

# A re-evaluation of the Cenozoic stratigraphy and paleontology of Sta. Ignacia Quadrangle, Tarlac Province

*R. N. de Lara\*, E.Y. Mula\*\*, and M.A. Zepeda, D. Sc.\**

*\*General Geology Section and \*\* Geological Laboratory Services Section, Lands Geological Survey Division, Mines and Geosciences Bureau*



# Outline

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- Introduction
- Statement of the Problem
- Significance of the Study
- Objectives
- Methodology
- Conceptual Framework
- Results and Discussion
- Conclusion and Recommendation

# Introduction

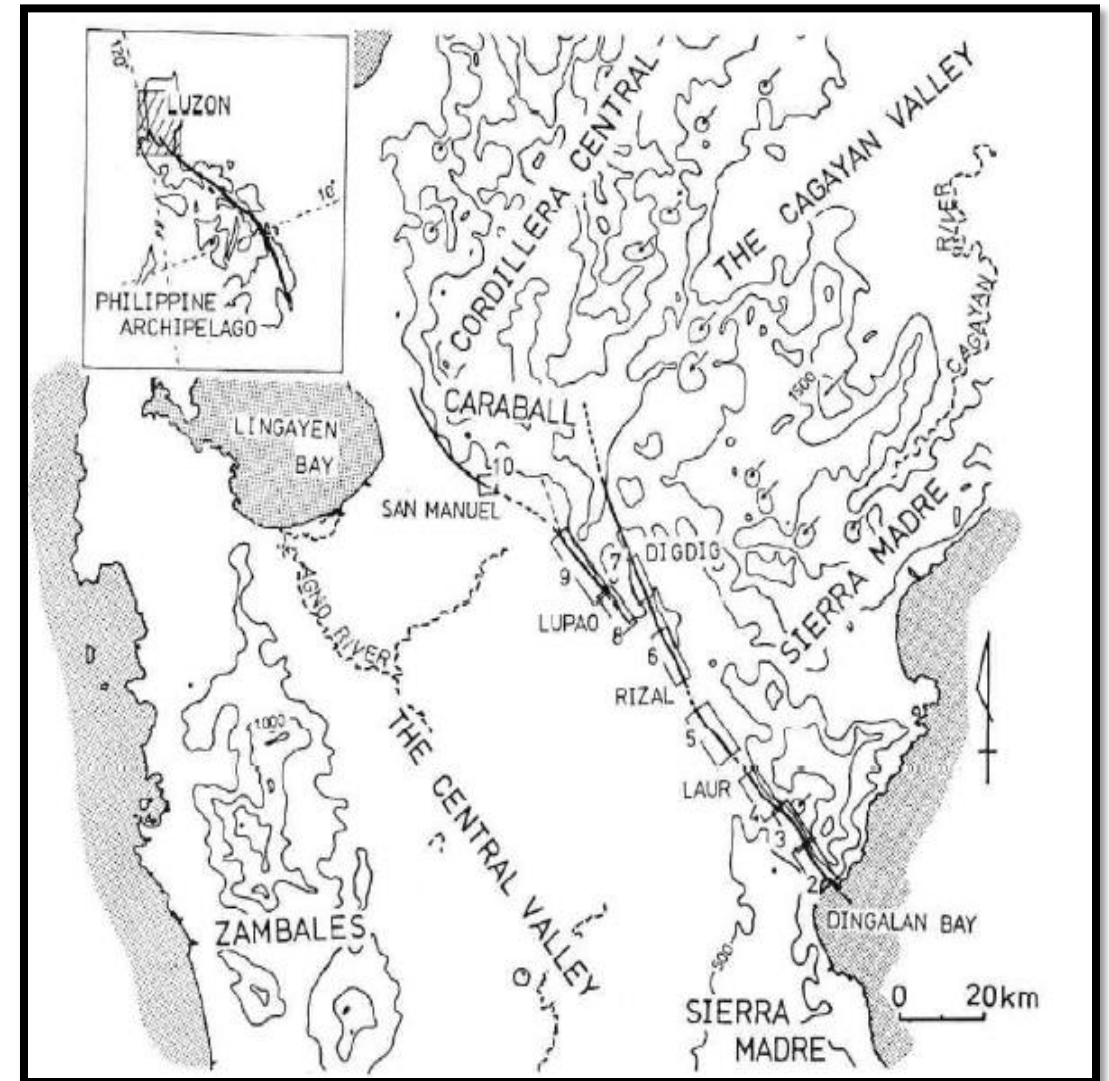
## *BACKGROUND OF THE STUDY*

- **Cenozoic Stratigraphy Project of the Philippines (research component of the National Geological Mapping Program)**
- Stimulated by the demand for precise geologic maps
- Highlights the role of paleontology and other basic science researches in enhancing **Quadrangle Geological Mapping**
- Way of addressing popular defects in the existing geologic maps through long-term mapping and rock sample analysis



