Results From Long-Term Aqueous Flux Measurements on the Costa Rican Convergent Margin

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The results of two long-term deployments of arrays of Chemical and Aqueous Transport (CAT) meters reveal new insights into the hydrogeology of the Costa Rican convergent margin. The CAT meters can record a time series of aqueous flow rates of 0.01-1500 cm/yr across the sediment-water interface with a temporal resolution as high as 0.5% of the deployment time. The first three month deployment consisted of 21 instruments in an array extending across the margin northwest of the Osa Peninsula. Three geologic provinces were sampled; A) the incoming plate (Cocos Ridge flank), B) the wedge slope, and C) the eroded shelf. A ridge parallel topographic high in province A exhibits inflow at <5 mm/yr on its flank and transitions to outflow of a few cm/yr upslope. Province B displays only outflow with average rates ranging 0.1-10 cm/yr. High flow rates averaging ˜50 cm/yr were found at sites in province C. A large amount of temporal variability was also associated with most of the sites in all provinces which frequently ranged up to an order of magnitude. Five of the sites, predominantly in province B, exhibited rapid flow reversals indicative of tidal forcing with no discernable net flow. A similar six month deployment of 14 instruments immediately followed in the ODP Leg 170 area off the Nicoya Peninsula. Preliminary results from this deployment indicate similar characteristics in each of the three provinces although sites of downflow were observed in province B for the first time.

These results suggest that the three provinces have distinct hydrologic properties which can be characterized by this method of long term monitoring. The source of the ubiquitous transience and of the high flux rates in the shelf area are the two most surprising results. Variability from what is assumed to be tidal, to multi-week periods was recorded. The linear relationship between the average flow rate and the range of variability suggests that these are coupled and dependent on the sediment permeability. One possible transient source may be the high seismicity in the area after the large September 1999 earthquake in the area. The high-flow shelf area is a wave-cut platform overlain with a thin layer of sediment. Flow may focus through this region due to a combination of the shallow fractured basement and updip flow from the bounding forearc basin and upper slope sediments.