PROVENANCE OF CENOZOIC CLASTIC SEDIMENTS IN THE TÁCHIRA SADDLE, WESTERN VENEZUELA, AND IMPLICATIONS OF SEDIMENT DISPERSAL PATTERNS IN THE NORTHERN ANDES

TCU School of Geology, Energy & the Environment

College of Science & Engineering

Ali Ricardo Gomez & Dr. Xiangyang Xie, School of Geology, Energy and The Environment, Texas Christian University. ali.gomezramos@tcu.edu

ABSTRACT

Northwestern South America is highly deformed due to the transpressive boundary with complex interactions among the Caribbean plate, the South American plate, the Nazca plate and the Panama arc. Previous studies suggest that the Cenozoic uplifting of the Mérida Andes and Eastern Cordillera of Colombia affected sediment dispersal patterns in the region, shifting from a Paleocene foreland basin configuration to the modern isolated basins. Well-exposed Cretaceous to Pliocene strata in the Táchira Saddle provides a unique opportunity to test proposed sediment dispersal patterns in the region. U-Pb detrital zircon geochronology and supplementary XRD heavy mineral data were used together to document the provenance of the Táchira Saddle sediments and refine the sediment dispersal patterns in the region. Results from the U-Pb detrital zircon geochronology show that there are six age groups recorded in this samples. Two groups related with Precambrian Guyana shield Terranes and Putumayo basement in the Eastern Cordillera, and four groups related to different magmatic episodes during the Andean Orogenic process. Three major paleogeography changes were also recorded in these detrital signatures, including a transition between the Cretaceous passive margin and the Paleocene foreland basin, the initial uplifting of the Eastern Cordillera with the isolation the Llanos Basin and Táchira Saddle from the Central Cordillera and the Magdalena Valley in the Early Oligocene, and the uplifting of the Mérida Andes by the Early Miocene.

