FIELD TRIP GUIDE

A VISIT TO CHACACHACARE TO EXAMINE OUTCROPS OF THE MARAVAL AND CHANCELLOR FORMATIONS

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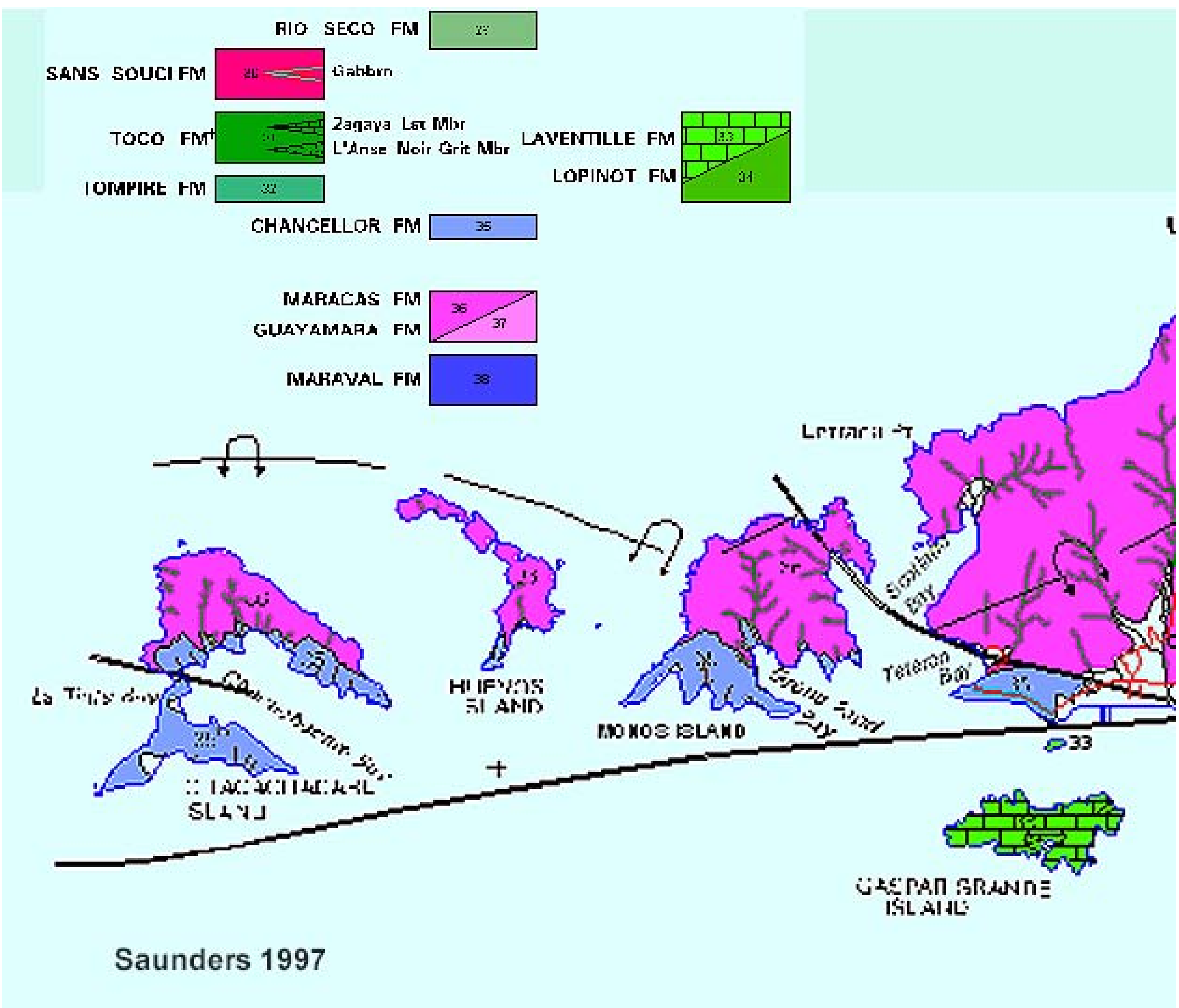
THE GEOLOGICAL SOCIETY OF TRINIDAD AND TOBAGO

A SYNOPSIS OF THE GEOLOGY WESTERN END OF THE NORTHERN RANGE

The Northern Range of Trinidad is an east – west trending exposure of subgreenschist to lower greenschist grade metasedimentary rocks (Frey et. Al. 1988) located in the Caribbean-South American plate boundary zone. The rocks are predominantly slates, schists, metaquartzites and metacarbonates. The protoliths from which these rocks were derived are interpreted to have been deposited on a north facing passive margin along northern South America (Pindell 1985, Speed 1985). Relict fossils from scattered indicate Tithonian to Maastrichtian protolith depositional ages. Ar^{40} / Ar^{39} ages from white micas indicate mid-Tertiary (25Ma) metamorphism, which was likely synkinematic with the South American – Caribbean plate transpression. These metasedimentary rocks were then exhumed and uplifted during the Neogene.



The structure of the Northern Range varies along its length but on the whole the oldest rocks, Maraval and Maracas formations, occupy the central spine of the range, while younger rocks outcrop along the north and south flanks.

In the western peninsula from Port of Spain to Chacachacare the structure that of a single north vergent overturned anticline trending East-West (Potter 1963), The fold appears to plunge gently westward as shown by the narrowing and then disappearance of the Maraval limestone core. There is a well developed overturned north flank at the longitude of Port of Spain with Chancellor Fm. on both flanks of the structure but this narrows westwards. Finally, only the gently dipping upright south flank is exposed above sea level. The axis of the structure appears to be displaced by the Morris Bay Fault on Monos island and is assumed to lie at depth north of Huevos and Chacachacare.

The southern edge of the Northern Range is dominated by the Arima Fault (Kugler 1959 map) and associated faults of this system. Algar & Pindell (1991) believe that the main outcropping fault, which marks the northern boundary of their 'Southern Northern Range Zone' shows thrusting of less metamorphosed rocks from the south over the more metamorphosed rocks of the main range - a backthrust.