# Introduction

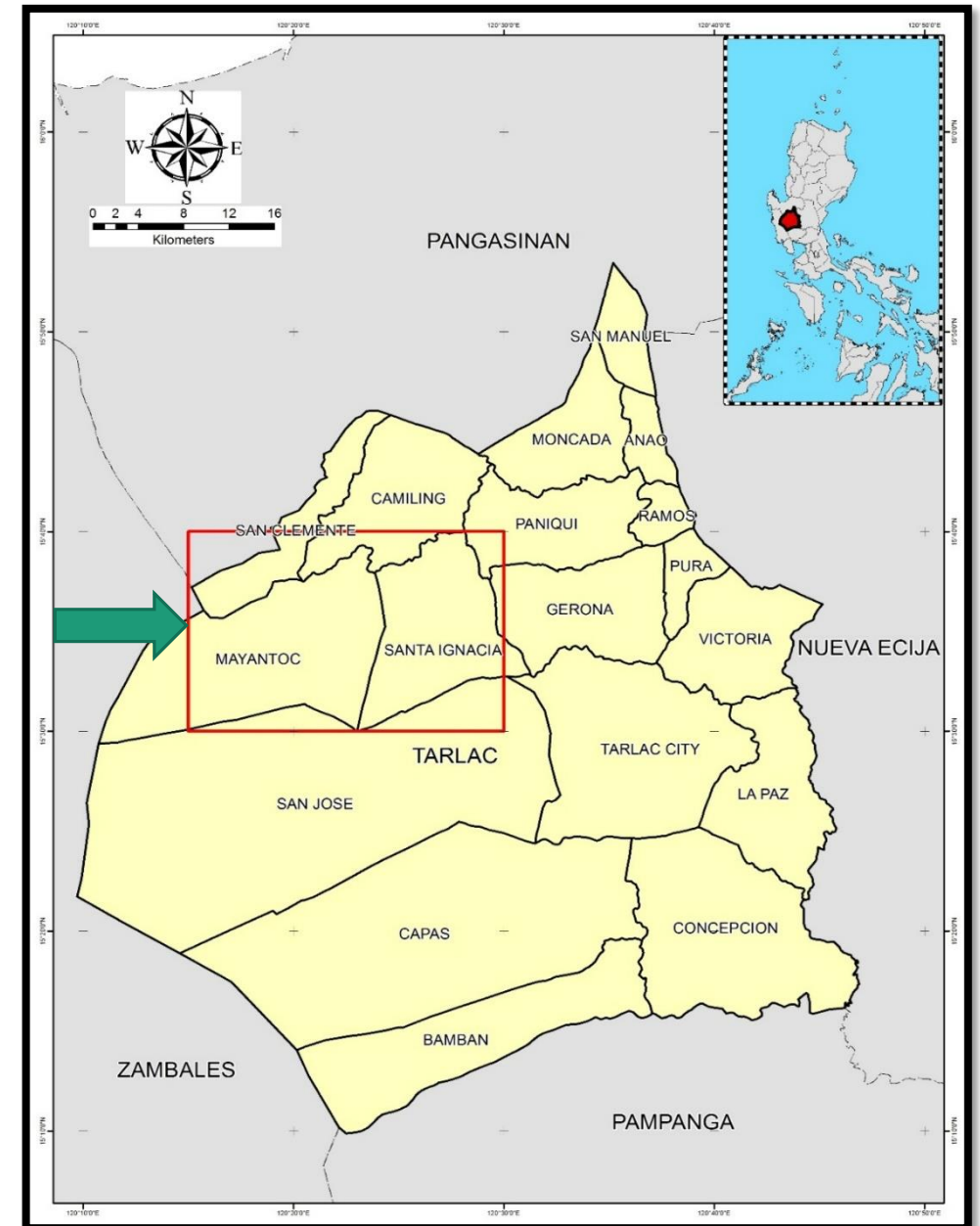
- **Central Luzon Basin**
  - filled with 8,000 meters thick sedimentary sequence (Saldivar-Sali, 1978)
  - Structurally controlled by the major branches of the northern segment of the Philippine Fault (Vigan-Aggao Fault) (Maleterre, 1989; Pinet, 1990)



# Introduction

- **Location of the study area**
  - Sta. Ignacia Quadrangle, Tarlac Province
  - Covers the municipalities of Santa Ignacia and Mayantoc, and portions of San Jose, Camiling, and San Clemente

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# Statement of the Problem

Previous workers on the stratigraphic sequence of western Central Luzon Basin had conflicting age assignments of four (4) sedimentary units, namely, Aksitero, Moriones, Malinta, and Tarlac formations

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AGE	N/P ZONES	DIVINO-SANTIAGO (1963)	DE LEON AND MILITANTE-MATIAS (1992)	PEÑA (2008)	
HOLO.	N23				
PLEISTO.					
	N22				
PLIOCENE	L	N21			
		N20			
	E	N19			
		N18		Tarlac Formation	Tarlac Formation
		N17			
MIOCENE	L	N16	Tarlac Formation	Malinta Formation	
		N15			
	M	N14			
		N13			
		N12			
		N11	Malinta Formation	Moriones Formation	Moriones Formation
		N10			
	E	N9			
		N8			
		N7	Moriones Formation		
		N6			
		N5			
		N4			
OLIGOCENE	L	P22/N3			
		P21/N2			
	M	P20/N1			
	E	P18/19			
	L	P17			
		P16			
		P15			
		P14			
				Aksitero Formation	

# Significance of the Study

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The results of this study would serve as a new source of information and refinement of the Cenozoic stratigraphy of Sta. Ignacia Quadrangle. Moreover, this would be of immense help to future researchers in reconstructing and understanding the geologic history of the area.

# Objectives

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This study mainly focuses on the re-evaluation of the age and stratigraphic relationships of these formations based on fossil evidence