INTRODUCTION

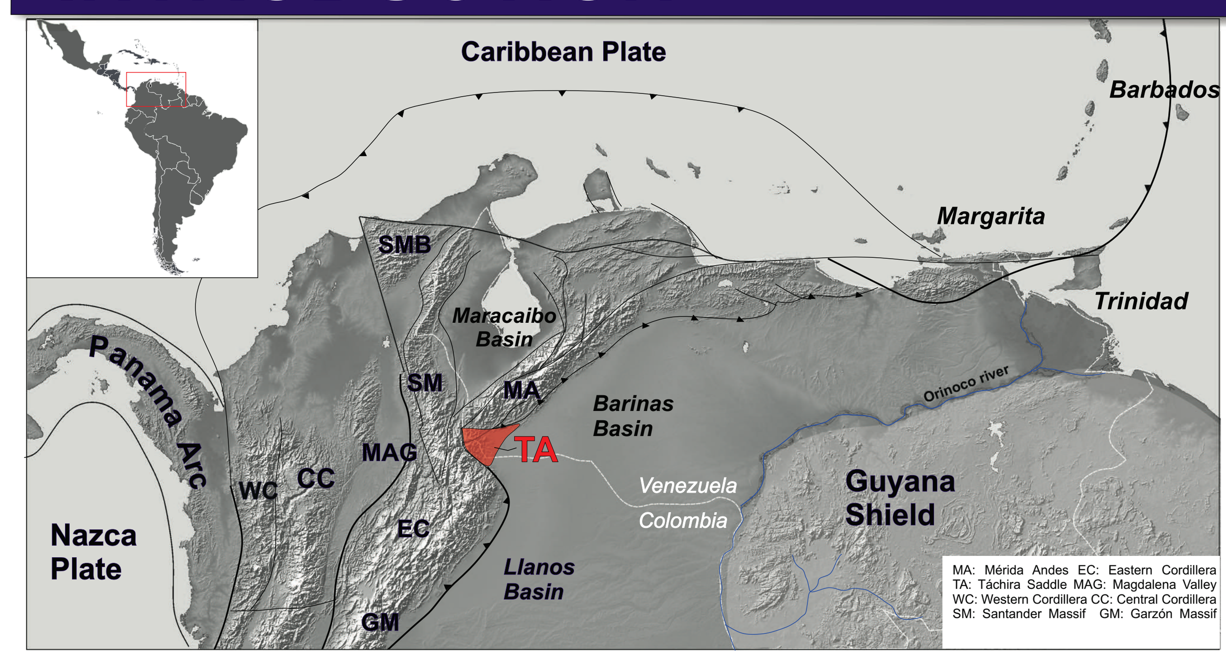


Fig. 1. Main geologic features in northwestern