

PLATE-TECTONIC INTERPRETATION OF LAS VILLAS REGION (Central Cuba)

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ABSTRACT. Las Villas region of Central Cuba consists of a paraautochthon (the zones of Remedios, Paleo-Camajuani and Camajuani) and two allochthons (Las Villas and Zaza). They resulted from the collision of the Caribbean and North American plates. Las Villas allochthon includes the zones of Las Villas, Paleo-Placetas and Placetas. It is a part of the southern margin of North American plate thrust over Bahamas platform. Zaza allochthon coincides entirely with the Zaza zone. It is an obducted part of the Caribbean plate comprising island arc lying on ophiolite complex. Serpentinite mélange in the lowest part of this complex marks an old (dead) subduction zone, transformed into obduction zone as a result of the collision. The boundary between the serpentinite mélange and the upper levels of the ophiolite complex is a detachment fault. Such a fault is supposed to exist between the basement and the folded cover as well. During the period of collision (Paleocene – Middle Eocene) and related thrusting and obduction, three basins of terrigenous-carbonate sedimentation were formed. They were featured by intensive resedimentation phenomena. The flyschoid sediments of two of the basins (Camajuani and Placetas) have been used as lubricators, facilitating the thrusting and obduction.

ТЕКТОНСКА ИНТЕРПРЕТАЦИЯ НА РЕГИОНА "ЛАС-ВИЯС" (Централна Куба)

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РЕЗЮМЕ. Регионът Лас Вияс на Централна Куба е изграден от параавтохтон (зоните Ремедиос, Палео-Камажуани и Камажуани) и два алохтона (Лас Вияс и Саса). Те са резултат от колизията между Карибската и Северноамериканската плочи. Алохтонът Лас Вияс включва зоните Лас Вияс, Палео-Пласетас и Пласетас. Той е част от южния ръб на Северноамериканската плоча, навлечена върху Бахамската платформа. Алохтонът Саса съвпада изцяло със зоната Саса. Той представлява обдуцирана част от Карибската плоча, включваща островна дъга, лежаща върху офиолитов комплекс. Серпентинитов меланж в най-долната част на този комплекс маркира стара (мъртва) субдукционна зона, трансформирана в зона на обдукция в резултат на колизията. Границата между серпентинитовия меланж и по-горните нива на офиолитовия комплекс представлява разлом на отлепване. Предполага се съществуването на подобен разлом между фундамента и нагнатата покривка. По време на колизията (палеоцен – среден еоцен) и свързаните с нея навличане и обдукция, са образувани три басейна с теригенно-карбонатна седиментация. Характерни за тях са интензивните реседиментационни явления. Флишиодните седименти на два от тези басейни (Камажуани и Пласетас) са използвани като смазка, благоприятстваща навличането и обдукцията.

Introduction

Las Villas region is situated among the towns of Yaguajay, Moron, Ciego de Avila and Cabaiguan of Central Cuba. This article aims to demonstrate the relationships of the tectonic units exposed in this region and to interpret them in the context of the plate-tectonics. The proposed tectonic model is based on field investigations and analysis of published literature, geofund reports and geological maps. It specifies the models of Gealey (1980), Iturralde-Vinent (1975; 1988), Tchouneuv et al. (1981), Haydoutov (1986), Mossakovsky et al. (1988), Ianev et al. (1993), Jelev (1993) and others.

The interpretation is made according to the denomination of the structural zones and formations used by Mossakovsky et al. (1988) with supplements.

Description of the zones

Several structural-facial zones are exposed in the studied region of Central Cuba as follows: Remedios, Camajuani, Las

Villas, Placetas and Zaza. The zones are prolonged in a direction, coinciding with the extension of the island.

Remedios zone is built up of limestones, dolomites and evaporates, incorporated in Remedios Group (K_{1-2}). In isolated parts (southwest of Mayajigua) flyschoid sediments (Vega Formation – Pg_{2-1-2}) characteristic for the Camajuani zone are exposed. Their contacts with Remedios Group are accepted to be tectonic (Kanchev et al., 1975; Mossakovsky et al., 1988 and others). The data from the borehole PE-1 and our detailed field investigation allow us to consider that Vega Formation lies transgressively on the Remedios Group not only here but along the whole prolongation of the two zones (Remedios and Camajuani) as well.

Camajuani zone is represented by irregularly alternating flyschoid (Vega Formation – Pg_{2-1-2}), carbonate (formations of Trocha – J_3^t , Margarita – K_1^{b-h} , Paraiso – K_1^{h-bm} , Mata – $K_1^{al}-K_2^{cm}$ and Lutgarda – K_2^{ml}), terrigenous-carbonate (Sagua Formation – Pg_{2-1-2}) sediments and metabasites. So far it has been interpreted as a tectonically imbricated zone. There are some data about resedimentation phenomena in this zone but they are considered to be local (Hatten et al., 1958; Tchouneuv et al.,

1981; Iturralde-Vinent, 1988). We opine that besides the local olistostromes with intra- and extra-clasts, all carbonate and terrigenous-carbonate formations of the zone as well as the metabasites are olistoplas included in flyschoid matrix (Vega Formation - Pg_2^{1-2}).

Las Villas zone is built up mainly of metabasites (Perea metamorphites) intruded by San Marcos troctolites and Tres Guanos quartz-monzonites (Hatten et al., 1958). These rocks together with the sediments of the Placetaz zone were described by the same authors under the name Las Villas tecto-unit. Because of their specific character and peculiarities we examine them separately, following Knipper and Cabrera (1974). Las Villas zone is considered to be a faulted and uplifted part of the basement of the Cuban orthogeosyncline (Hatten, 1967) or a metamorphosed part of the ophiolite association (Somin and Millan, 1977; Haydoutov, 1986). We agree that the rocks of the zone possess specific elements, characteristic for the ophiolite association as a whole. But they are too different from the ophiolite complex of Zaza zone in which they have been recently included (Mossakovsky et al., 1988; Tchounev et al., 1981; Haydoutov, 1986; Shein et al., 1985; Vassilev et al., 1989 and others).

