Sequence Stratigraphy on Recent Deposits of Patia Delta, Southwest Colombia*

Luis Castillo[1], Marvick Ruiz[1], and Thais Kazmierczak[1, 2]

Search and Discovery Article #50563 (2011)
Posted February 29, 2012

*Adapted from extended abstract prepared in conjunction with poster presentation at AAPG International Conference and Exhibition, Milan, Italy, October 23-26, 2011

[1]Universidad Nacional de Colombia, Bogota, Colombia (lacastillol@yahoo.com.br)
[2]Pacific Rubiales Energy

Abstract

Patia River has built one of the larger deltas located to the south of Colombia in South America. Although a few have documented it from a stratigraphy point of view, it is important to study it with geological tools that integrate chronological and satellite images. According to Martinez et al. (1995), five genetic island groups are identified: two groups associated with straight stretches of coastal lowland and three delta lobe groups (Rio San Juan, Rio Patia, and Rio Mira Deltas). Initially the islands were probably transgressive, then became regressive for an indeterminate period before recent reinitiating of a transgressive phase and severe island front erosion. The Patia Delta is located in the southwest Colombian coast (Figure 1), classified as a Niger Island Type (Stutz and Pilkey, 2002). We identified 5 islands over 40 km. The tidal range increases around 4 m. The average island is 7.48 km. The average inlet width is 19.96 kilometers. Islands have the characteristic drumstick shape. They comprise a coast dominated by a deltaic barrier without a level curve that shows their sea level history, while other places show sea level curves, for instance Brazil, South Africa and Australia (Pirazolli, 1991).

Sequence stratigraphy analyses from the recent deposits in the Patia Delta were based on TM-TEM Landsat satellite images, digital aerial photographs and digitized maps between 1962 and 2007 for three periods. The methodology includes three types of analyses: 1) With indicators based on the stabilization of recent deposits (1962-2007) in zones delimitated by no consolidated sediments, 2) Analyses based in the delimitation of the water bodies for separating the sedimentary deposits, i.e. rivers and channels, 3) Analyses focused on observations considering deposition, erosion and sediment accumulation in each analyzed image. Normalized Difference Vegetation Index (NDVI) was used for evidence stabilization of the recent deposits. This index uses the rate between red visible band

(R) and the near infrared (IR). The NDVI permits discrimination of areas with vegetation because it is reflective in the near infrared (ESRI, 2010);

$$NDIV = \frac{(IR - R)}{(IR + R)}$$

The sensing image of the Landsat Satellite catches the different wavelengths. For geomorphologic structures where the principal component analyses on principal multiband image comprise the data and eliminate their redundancies (Esri, 2010), highlighting the structures of the first layer and the second layer that there is not over the first (Figure 2).

The following procedures are for sequence arrays corresponding to seventh order cycle, 0.003 my. Also, we can establish the weathering of the point bar and barrier island delimited by geoforms indicated. From these interpretations the change of the sediment deposition could be demonstrated. The sediment supplied to the margins of delta are presented in the lateral extremes due to the fluvial drainage and denudation process of the Patia River.

The correlation between sediment supply of the Patia River and the tidal energy build variations of the geoforms, for example accommodation and extension of the barrier island 1875 y 1924, and erosion between 1962 y 2007: transverse and longitudinal variations (Ruiz, 2009).

Derived from the analysis of images and old maps, we were able to establish an approximation of a sequence stratigraphy defining a sequence for the period analyzed. There is probably a trend in a lower system tract followed by a transgressive system tract, as barrier islands and subsidence (rise and fall of sediments) were indicating. An analysis of the delta has been made under these assumptions (Figure 3).

Selected References

Martinez, J.O., J.L. Gonzalez, O.H. Pilkey, and W.J. Neal, 1995, Tropical Barrier Islands of Colombia's Pacific Coast: Journal of Coastal Research, v. 11/2, p. 432-453.

Pirazolli, P.A., 1991, World atlas of Holocene sea-level changes, Elsevier Science Publishers, Amsterdam, The Netherlands, 300 p.

Restrepo, J., and S. López, 2007, Morphodynamics of the pacific and caribbean deltas of Colombia, South America: Journal of South American Earth Sciences, v. 25/1, p. 1-21.