South America.

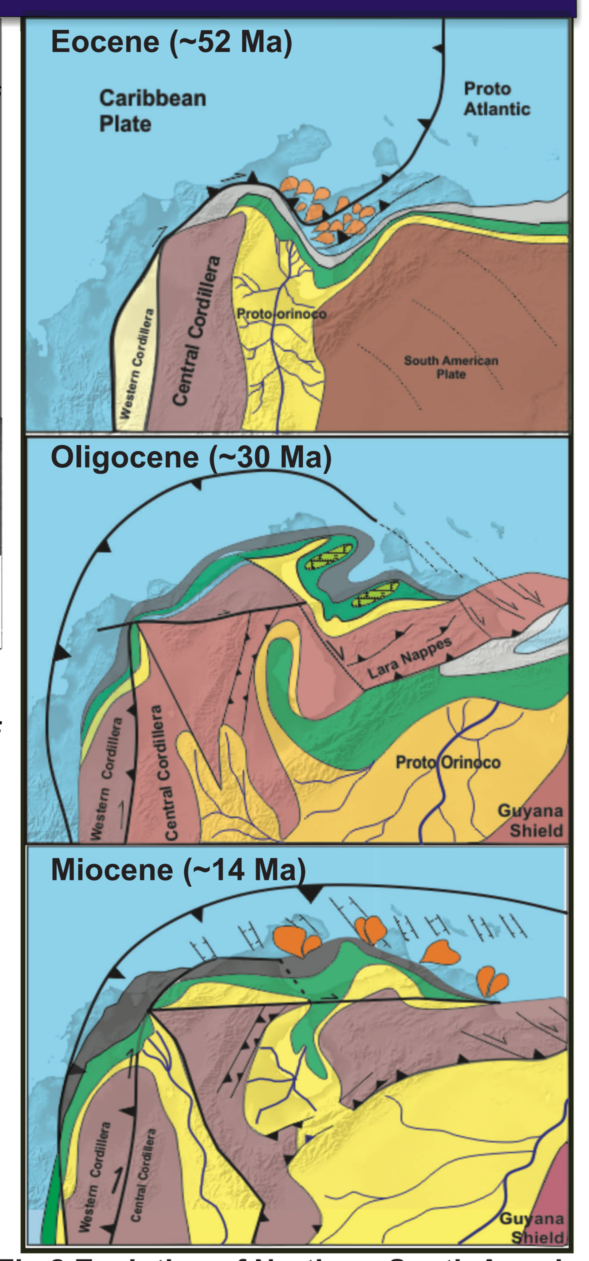
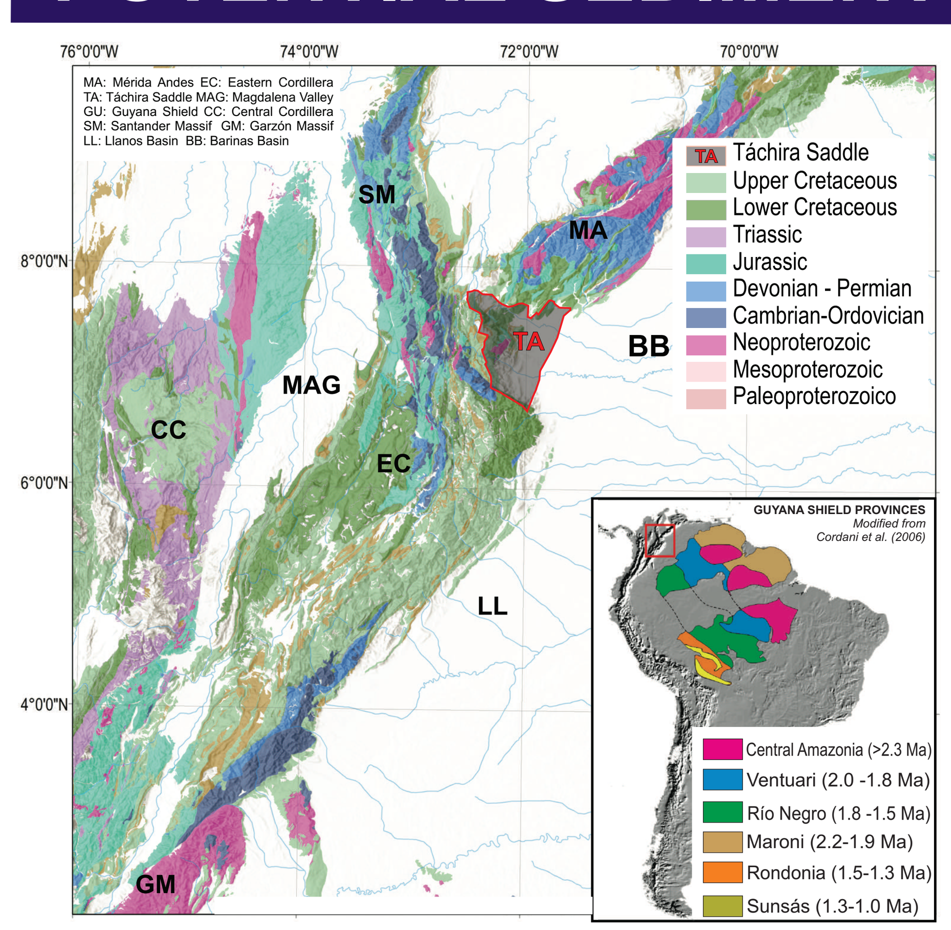


