, also effect q. Superposition of these two effects result in characteristic differences of cross-strike flow rate patterns for (a) far-field ($L_x/d = 0.5$) and (b) near-field ($L_x/d = 6$) ruptures.