Ruiz, M., 2009, Transformación espacial del rio sanquianga (patianga) y su delta, derivada de la construcción del canal naranjo en 1973: Tesis para optar por el título de Geografía, Universidad Nacional de Colombia.

Stutz, M.L., and H.O. Pilkey, 2002, Global Distribution and Morphology of Deltaic Barrier Island: Journal of Coastal Research, SI 36, p. 694-707.

Websites

ESRI, 2010, GIS Best Practices, V. II, Sustainable Development: ESRI. Web accessed 28 January 2012, http://www.esri.com/library/bestpractices/sustainable-development-vol2.pdf.

USGS, 2010, Servicio Geológico de los Estados Unidos: Web accessed 28 January 2012, http://landsat.usgs.gov; http://landsat7.usgs.gov/about_landsat7.php.

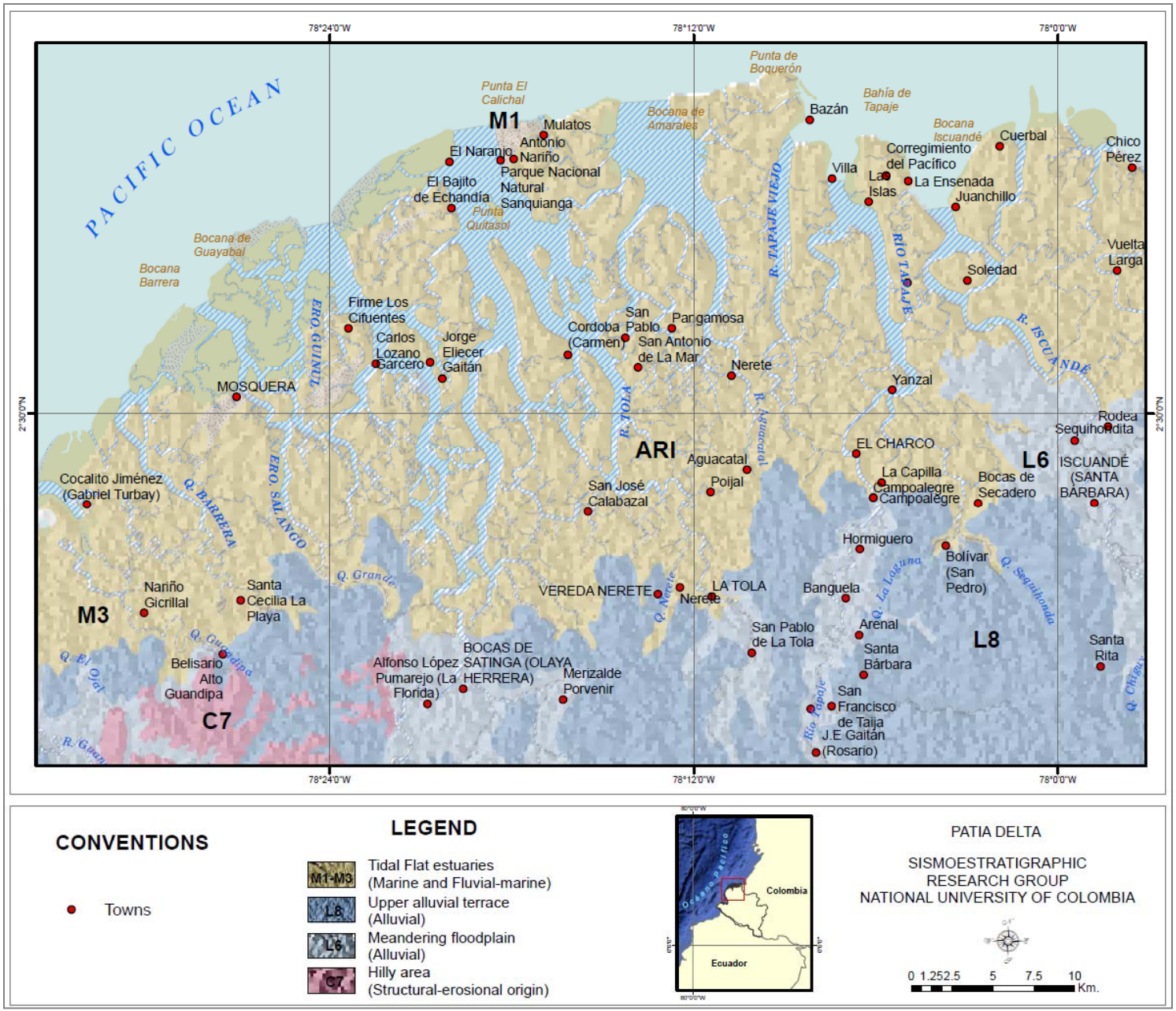

Figure 1. Location of study area with geomorphologic units (Modifed from Ingeominas, 2005).