Seismic and gravity work by Dominion Oil disclosed a number of parallel faults south of the main Arima Fault and the inclination of these faults appeared to be nearly vertical. Drilling of two wells to the south of the Laventille area showed downthrow of thousands of feet across one, and probably both, of these faults which have so far been considered to be an extension of the El Pilar Fault system. The relationship of the Arima Fault to the El Pilar fault system is as yet unclear.

The rocks in the western Northern Range experienced 3 principal phases of deformation (Table 1, Weber et al 1999).

	S_o	-probable sedimentary bedding - locally parallels early mimetic (?) mica foliation
D1	F_1	- tight to isoclinical - long accordion trains - sub-meter wavelengths - limbs highly attenuated - isolated hinges common
	S_1	- penetrative - schistose - approximately axial planar to F1 mesofolds - transposes S_0 - dips consistently < 20-30^0 south - south dipping homocline
	L_1	- generally trends E-W - subhorizontal plunges - metaquartzite stretching lineations: long axes of stretched detrital quartz grains and fibrous quartz overgrowths - metacarbonates: generally only S_o-S_1 intersection lineations
D_2	F_2	- main body of range and north coast: recumbent folds with consistent asymmetry and top-south vergence, hinges commonly parallel L_1. - Other
	S_2	- spaced pressure solution foliation locally well developed - approximately axial planar to F_2 mesofolds
D_3		- main body of range and north coast: normal displacement bands and normal faults: strike roughly N-S; dip steeply toward the E and w; subhorizontal E-W principal extension - range front: normal faults and shear bands

MARACAS FM

These rocks lie apparently conformably above the Maraval Fm. Measurements of a number of sections suggest surprisingly uniform thicknesses of approximately 1500m without there being any good correlations between the sections.

There seems to be a tendency for the lowest part of the formation to contain more slates and sericitic phyllites than average, with some thin interbedded sericitic quartzites. Higher in the formation are beds of massive orthoquartzites. Individual beds may reach 100m in thickness, but their lateral extent is limited. These rocks form high cliffs and deep gorges and they underlie the highest peaks in the western part of the Northern Range.

A considerable part of the Maracas Fm consists of interbedded quartzites and phyllites. In the laminated material a number of sedimentary structures can still be seen, such as scarce graded bedding, convolute bedding, slump folds and poor ripple flow marks. The strange thing about these features is that, considering the nature of the original sediments, we would have expected the current direction in these submarine fans to have been northwards off the South American Plate; but in fact most of the current indications seems to be southwards.

CHANCELLOR FM

Although the Chancellor Fm (formerly Chancellor Beds) is confined to the western end of the Northern Range, extending 36 km eastwards, it does outcrop on the north coast as well as on the south coast of the peninsula and islands. The formation occurs overturned on Maravaca Island, Medine Point and Les Boquets Islands lying under the overturned Maracas Fm. It therefore provides important additional evidence on details of the main north-vergent antiform.

There appear to be four members in the Chancellor Fm - a lower limestone member lying apparently conformably on the Maracas Fm, succeeded by a phyllite member which is followed in turn by an upper limestone sequence; then finally by upper phyllitic beds. The Morvant beds may lie unconformably on the Chancellor Fm, although evidence for the nature of the unconformity is not everywhere clear. The thickness of the Chancellor Fm. varies and seems to average about 400m.

The Chancellor limestones are usually dark grey, recrystallised and thinly bedded (1cm to 1 m) with interbedded dark grey slates, phyllites and occasional schistose quartzites. The lower limestone has a number of sedimentary structures in the interbedded phyllites. In this section the Chancellor limestones appear less pure than Maraval limestones, and are finer grained. Quartz is present in almost every Chancellor limestone and sericite is common in irregular bands. Pyrite is also common. Recrystallisation has not been carried as far as in the Maraval limestones, possibly because of the thinner bedding and the higher pelitic content.

The phyllite members are frequently poorly exposed and the uppermost phyllites have been much eroded along the south coasts of the islands. At widely scattered localities these beds weather lilac to purple in colour. On Fort George Road the lilac to purple colouring has spread to other parts of the formation, as it has on Lady Young Road. In Dumas Bay at the southwest end of the island on Monos, the uppermost bedded limestones are interbedded with conglomerates. In the conglomerates are rounded quartzite pebbles and limestone pebbles resembling Chancellor rocks. The pebbles are up to 150 mm diameter.

As well as interbedded conglomerates there are also what appear to be channels cut into the bedded limestones and now filled with conglomerates. There is also one example of a channel in the conglomerate which appears to have been filled with normal bedded Chancellor limestone.

In Kugler's1959 map the Chancellor Formation is shown as the Chancellor beds, the uppermost member of the Grande Riviere Formation, which itself is no longer recognised. However, these beds were not shown on the islands of Monos or Huevos, although they were shown on Chacachacare on the 1959 map.