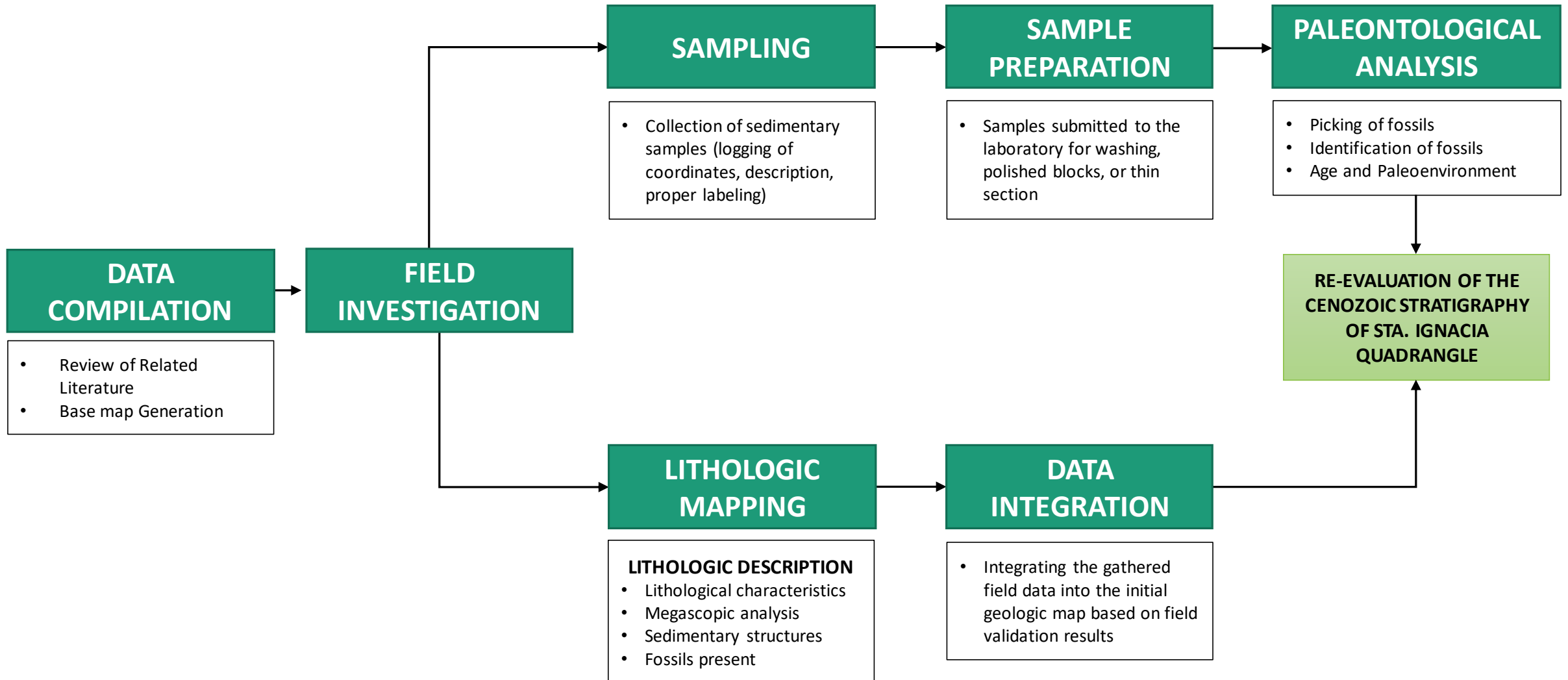


# Methodology

1. Data Compilation
2. Base Map Generation
3. Field Investigation and Sampling
4. Laboratory Analysis
5. Data Synthesis

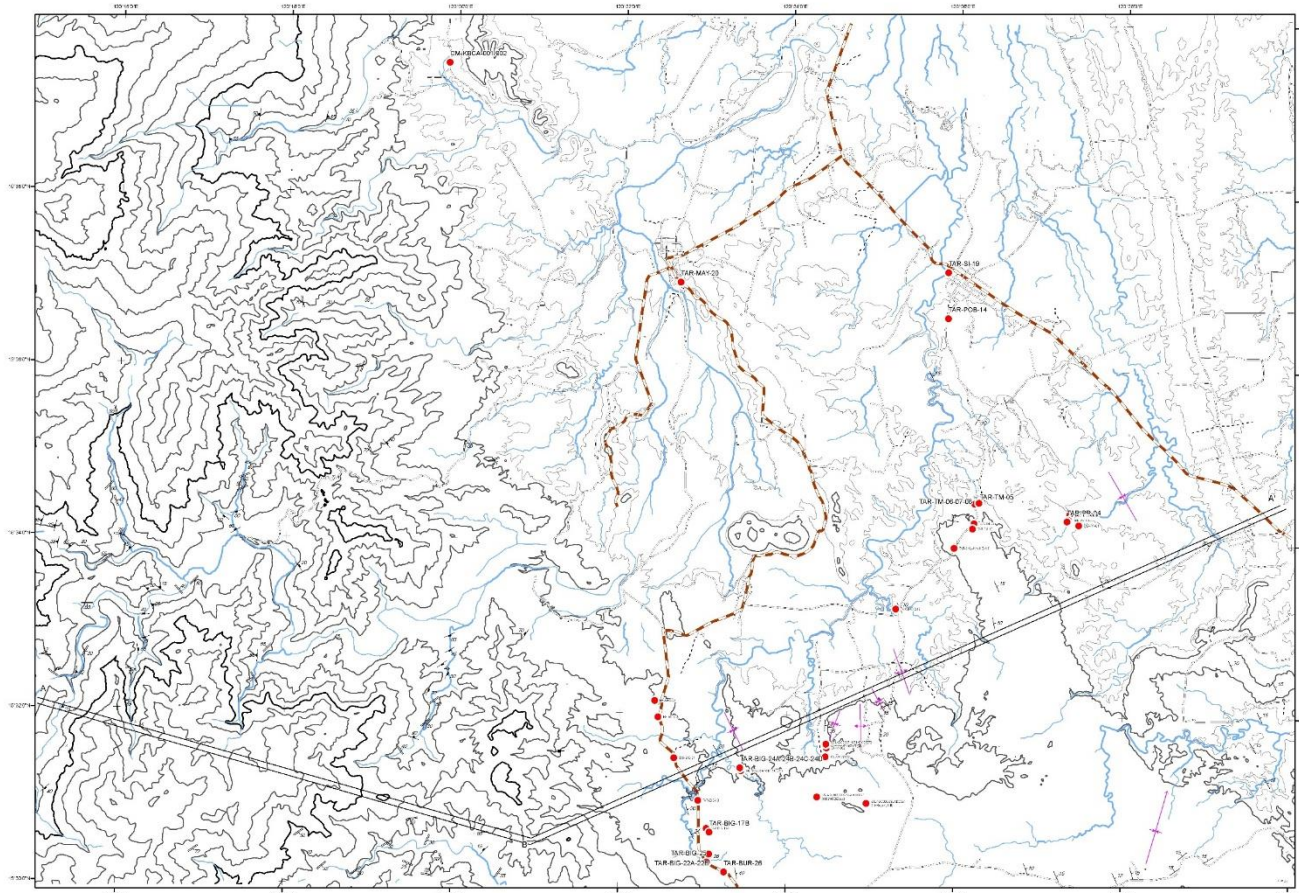


# Conceptual Framework

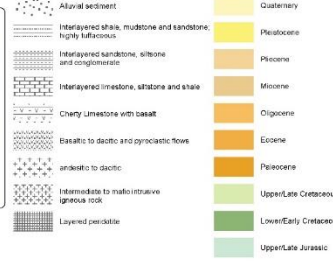
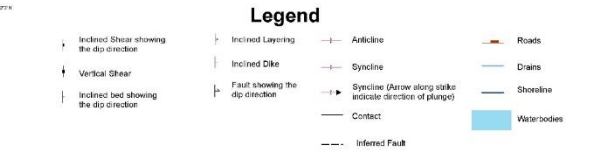
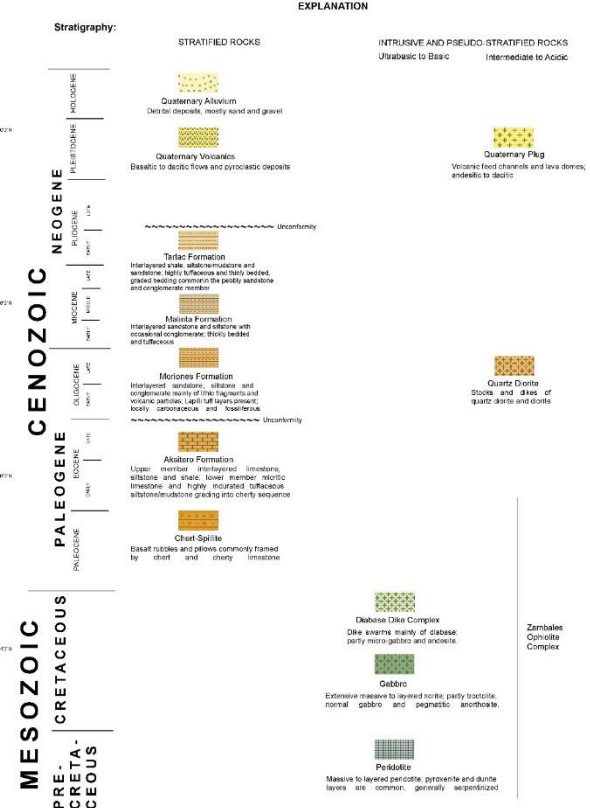




# SHEET 3065-II GEOLOGICAL MAP OF STA IGNACIA QUADRANGLE



SECTION ALONG A - A'  
Vertical Exaggeration: 1.0



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 PUBLISHED DECEMBER 2017

Data Sources :  
 MGSB Quadrangle Mapping Team  
 Lands Geological Survey Division  
 National Mapping and Resource Information Authority  
 GIS Processing :  
 Lands Geological Survey Division

Coordinate System :  
 Spheroid : Clark 1866  
 Projection : Transverse Mercator  
 Datum : Luzon 1911  
 Mapping scale 1:50,000



# Results and Discussion

---

- **Lithology**

## AKSITERO FORMATION

- Oldest sedimentary formation considered as the carapace of the Zambales Ophiolite
- Pale yellow to yellowish-white fine-grained limestone



# Results and Discussion

- **Lithology**

## MORIONES FORMATION

- Unconformably overlying Aksitero Formation
- Interbedded sandstone, shale, and conglomerate with minor limestone



(TAR-BIG-22B) An interlayering of sandstone, siltstone, and shale in an outcrop seen along the riverbank of Bayating River in Brgy. Bigbiga, Mayantoc, Tarlac. (GPS N 15° 31' 22.789" E 120° 23' 26.904").

# Results and Discussion

- **Lithology**