Fig.2 Evolution of Northern South America Modified from Escalona & Mann, 2011

Northern South America is a highly deformed area as a product of complex interactions among between the Caribbean plate, the South American plate, the Nazca plate and the Panama arc. Regional paleogeographic reconstructions based on the stratigraphic record and thermochronological evidence suggest that the diachronical uplifting of the Mérida Andes and Eastern Cordillera deviated a Paleocene drainage systems mainly from a northward direction to a northeast direction by Miocene. (Hoon et al., 1995. Diaz de Gamero, 1995, Horton et al. 2011, Bande et al., 2012). However, the temporal and spatial extent of those changes and their implication on the sediment dispersal pattern on associated basins is still under debate.

POTENTIAL SEDIMENT SOURCES



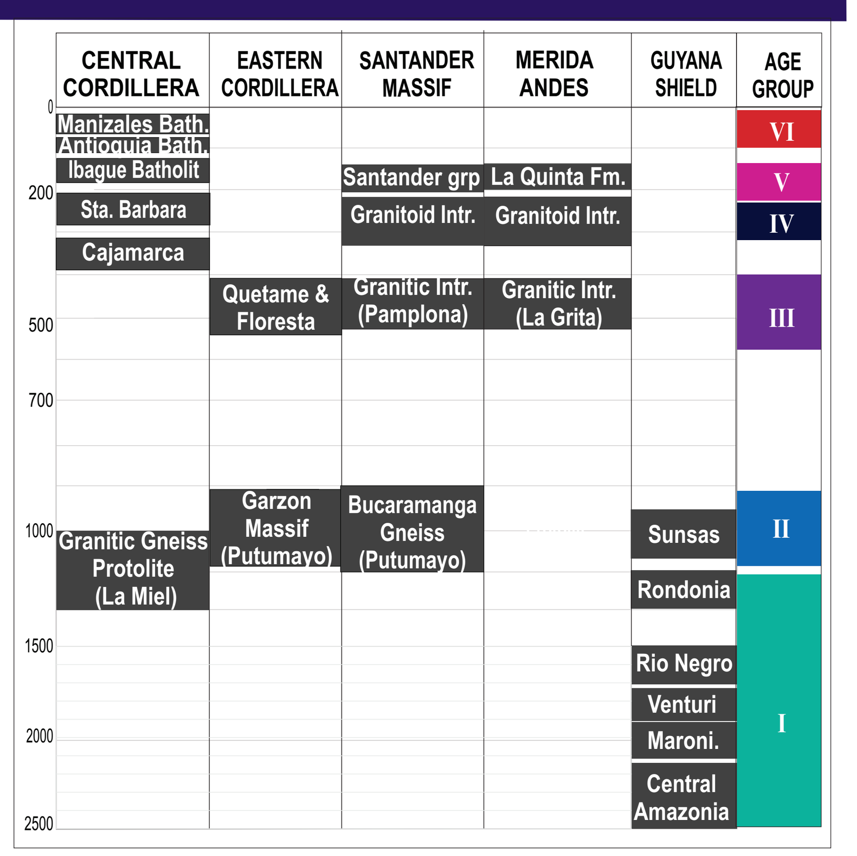


Fig. 3. Geological map and compilation diagram of major Pre-Cenozoic terranes in northern southamerica.

OBJECTIVE

In this study we use detrital zircon geochronology and X-ray diffraction of heavy mineral to identify the provenance of Táchira Saddle sediments and understand the implications for sediment dispersal patterns in northern South America after the uplifting of the Eastern Cordillera and Mérida Andes

METODOLOGY

Six sandstone samples were collected from outcrops of Cretaceous to Pliocene aged strata at La Alquitrana in the Táchira Saddle.