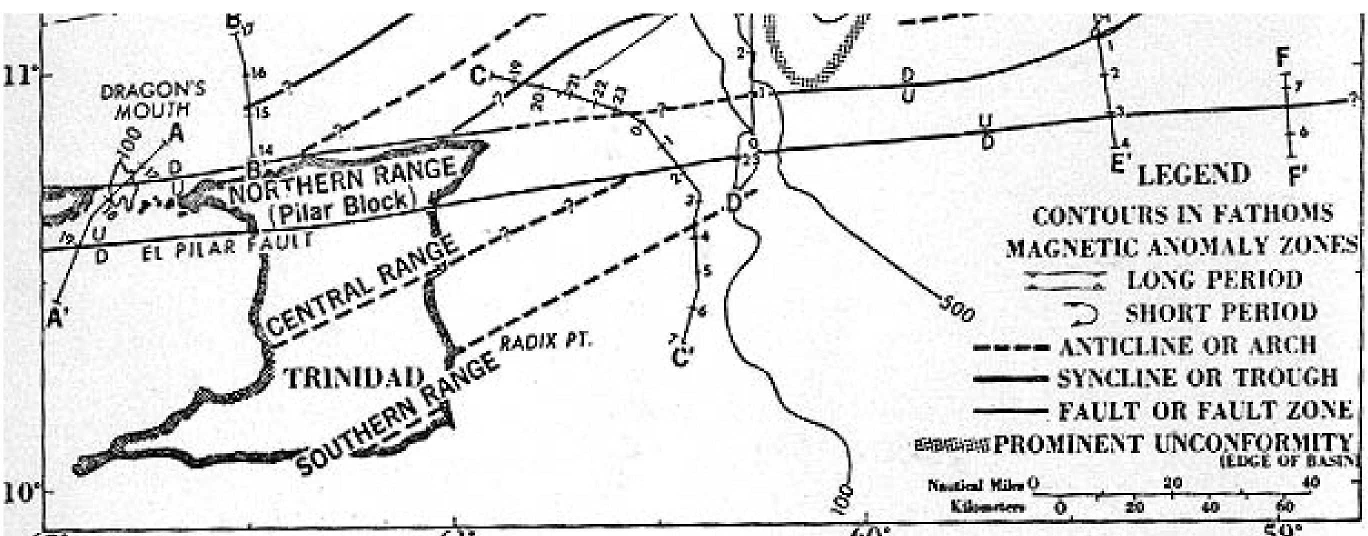


FIG. 1.—Major structural trends and location of representative traverses. Barbados anticlinorium is complex of structures lying east of Tobago Trough through East ridge.

This traverse through the Dragon's Mouth shows the Pillar Block as a partially buried horst flanked by sedimentary strata. This basement is the lateral continuation of the late Jurassic – Late Cretaceous metamorphics of the Paria Peninsula and the Northern Range. Small down to the north growth faults are present near the north end of the profile. The southern half of the profile shows a shallow zone of relatively transparent sediments apparently transgressing the block from the south.

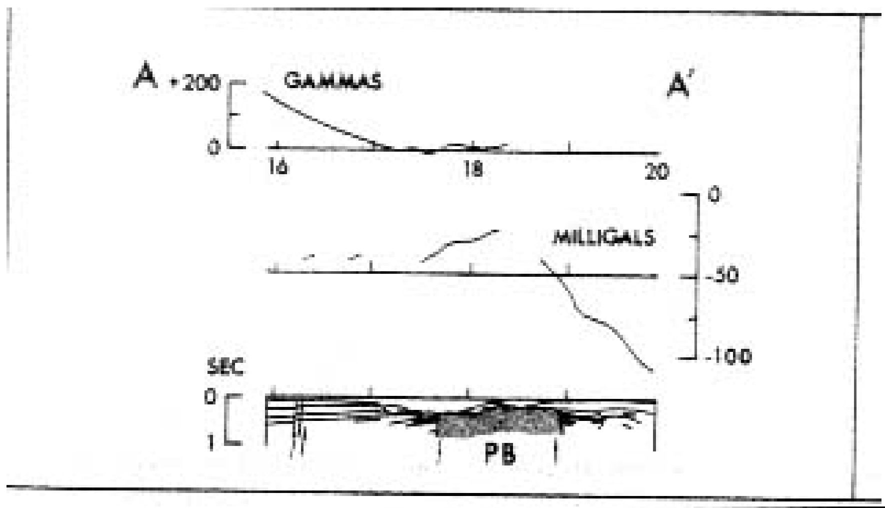


FIG. 2.—Residual magnetic field intensity (regional field removed by inspection), free-air gravity ano and seismic reflection profiles. Vertical scale of seismic records is two-way time. Position numbers are h CS, Central syncline; ER, East ridge; ETS, East Tobago syncline; NTA, North Tobago anticline; PB, block; TT, Tobago Trough; and WR, West ridge.

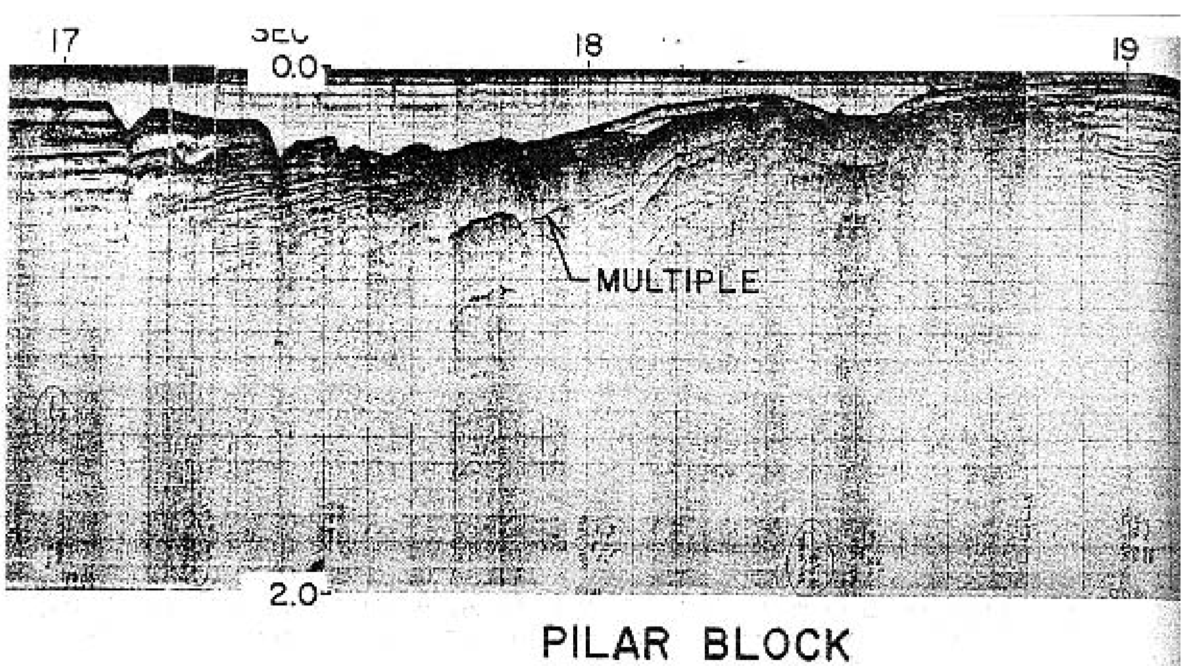


FIG. 3.—North-south seismic reflection profile through Dragon's Mouth (profile A-A', Fig. 1) showing Pilar blo adjacent to thick sedimentary sequences. Vertical scale is two-way time.