## MALINTA FORMATION

- Conformably overlies the Moriones Formation
- Interbedded sequence of well-bedded, fine- to coarse-grained lapilli tuff, shale, sandstone, and minor tuffaceous conglomerate



(TAR-BR-13) Thin bed of siltstone interbedded between two sandstone beds. The bedding planes are generally striking N15E and dipping 50NW. (GPS N 15° 33' 50.40" E 120° 26' 20.40")

# Results and Discussion

- **Lithology**

## TARLAC FORMATION

- Conformably overlies the Malinta Formation
- Thinly stratified, calcareous, light gray to greenish gray shale and sandstone
- Most widespread sedimentary rock in the study area



(a) An 3-m high outcrop located in Brgy. Timmaguab, Sta. Ignacia, Tarlac (GPS N 15° 34' 28.288" E 120° 26' 16.009").

(b) Closer view of the outcrop: 1- fine-grained sandstone; 2- shale; 3 - coarse-grained sandstone

# Fossil Assemblage

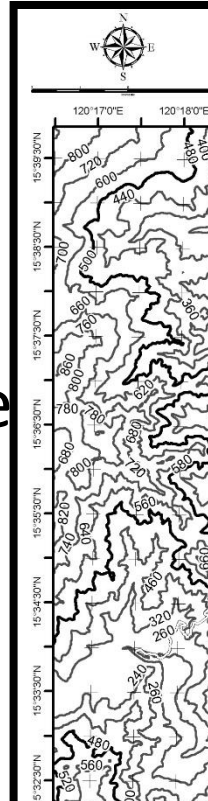
- Aksitero Formation**

## Sample MY-MB-003

- Highly indurated, well-bedded, fossiliferous limestone (striking NE and dipping SE) extending approximately 30 meters in Brgy. Bigbiga, Mayantoc, Tarlac

### Presence of:

- ✓ *Globorotalia opima nana*
- ✓ *Globogerina tripartita*



AGE		N/P ZONES		MY-MB-003	<i>Globorotalia opima nana</i>	<i>Globogerina tripartita</i>
HOLO.		N23				
PLEISTO.		N22				
PLIOCENE	L	N21				
		N20				
	E	N19				
		N18				
MIOCENE	L	N17				
		N16				
	M	N15				
		N14				
		N13				
		N12				
		N11				
		N10				
	E	N9				
		N8				
N7						
N6						
OLIGOCENE	L	P22/N3				
		P21/N2				
	M	P20/N1				
		P18/19				
	E	P17				
		P16				
		P15				
		P14				
E	L	P13				