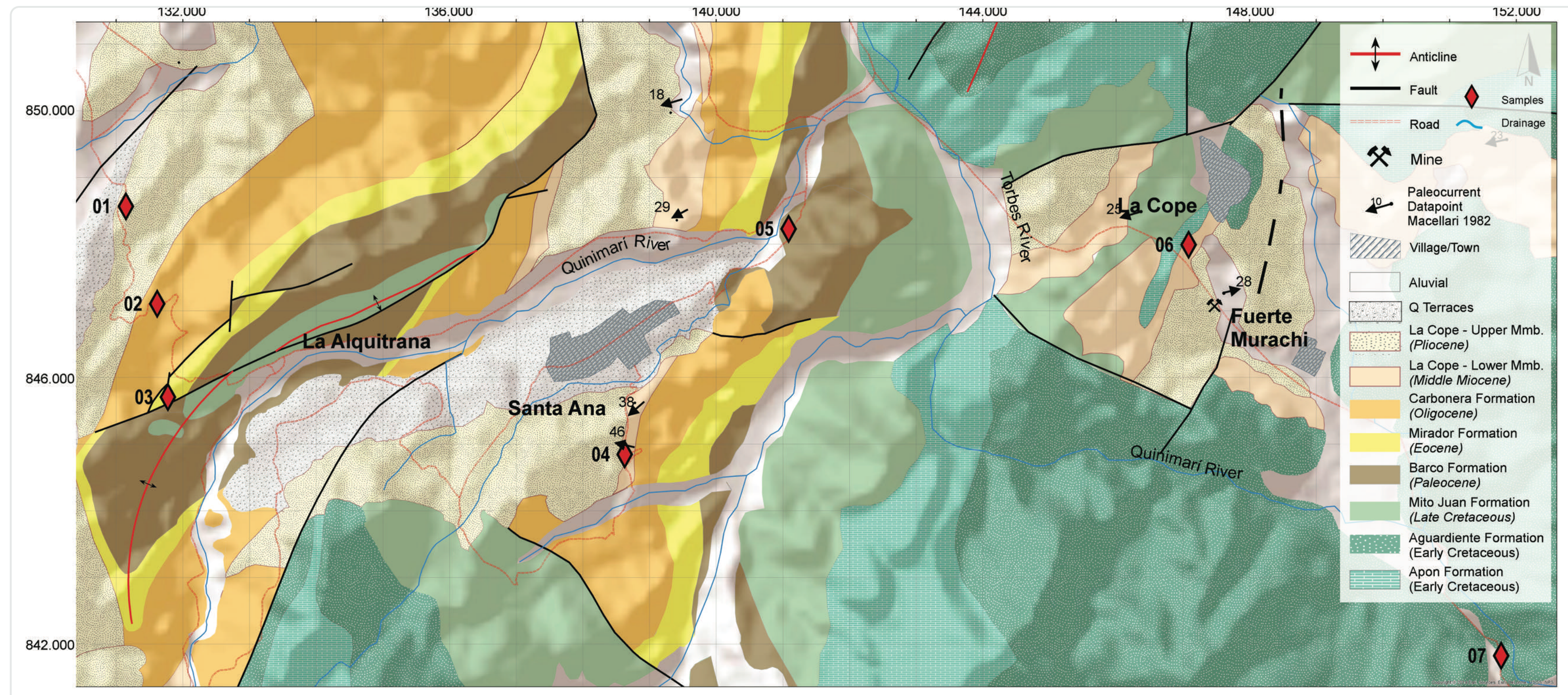
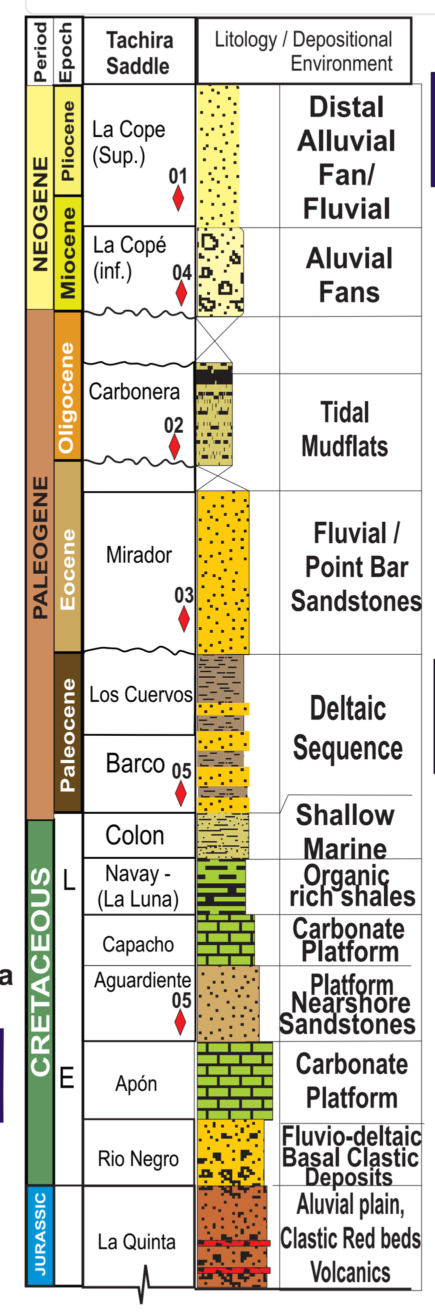


Fig. 4. Geological map of Tachira saddle showing the location of the samples.



HEAVY MINERAL SEPARATION

Heavy minerals fraction by using:

- Disc mill to crush and grind into sand
- Washed with gold pan to remove clay
- Frantz magnetic separator (Fig. 5)
- Heavy liquid separation using:
  - Methylene Iodide MI (ρ>3.3g/cubic cm)
  - Lithium metatungstate LST (ρ>2.95 g/cm)
- Zircon grains picked by hand under microscope

Fig. 5 Frantz Magnetic separator

X-RAY DIFFRACTION

Samples were analyzed using an Olympus Terra mobile XRD System (Fig. 6) with CoKα radiation and a data collection range of 10° to 55°, and interpreted by using PANalytical's X'Pert High Score software.(Fig 7)