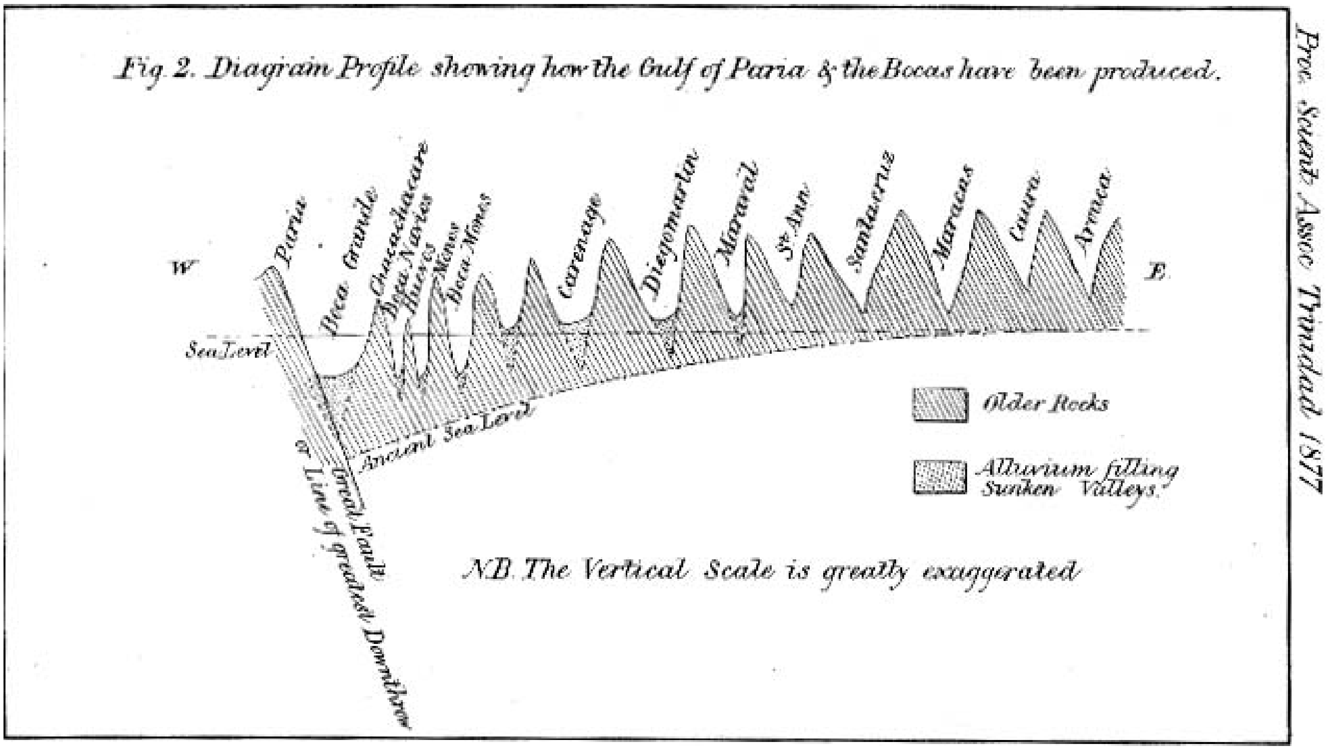


Fig. 2. Diagram Profile showing how the Gulf of Paria & the Bocas have been produced.