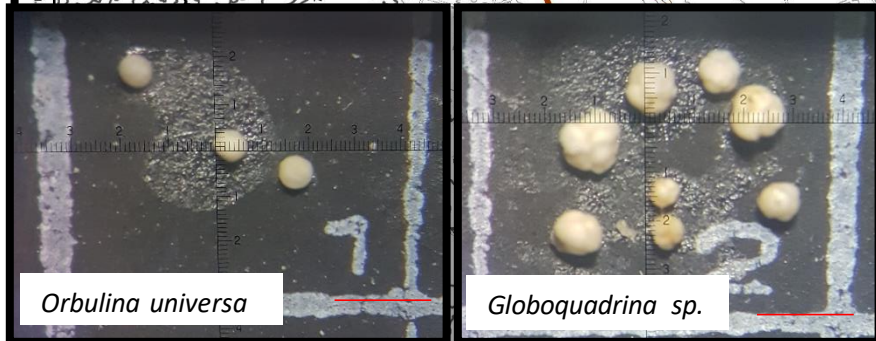
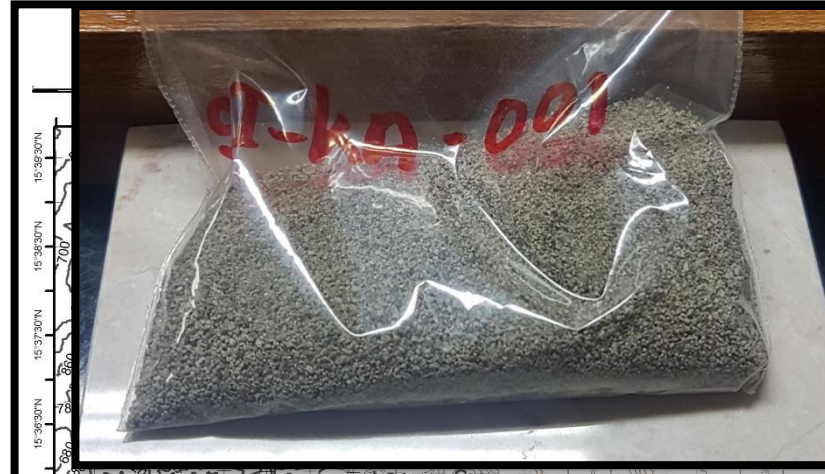


# Fossil Assemblage

- **Moriones Formation**

## Sample SI-KA-003

- Alternating thin to medium beds of tuffaceous siltstone and sandstone (striking N40W and dipping 11NE) overlain by a conglomerate bed (limestone clasts set in a sandy matrix)



Presence of:

- ✓ *Orbulina universa*
- ✓ *Globogerinoides trilobus*
- ✓ *Globoquadrina globosa*
- ✓ *Globoquadrina dehiscens*

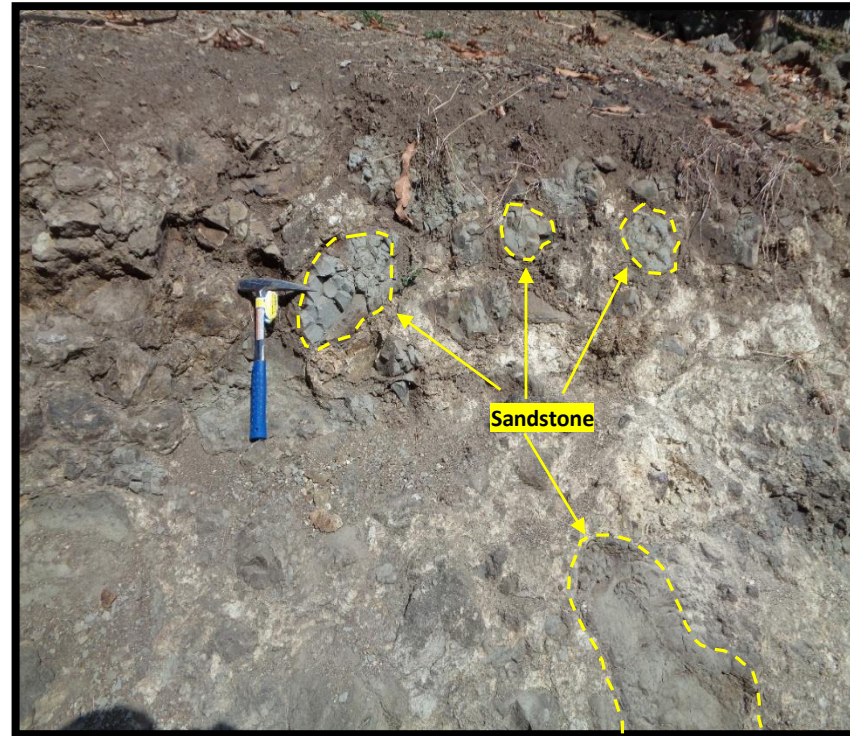
AGE	N/P ZONES	SI-KA-003	<i>Orbulina universa</i>	<i>Globigerinoides trilobus</i>	<i>Globoquadrina globosa</i>	<i>Globoquadrina dehiscens</i>
HOLO.	N23					
	N22					
PLEISTO.	N21					
	N20					
	N19					
	N18					
	N17					
MIOCENE	N16					
	N15					
	N14					
	N13					
	N12					
	N11					
	N10					
	N9					
	N8					
	N7					
E	N6					
	N5					
	N4					
	L P22/N3					
	M P21/N2					
OLIGOCENE	E P20/N1					
	P18/19					
L	P17					
	P16					

# Fossil Assemblage

## • Moriones Formation

### Sample CM-KBCA-001

- An outcrop of conglomerate cropping out along a rough road in Brgy. Maasin, San Clemente
- Consists chiefly of pebble- to cobble-sized, angular to sub-angular clasts of well-indurated fine-grained grayish sandstone in a sheared brownish silty matrix



Presence of:  
 ✓ *Orbulina universa*  
 ✓ *Globigerinoides trilobus*  
 ✓ *Globoquadrina globosa*