Fig. 6 Olympus Terra portable XRD

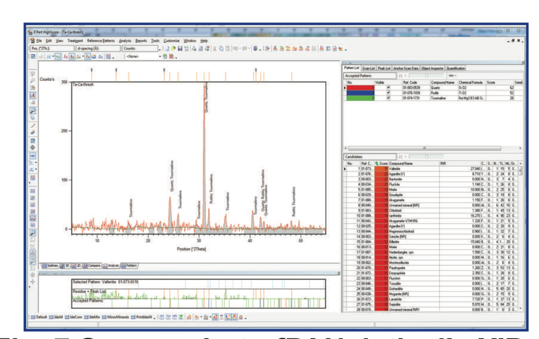


Fig. 7 Screen shot ofPANalytical's X'Pert High Score software

DETRITAL ZIRCON GEOCHRONOLOGY

Fig. 8 Backscattered electron images of selected Zircon crystals

An average of 100 zircon grains for each sample were selected to perform a geochronological analysis using the Laser-ablation inductively coupled plasma mass spectrometer (LA-ICP-MA) at the Arizona Laserchron Gechronology center.

Fig. 9 Laser-ablation inductively coupled plasma mass spectrometer in the University of Arizona

RESULTS

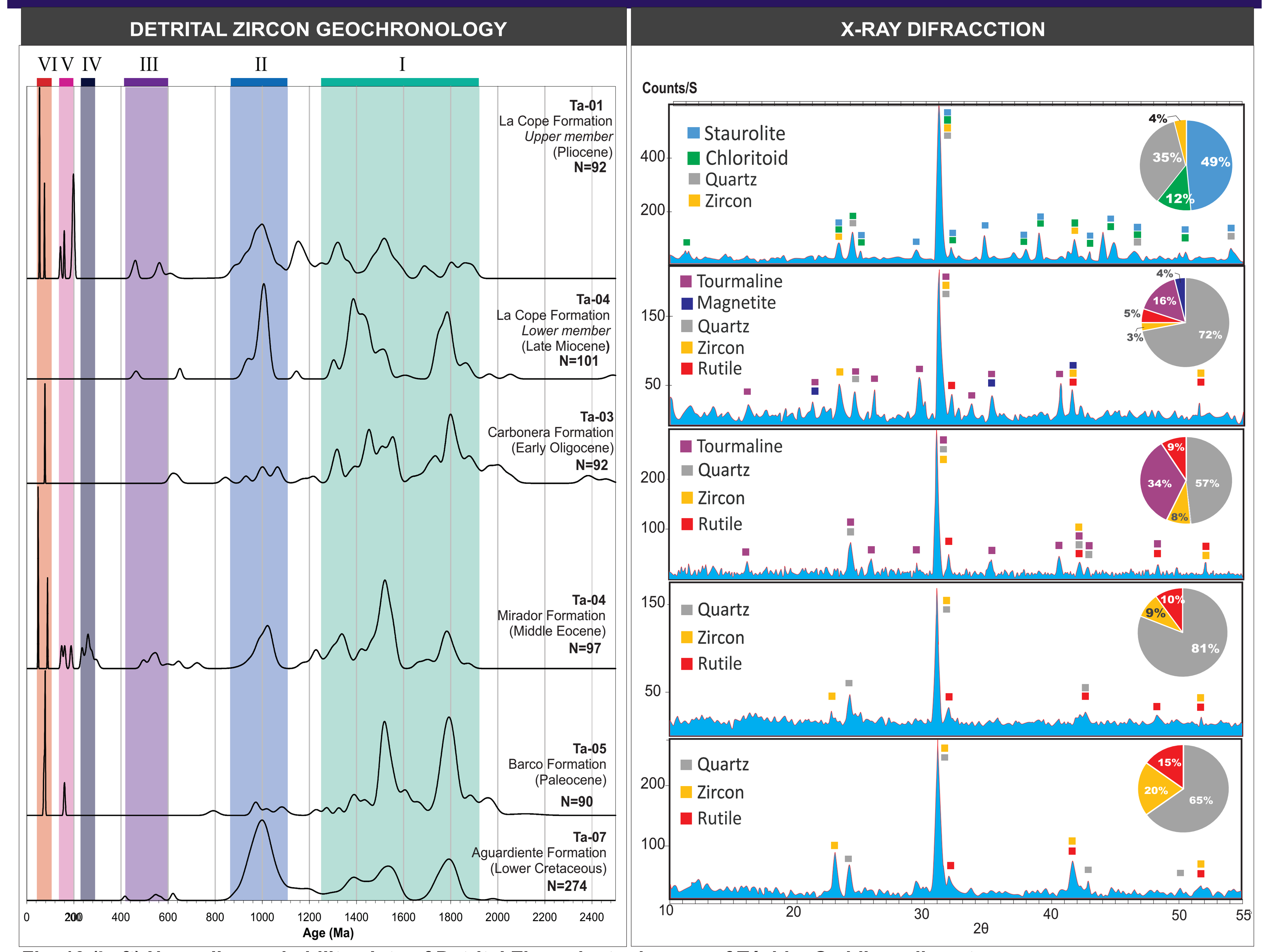


Fig. 10 (Left) Normalize probability plots of Detrital Zircon isotopic ages of Táchira Saddle sediments (Right) Compilation of Difractograms from the Cenozoic sediments in Táchira Saddle. .

SEDIMENT DISPERSAL PATTERNS IN NW SOUTHAMERICA

- Cretaceous deposition show predominately Precambrian ages, from the Guyana provinces and peripheral terrains from the Grenville-Putumayo orogeny. This is coherent with a passive margin stage and a northwestern sedimentation.
- During the Paleocene, the influx from Grenville sources stops, suggesting that this terrane was buried by the Cretaceous sequence.
- The Eocene fluvial sedimentation of Mirador Formation shows the first influence from Andean sources in this area. This implies connection between the Central Cordillera with our study area.
- The Oligocene Carbonera formation seems to lose this connection with the Central cordillera, suggesting an initial uplift of Easter Cordillera/Merida Andes, blocking the sedimentation from the west and acting as a dam for fluvial sediments in the east.
- Mio-Pliocene sedimentation was already controlled by the Merida Andes uplift. DZ and XRD data from La Cope Formation show the unroofing of a metamorphic basement and recycling of Mesozoic units.

