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Hurricane effects on the coastline from Cabo San Lucas Bay, Baja California Peninsula, Mexico

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Cabo San Lucas, located on the southern tip of the Baja California Peninsula, is on the track of two to five hurricanes per year. Thus the purpose of this work was to evaluate the effects of hurricanes on the stability of the coastline of San Lucas Bay. We apply GIS for determining inland geomorphology and conducted bathymetric surveys for the marine area. Results from previous sedimentological researches of fluvial, littoral and shallow marine environments were reanalyzed to determine the sedimentary processes responsible for the stability of the coastline. Also, we were monitoring beach profiles in the bay and also other beaches from the tip of the peninsula from 1997 to 2004 and recorded the effects of Hurricane Juliette in 2001 (category 3 in the Saffir-Simpson scale), which left an accumulative precipitation of 850 mm and formed waves of 8 m in height during the four days of maximum impact.

We found out that inland and marine geomorphology, as well as littoral and alluvial sediment transport play a major role to keep the coastline relatively stable for at least the last 3,000 years. Geomorphology of the drainage basin is steep favoring the formation of flash floods that feed an alluvial fan to finally discharge sediments to the San Lucas Bay where a temporal fan-delta is developed during catastrophic rains. Marine morphology is dominated by the San Lucas submarine canyon, located on the southern half of the bay, whose canyon head is just at the foot of the beach (4 to 6 m in depth). On the northern half, there is a narrow submarine terrace with a break 40 m deep, covered mostly by fluvial sediments. At the littoral, there is only one dune ridge which is almost continuous and only cut by the arroyo. The dune ridge was dated at two levels; at the bottom, just above Pleistocene fluvial sediments and at the top, giving dates of 3200 and 800 years respectively. These dates are interpreted as an evidence for the stability of the dune ridge.

The sand from the beach, responsible for the coastline stability, is sourced by two processes: (1) the littoral drift bringing sand from the Pacific coast, which turns around San Lucas Cape and enters the bay, process that is continuous, with stronger events every 3 to 7 years (matching ENSO cycles) following seasonal periods of heavy cyclonic rains that favor important fluvial sediment discharges; and (2) direct input of fluvial sediments, discharged by the El Salto arroyo during catastrophic hurricane rains with returning periods of 50 years. The canyon head traps most of the sediment “excess” of the beach system. Winter waves erode the beach and generate a weak littoral transport to the south where sediments are trapped by the canyon head. Also, because the mouth of the El Salto arroyo is just in front of the canyon head, the debris flows during catastrophic rains are dumped on the canyon and a small portion remains to form a fan delta whose sediments are later removed by waves to feed the eroded beach in both direccions, as we observed during the path of Hurricane Juliette.