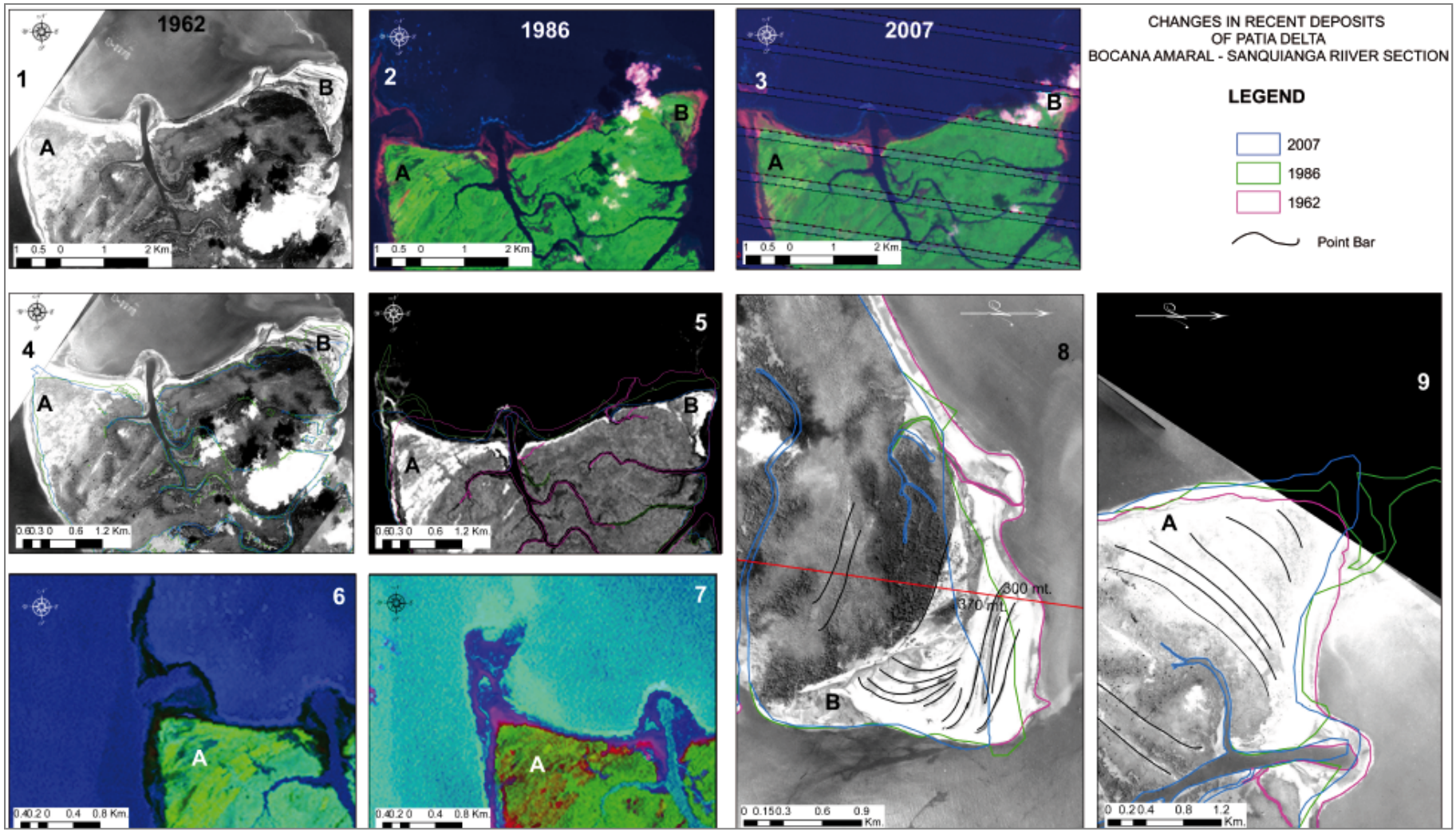

Figure 2. Methodology for analyses sequence of Recent deposits. 1-4) Delimitation of sedimentary deposits based on Normalized Vegetation Index, 5) Water body