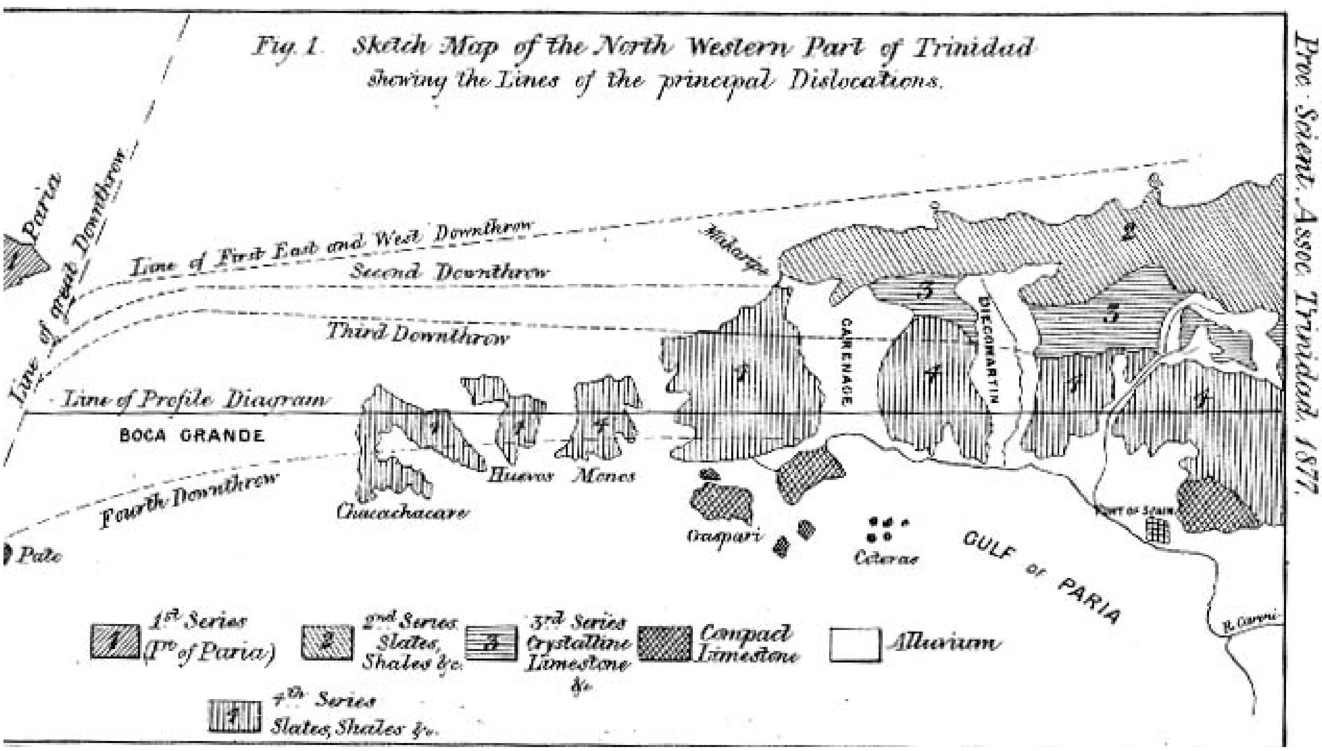


Fig. 1. Sketch Map of the North Western Part of Trinidad showing the Lines of the principal Dislocations.

Guppy 1877, Suggested that the Gulf of Paria occupied a depression the lowest axis of which passes through the Boca Grande in a north south direction. The amount of subsidence diminishes gradually eastward, until at the valley of Arima its effects disappear. Evidence of this subsidence is to be found in the submerged valleys about the Bocas – valleys obviously produced by sub-aerial denudation, but now sunk below the level of the sea.

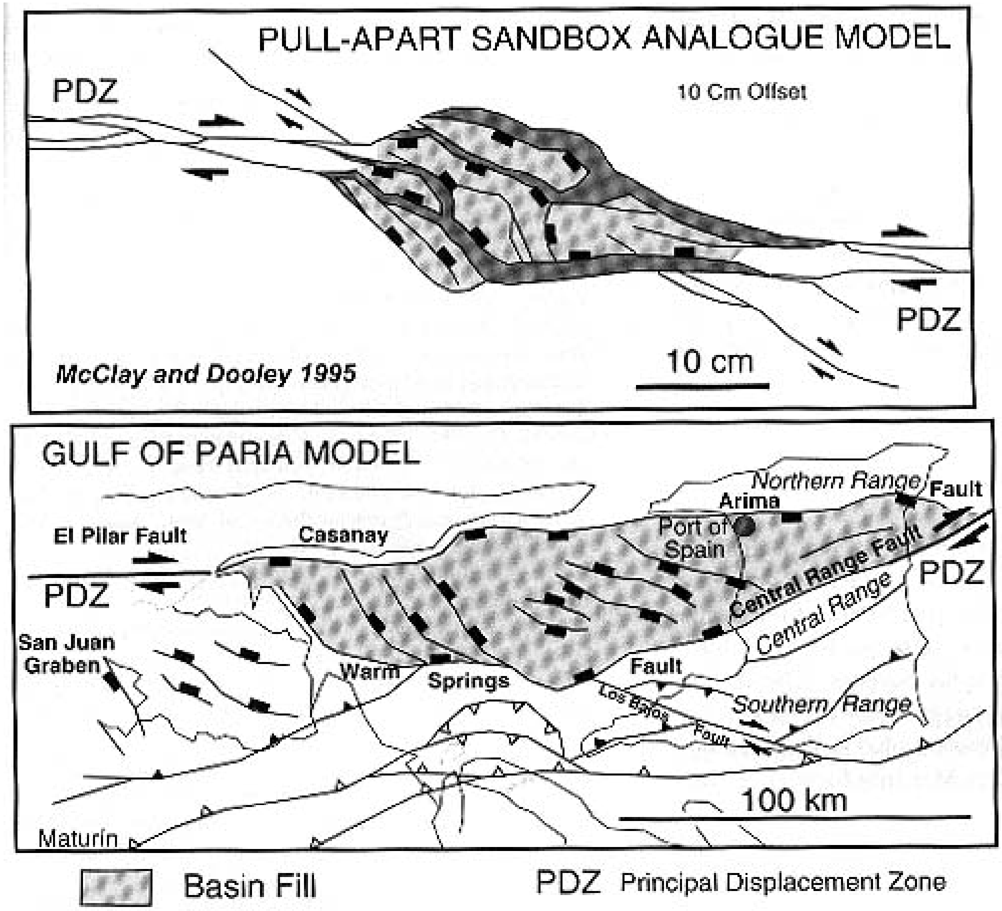
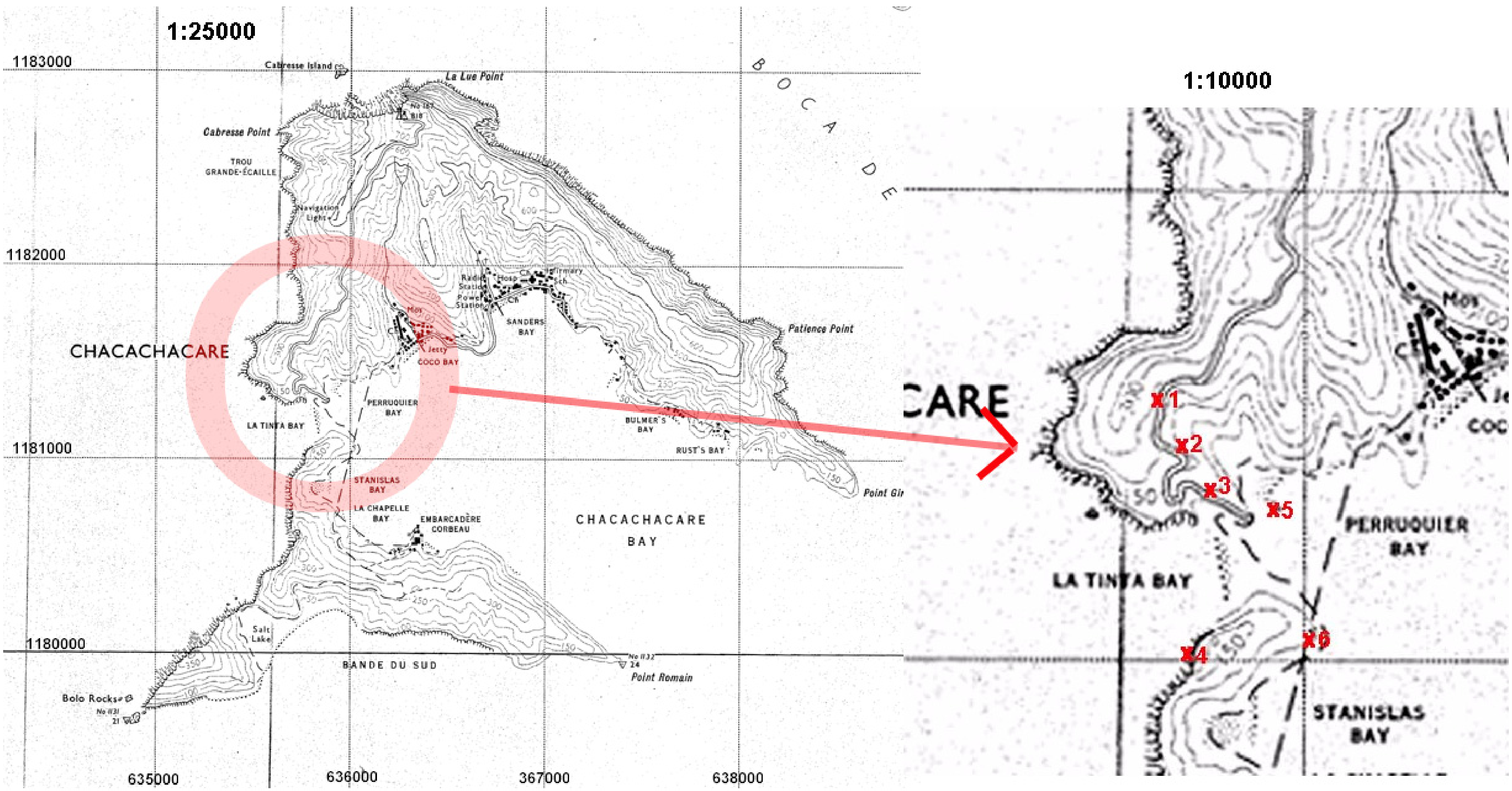