AGE		N/P ZONES	CM-KBCA-001	<i>Orbulina universa</i>	<i>Globigerinoides trilobus</i>	<i>Globoquadrina globosa</i>	
HOLO.		N23					
PLEISTO.		N22					
PLIOCENE	L	N21					
		N20					
	E	N19					
		N18					
	MIOCENE	L	N17				
			N16				
M		N15					
		N14					
		N13					
		N12					
		N11					
		N10					
		N9					
		N8					
E	N7						
	N6						
	N5						
	N4						

# Fossil Assemblage

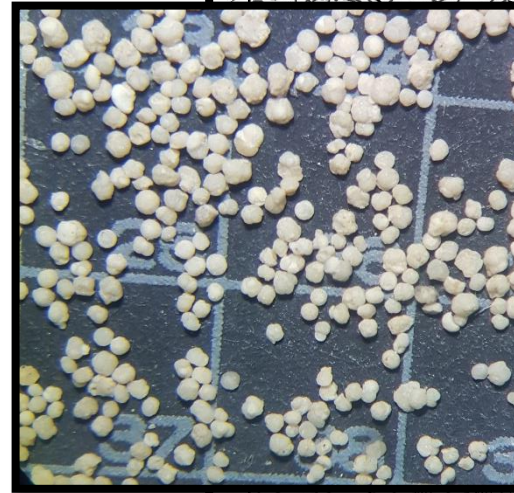
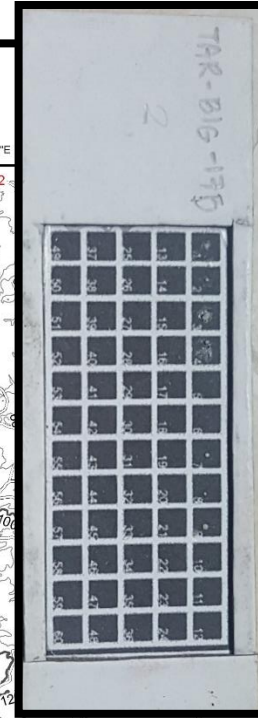
## • Moriones Formation

### Sample TAR-BIG-17B

- Gray colored highly fossiliferous shale found in Brgy. Bigbiga, Mayantoc

### Sample TAR-BIG-22B

- Interbedds of sandstone, siltstone and shale along the right bank of Bayating River in Brgy. Bigbiga, Mayantoc



AGE	N/P ZONES	TAR-BIG-17B				TAR-BIG-22B			
		Orbulina universa	Globoquadrina globosa	Globoquadrina dehiscens	Sphaeroidinella disjuncta	Orbulina universa	Globoquadrina globosa	Globoquadrina dehiscens	Sphaeroidinella semiminulina
QUADRANGLE									
HOLO.	N23								
PLEISTO.	N22								
PLIOCENE	L								
	N21								
	N20								
	E								
	N19								
	N18								
MIOCENE	L								
	N17								
	N16								
	N15								
	N14								
	N13								
	N12								
	N11								
	N10								
	N9								
E	N8								
	N7								
	N6								
	N5								
	N4								
OLIGOCENE	L								
	P22/N3								
	M								
	P21/N2								
	P20/N1								

# Fossil Assemblage

## • Malinta Formation

### Sample TAR-BR-13

- Interbeds of siltstone and sandstone (striking N15E and dipping 50NW)

#### Presence of:

- ✓ *Orbulina universa*
- ✓ *Globigerinoides trilobus*
- ✓ *Globoquadrina altispira*
- ✓ *Globoquadrina globosa*
- ✓ *Globorotalia acostaensis*
- ✓ *Globoquadrina dehiscens*
- ✓ *Sphaeroidinellopsis disjuncta*
- ✓ *Sphaeroidinella seminulina*



AGE	N/P ZONES	TAR-BR-13	<i>Orbulina universa</i>	<i>Globigerinoides trilobus</i>	<i>Globoquadrina altispira</i>	<i>Globoquadrina globosa</i>	<i>Globorotalia acostaensis</i>	<i>Globoquadrina dehiscens</i>	<i>Sphaeroidinellopsis disjuncta</i>	<i>Sphaeroidinella seminulina</i>
HOLO.	N23									
	N22									
PLIOCENE	L N21									
	N20									
	E N19									
	N18									
MIOCENE	L N17									
	N16									
	N15									
	N14									
	M N13									
	N12									
	N11									
	N10									
	N9									
	N8									
E	N7									
	N6									
	N5									
	N4									
PILIGOCENE	L P22/N3									
	M P21/N2									