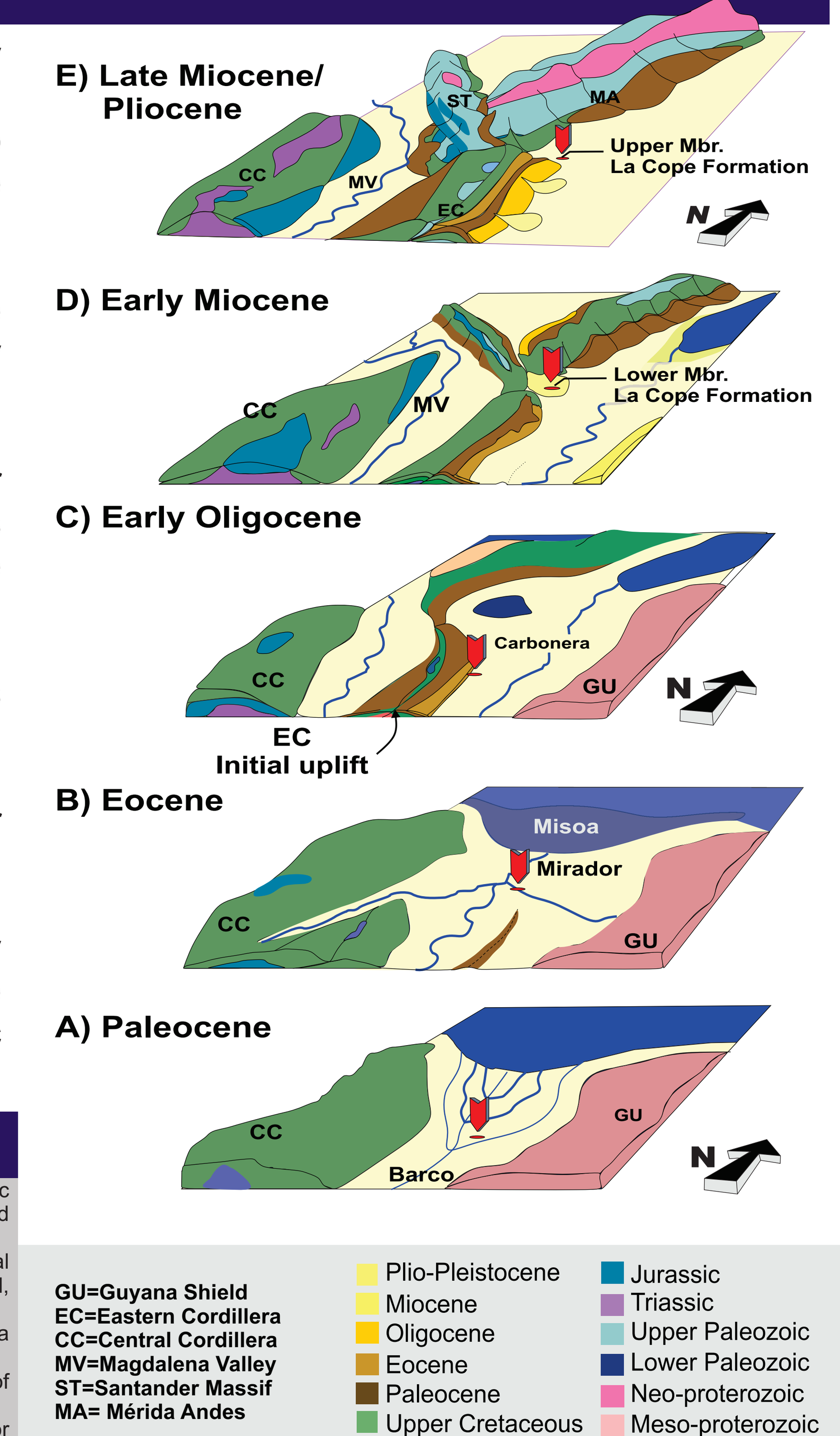


Fig. 11 Diagram with paleogeographic reconstructions from Northwestern South America showing a proposed location and potential sediment sources of Táchira Saddle deposits

REFERENCES

- Bande, A., Horton, B.K., Ramírez, J.C., Mora, A., Parra, M. and Stockli, D.F., 2012. Clastic deposition, provenance, and sequence of Andean thrusting in the frontal Eastern Cordillera and Llanos foreland basin of Colombia. Geological Society of America Bulletin, 124: 59-76.
- Cordani, U. G., Sato, K., Teixeira, W., Tassinari, C. C. G., and Basei, M. A. S., 2000, Crustal evolution of the South American Platform, In-Folo Producao Editorial, Grafica e Programacao Visual, Rio de Janeiro.
- Diaz de Gamero, M.L., 1996. The changing course of the Orinoco River during the Neogene: a review. Palaeogeography, Palaeoclimatology & Palaeoecology. 123, 385–402.
- Escalona, A., Mann, P., 2011. Tectonics, basin subsidence mechanisms, and paleogeography of the Caribbean–South American plate boundary zone. Marine and Petroleum Geology 28, 8–39.
- Hoorn, C., Guerrero, J., Sarmiento, G., Lorente, M.A., 1995. Andean Tectonics as a cause for changing drainage patterns in Miocene northern South America. Geology 23, 237–240.
- Horton et al. 2010. Linking sedimentation in the Northern Andes to basement configuration, Mesozoic extension, and Cenozoic shortening; evidence fromdetrital zircon U–Pb ages, Eastern Cordillera, Colombia. Geological Society of America Bulletin 122, 1423–1442.