Fig. 8. Comparison of the structure of the Gulf of Paria (lower panel) with the pull-apart experimental analogue model of McClay and Dooley (1995) (upper panel). The westward PDZ is represented by the El Pilar fault while the eastward PDZ is the Central Range fault of Trinidad. The Southern Basin sidewall is the Warm Springs fault and the northern the Arima-Casanay fault. Cross-basin fault zones define the Domoil, Posa, Gulf and Avocado–Couva Highs.

Flinch et. al.



Location map for Chacachacare, with outcrops visited.

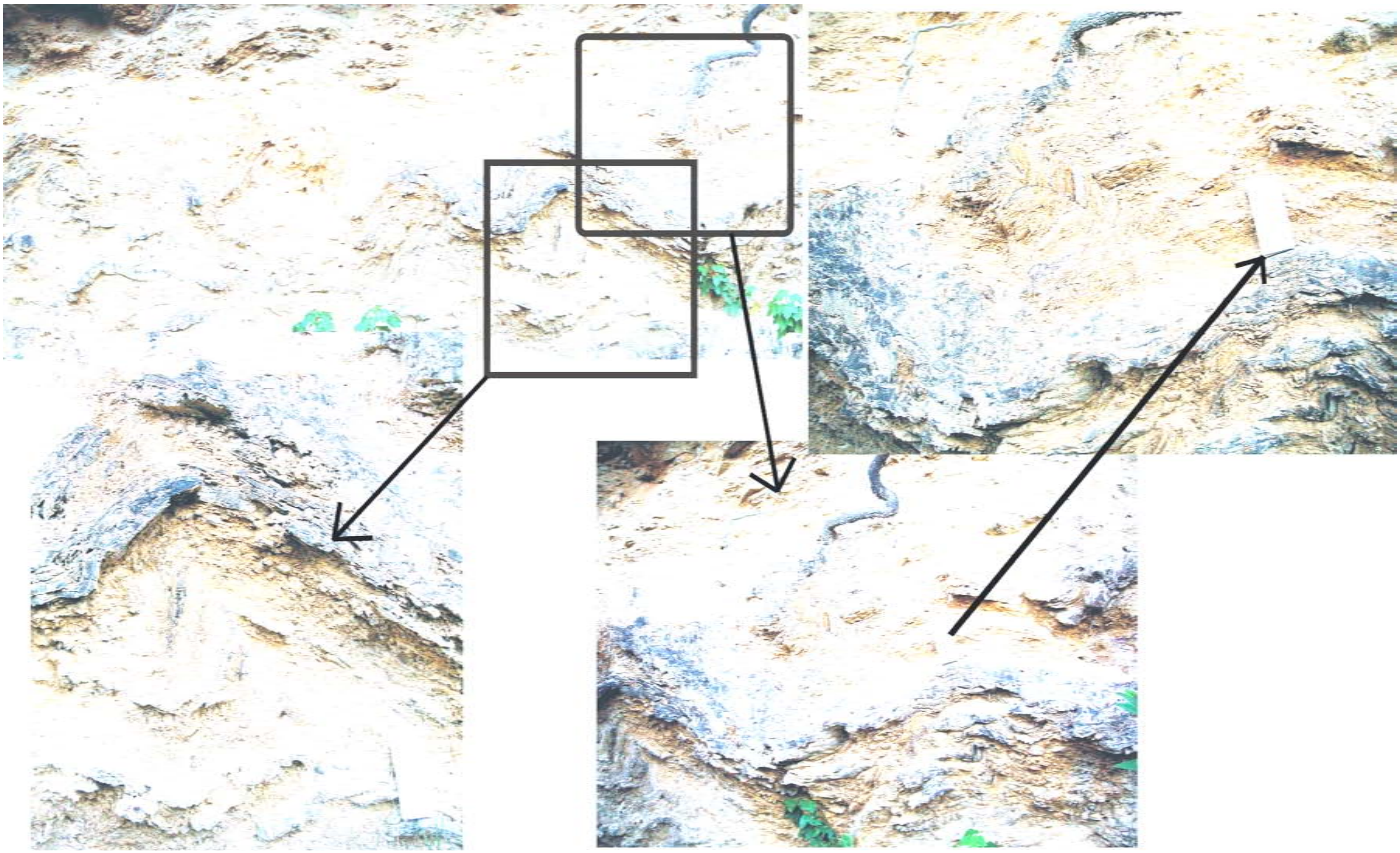
A view of the Grand Boca looking west to the Paria Peninsula (Venezeula) from the lighthouse .Patos is the small island to the right of the photo.