# Fossil Assemblage

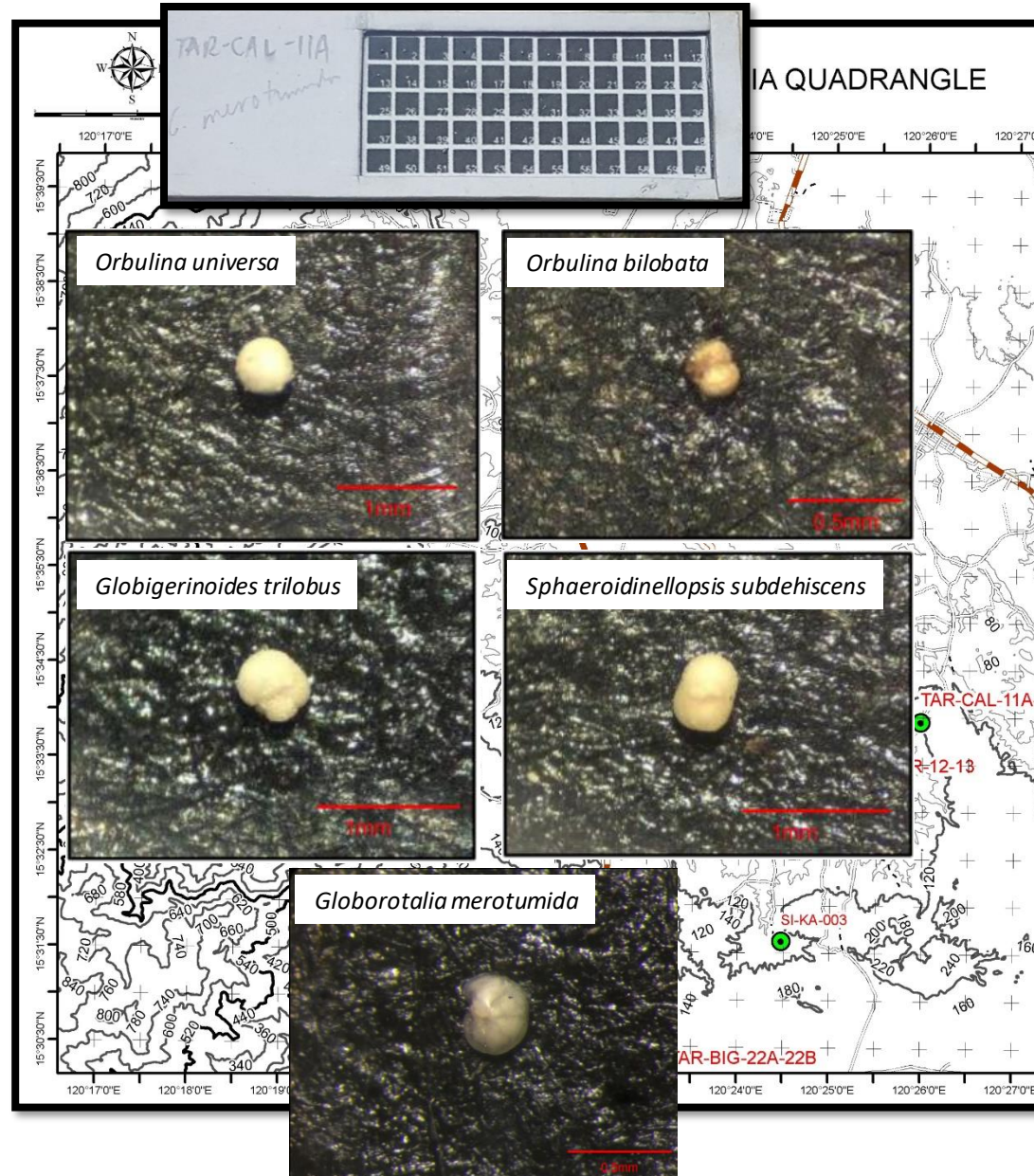
## • Tarlac Formation

### Sample TAR-CAL-11A

- Thick medium- to coarse-grained sandstone beds ranging from brownish to dark gray color with thin interbeds of highly jointed and fissile brownish gray shale

#### Presence of:

- ✓ *Orbulina universa*
- ✓ *Orbulina bilobata*
- ✓ *Globigerinoides trilobus*
- ✓ *Globorotalia merotumida*
- ✓ *Globorotalia plesiotumida*
- ✓ *Sphaeroidinellopsis subdehiscens*
- ✓ *Sphaeroidinellopsis penedehiscens*

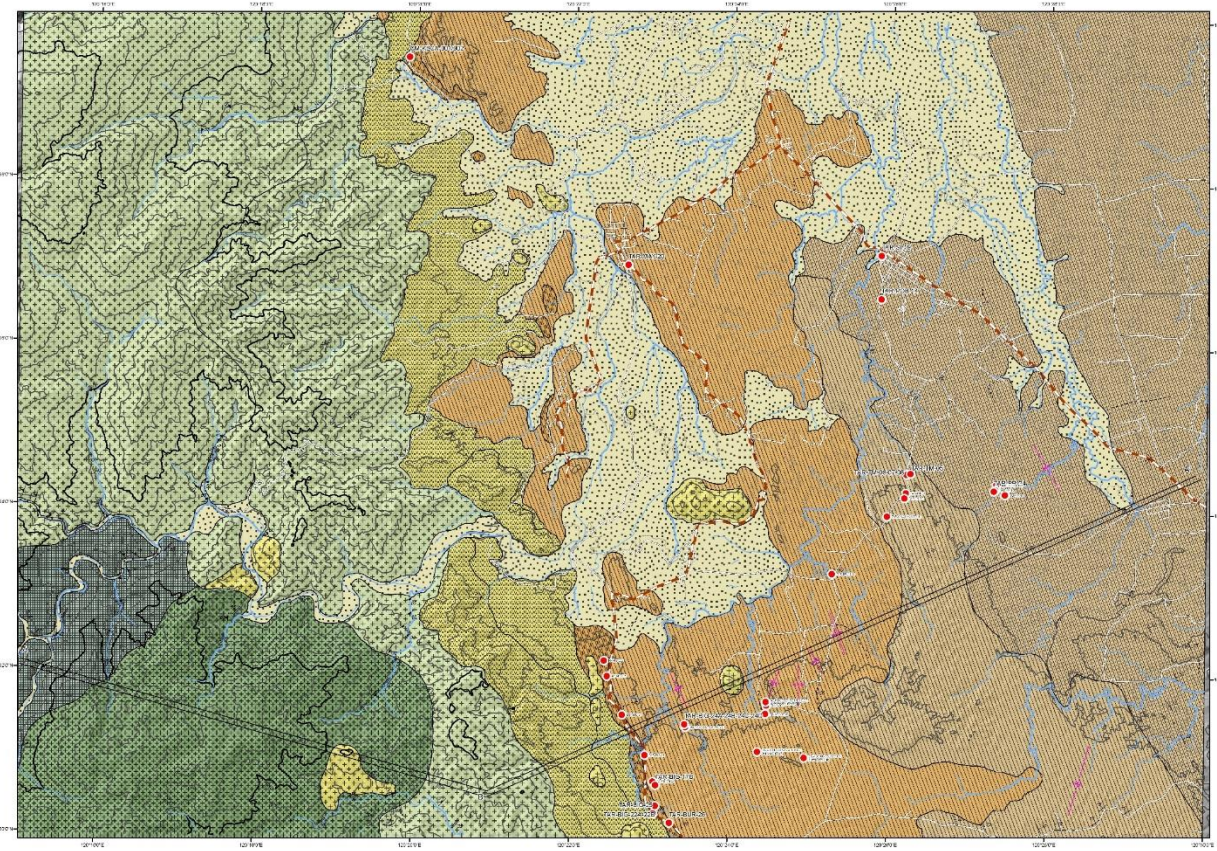


AGE	N/P ZONES	TAR-CAL-11A	<i>Orbulina universa</i>	<i>Orbulina bilobata</i>	<i>Globigerinoides trilobus</i>	<i>Globorotalia merotumida</i>	<i>Globorotalia plesiotumida</i>	<i>Sphaeroidinellopsis subdehiscens</i>
HOLO.	N23							
PLEISTO.	N22							
PLIOCENE	L N21							
	N20							
	E N19							
	N18							
MIOCENE	L N17							
	N16							
	M N15							
		N14						
		N13						
		N12						
		N11						
		N10						
	E N9							
		N8						
		N7						
		N6						
OLIGOCENE	N5							
	N4							
	L P22/N3							
	M P21/N2							
P20/N1								
E P18/19								