delimitation, 6-7) Principal component, and 8-9) Final Result.

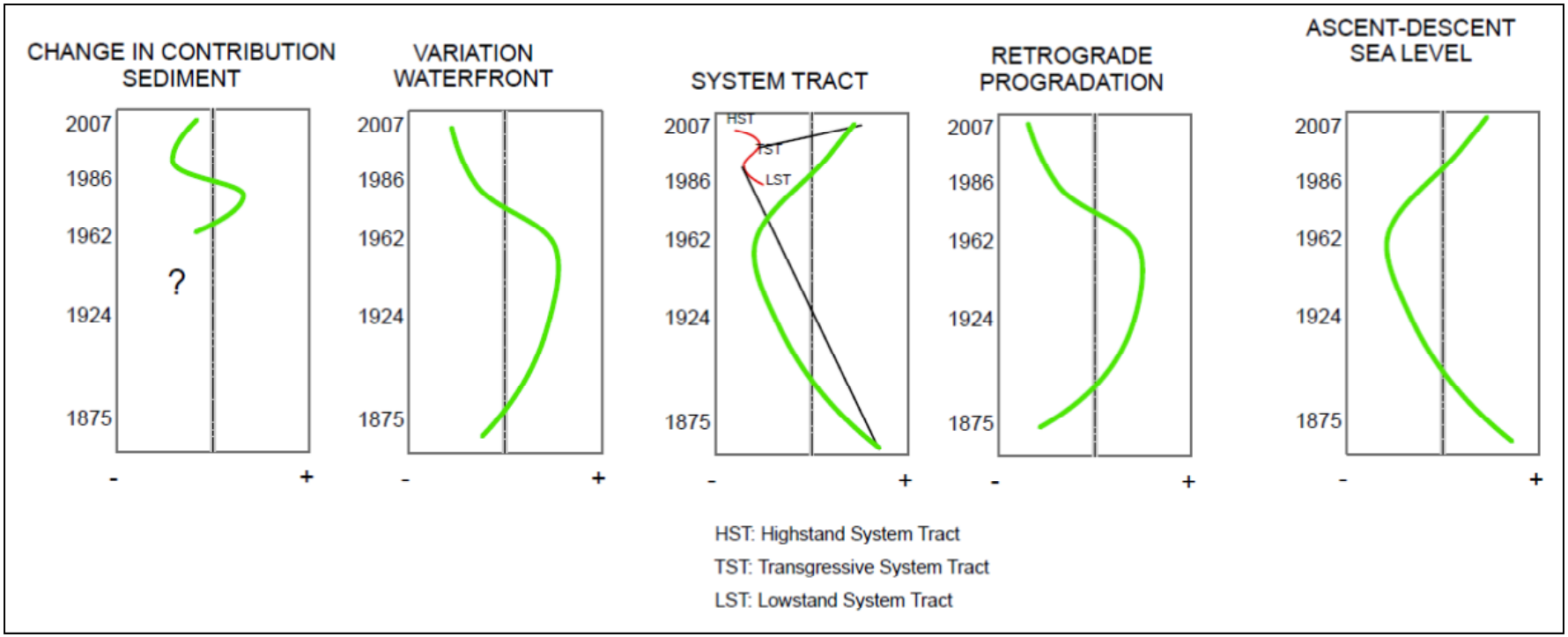

Figure 3. Interpretation of delta behavoir 1875-2007 according to stratigraphy sequences analyses.