STOP 1 :WGS 84 ZONE 20 UTM (Naparima Datum): **E 0635697 N 1181570**

Folded phyllites and sandstones.

STOP 2 :WGS 84 ZONE 20 UTM (Naparima Datum): **E 635732 N 1181458**

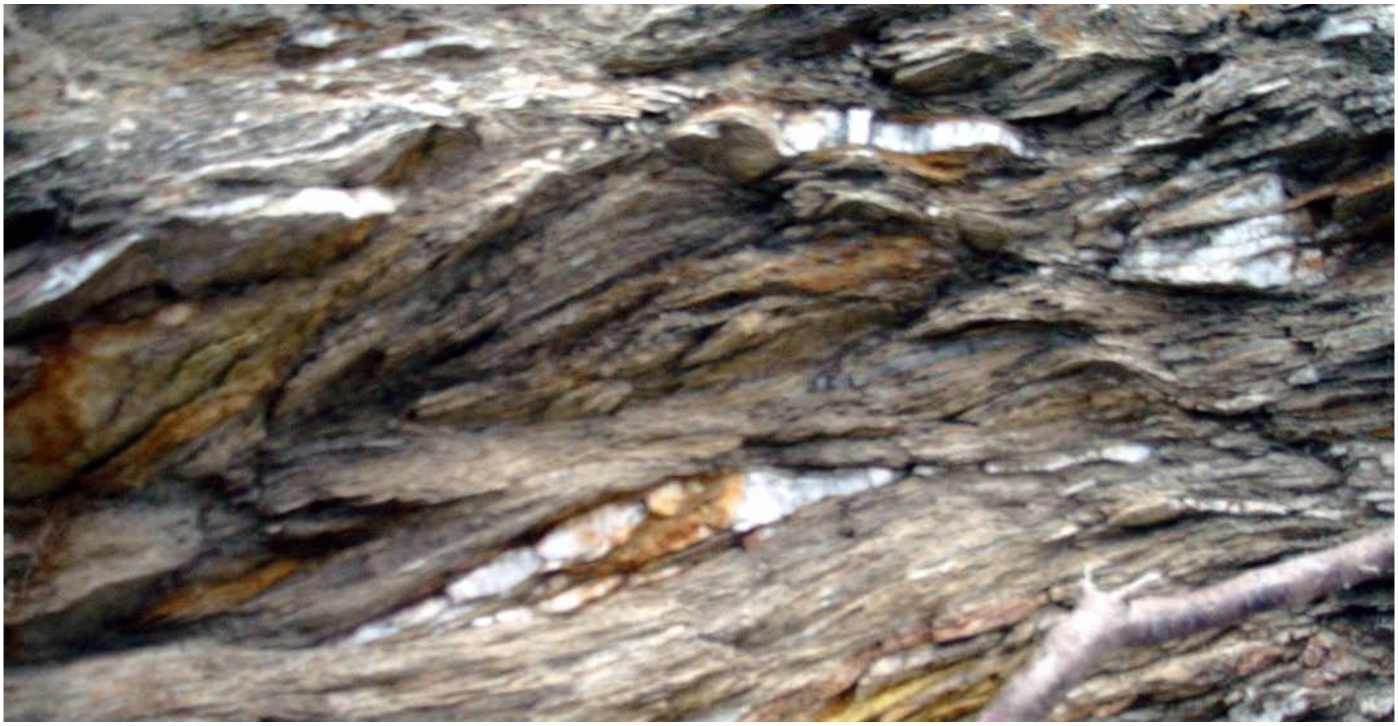
Phyllite dominated, sequence with thin sub-ordinate sandstones. One can note that the sandstones have been folded into broad gentle folds while the phyllites exhibit more severe deformation.



STOP 3 :WGS 84 ZONE 20 UTM (Naparima Datum): **E 635794 N 1181371**

Tightly folded limestones, fold axial planes all dip to the south and also appear to be folded.