# SHEET 3065-II GEOLOGICAL MAP OF STA IGNACIA QUADRANGLE



**Stratigraphy:**

Stratigraphic Unit	Description	Color/Pattern
Quaternary Alluvial	Dental deposits, mostly sand and gravel	Yellow with dots
Quaternary Volcanics	Basaltic to dacitic flows and pyroclastic deposits	Yellow with horizontal lines
Quaternary Plugs	Volcanic neck channels and lava cores, androitic to basaltic	Yellow with vertical lines
Tarlac Formation	Interlayered siltstone, silty sandstone and calcarenite, light calcarenite and micaceous gravel bedded, contains the pebbly sandstone and conglomerate member	Light brown with horizontal lines
Molina Formation	Interlayered sandstone and siltstone with occasional conglomerate, shaly bedded and tuffaceous	Light brown with vertical lines
Motones Formation	Interlayered sandstone, siltstone and conglomerate, many of the fragments and volcanic pebbles, light to gray, pebbles, locally calcarenaceous, calc. basaltic	Light brown with diagonal lines
Aradete Formation	Upper member: interbedded siltstone, siltstone and shale, lower member: micritic limestone and highly indurated tuffaceous siltstone/limestone grading into cherty sequence	Light brown with horizontal lines
Chert Spillite	Basalt flows and pillows commonly framed by chert and cherty limestone	Light brown with vertical lines
Davao Dike Complex	Dike swarms mainly of diabase partly micro-gabbro and anesite	Dark brown with horizontal lines
Gabbro	Extensive massive to layered basaltic, partly trachytic, normal gabbro and pyroclastic, anorthitic	Dark brown with vertical lines
Pelidolia	Massive to layered peridotite, pyroxenite and diorite layers are common, generally serpenitized	Dark brown with diagonal lines
Zamales Ophiolite Complex		Dark brown with horizontal lines

**EXPLANATION**

**INTRUSIVE AND PSEUDO-STRATIFIED ROCKS**  
Ultrabasic to Basic      Intermediate to Acidic

**Legend**

- Inclined Shear showing the dip direction
- Vertical Shear
- Inclined bed showing the dip direction
- Inclined Layering
- Inclined Dike
- Fault showing the dip direction
- Anticline
- Syncline
- Syncline (Arrow along strike indicate direction of change)
- Contact
- Inferred Fault
- Roads
- Drains
- Shoreline
- Water bodies



Alluvial sediment	Quaternary
Interlayered shale, mudstone and sandstone, highly tuffaceous	Pleistocene
Interlayered sandstone, siltstone and conglomerate	Pliocene
Interlayered limestone, siltstone and shale	Miocene
Cherty Limestone with basalt	Oligocene
Basaltic to dacitic and pyroclastic flows	Eocene
androsite to dacitic	Paleocene
Intermediate to mafic intrusive igneous rock	Upper/Late Cretaceous
Layered peridotite	Lower/Early Cretaceous
	Upper/Late Jurassic

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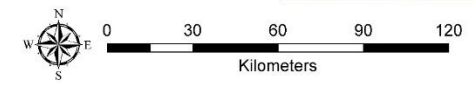
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**Data Sources:**  
MGB Quadrangle Mapping Team  
Lands Geological Survey Division  
National Mapping and Resource Information Authority

**GIS Processing:**  
Lands Geological Survey Division

**Coordinate System:**  
Spheroid: Clark 1896  
Projection: Transverse Mercator  
Datum: Luzon 1911

Mapping scale 1:50,000



# Conclusion

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- **The AKSITERO FORMATION** – considered base of the sequence is dated **Late Eocene to Late Oligocene (P14-P22)** based on the occurrence of *Globorotalia opima nana* and *Globigerina tripartita*
- **The MORIONES FORMATION** – faunal assemblages showed an abundance of *Globoquadrina dehiscens*, *Globoquadrina globosa*, and *Sphaeroidinellopsis disjuncta* which is indicative of a **Middle Miocene age (N9-N16)**
- **The MALINTA FORMATION** – an age of **Late Miocene (N16)** is assigned based on the first appearance of *Globorotalia acostaensis* and the last appearance of *Globoquadrina globosa*
- **The TARLAC FORMATION** – an age of **late Late Miocene to Early Pliocene (N17-N19)** based on the stratigraphic range of *Sphaeroidinellopsis subdehiscens*, *Sphaeroidinellopsis penedehiscens*, *Globorotalia plesiotumida* and *Globorotalia merotumida*



# Recommendation

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- A research on Cenozoic stratigraphy should be employed after a semi-detailed geologic quadrangle mapping especially in areas where there are formations with conflicting or no definitive age assignments
- A more detailed biostratigraphic zonation is necessary for a more definitive age assignment
- In-depth trainings on establishing synchronized biostratigraphic schemes for micro- and microfossil studies calibrated by isotopic or radiometric techniques should be conducted

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# Thank you for listening!

Department of Environment and Natural Resources  
Mines and Geosciences Bureau

North Avenue, Diliman, Quezon City, Philippines

[ranadelara.mgb@gmail.com](mailto:ranadelara.mgb@gmail.com)

**General Geology Section: (02) 8667-67-00 local 177**