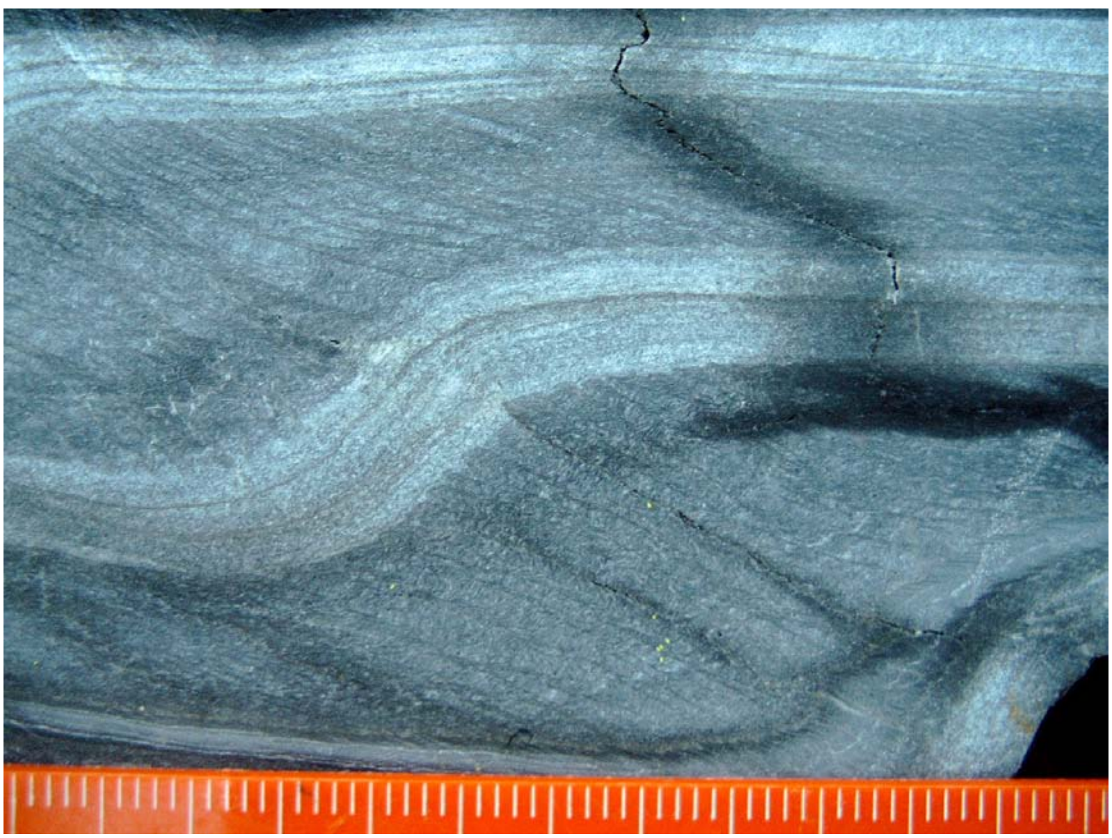
STOP 4 :WGS 84 ZONE 20 UTM (Naparima Datum): **E 635747 N 1181070**, La Tinta bay, southern headland



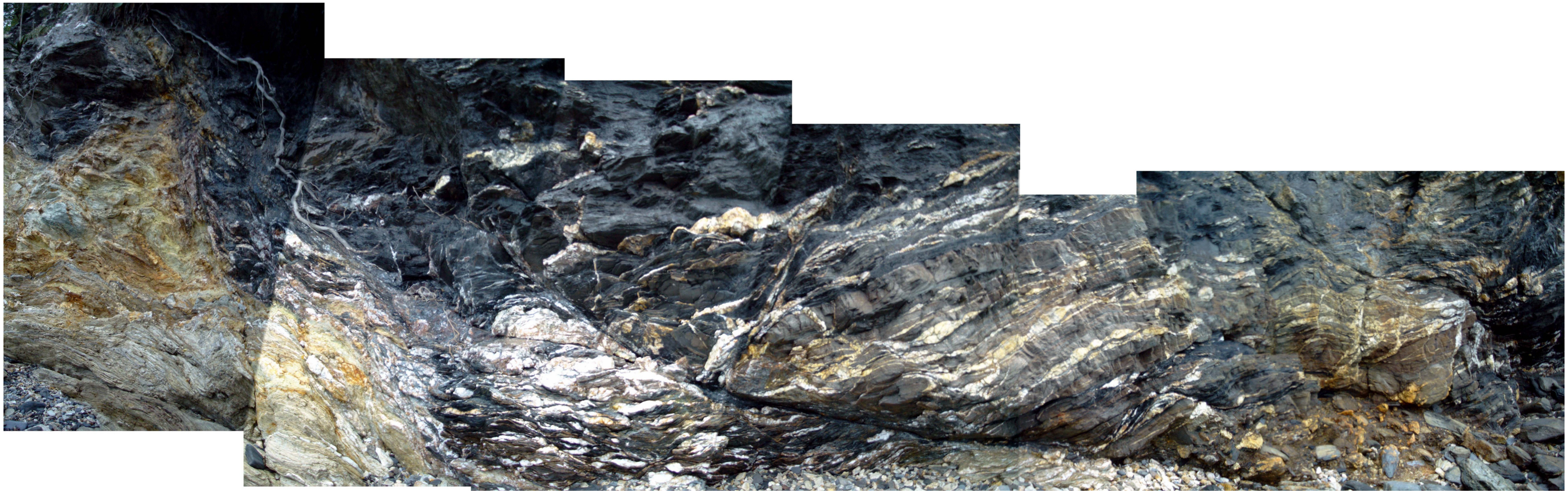
Schist with boudinaged calcite.

Carbonate layer, thinly banded, rapid fizzing with acid.

Calcareous schist has abundant irregularly shaped pyrite crystals



Folded phyllite with axial plane cleavage



Fault zone, rocks in the footwall are dominantly calcareous sandstones andcalcareous pyritic schists. Abundant calcite nodules and boudinaged calcite are found in the fault zone

Close up of the fault, showing calcite along the fault plane and abundant calcite near it.

Headland at end of La Tinta Bay, to the left is North and the the right is south. The fault is visible as the abrupt change from light brown rock to black.

Harmonic folding, phyllites are severly deformed

Calcite filled tension gashes within sandstone layer, north is to the right.

STOP 5 :WGS 84 ZONE 20 UTM (Naparima Datum): **E 635954 N 1181313**

Small headland separating 2 beaches in Perruquier Bay,

Rocks are sand dominated with thin phyllites between.

Close up of rocks, showing sandstones separated by thin deformed phyllites, there appears to be primary sedimentary fabric preserved here.

Sandstones with thin phyllites, bottom bed show what seems to be scouring into the underlying phyllites at the base of the bed.

STOP 6 , headland near jetty, moving south to Stanislas Bay.

Folded phyllites and sandstones.

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