Placetaz zone is marked by the occurrence of Vega Alta Formation (Pg_{1-2}). It has flyschoid character with resedimented (Mossakovsky and Albear, 1978) olistoliths and olistoplas mainly of siliceous-carbonate and terrigenous-carbonate rocks (the formations of Veloz - $J_3-K_1^a$, Carmita - $K_1^{al}-K_2^{cm}$, Amaro - K_2^{mt} and others) as well as rare clasts of metabasites and vulcanites (Vassilev et al., 1989).

Zaza zone is represented by an ophiolite complex including ultrabasites, cumulative gabbro, sheeted dykes and diabases

(Zurrapandilla Formation). In the lowest part of the complex there is serpentinite mélange comprising clasts extracted from the overlying and underlying rocks. Volcano-sedimentary formations (Cabaiguan - K_1^{a-al} , Provincial - $K_1^{al}-K_2^{cm}$, La Rana and Dagamal - K_2^{cp-mt} and others) of an island arc lie above the ophiolite complex. Molasse (Mossakovsky and Albear, 1978) sediments (Bijabo Formation - Pg_2^{1-2}) accompanied by olistostromes in the lowest level (Taguasco Formation - Pg_1) follow upward.

All the zones are transgressively and discordantly covered by post-Middle Eocene (post-Cuban phase) platform formations (neoautochthon).

Tectonic model

The tectonic interpretation of both the relationships and character of the zones described above is demonstrated on the structural section (Fig. 1). It is based on the geophysical data about the deep structure of the Central Cuba interpreted by Bovenko et al. (1978) and Iturralde-Vinent (1988). According to these authors, the volcano-sedimentary cover in cross-section resembles a wedge, enlarging to the southwest and lying on a sialic basement broken by two northeast verging reverse faults. The zones of Remedios and Camajuani are a paraautochthonous part of the Bahamas platform, situated beneath two allochthons (Las Villas and Zaza). Las Villas allochthon (= Las Villas tecto-unit of Hatten et al., 1958) includes the zones of Las Villas and Placetaz. Zaza allochthon (= Las Villas thrust fault of Hatten et al., 1958) coincides entirely with the Zaza zone.

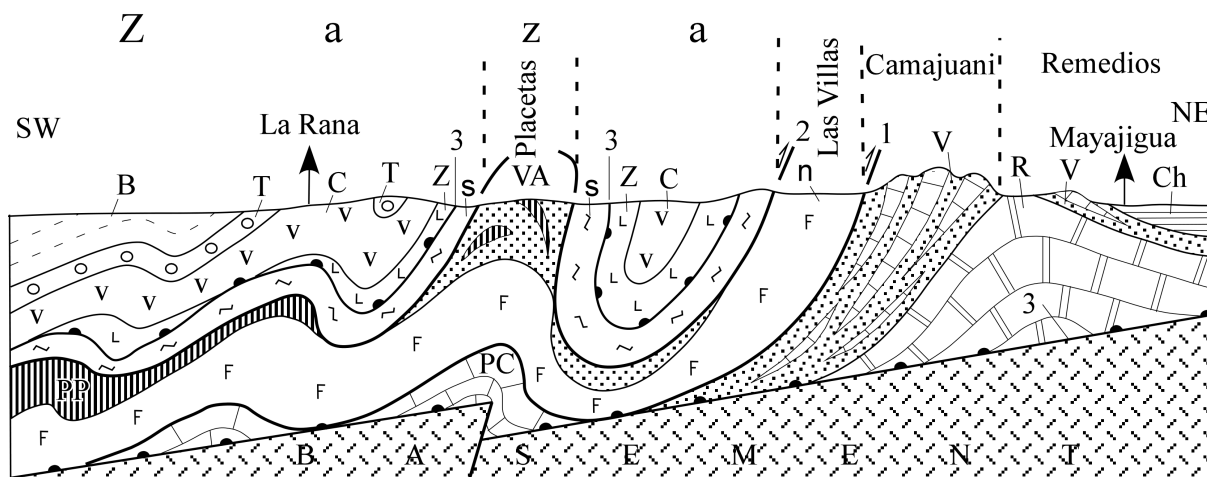


Fig. 1. Structural section across Las Villas region, Central Cuba (out of scale)

PARAAUTOCHTHON: (Remedios, Camajuani and Paleo- Camajuani (PC) zones): R- Remedios Group (K_{1-2} , limestones, dolomites, evaporates); V - Vega Formation (Pg_2^{1-2} , flyschoid sediments with olistostroms and olistoplas derived from Las Villas zone and from the formations of Paleo-Camajuani (PC) zone.

LAS VILLAS ALLOCHTHON (Las Villas, Placetaz and Paleo-Placetaz (PP) zones): n - Las Villas zone (Perea metamorphites, San Marcos troctolites and Tres Guanos quartz-monzonites); VA - Vega Alta Formation (Pg_2^{1-2} , flyschoid sediments with olistostroms and olistoplas derived from Las Villas zone and from the formations of Paleo-Placetaz (PP) zone.

ZAZA ALLOCHTHON (= Zaza zone): (s, Z) - ophiolite complex: s - serpentinite mélange, Z - gabbros and diabases (Zurrapandilla Formation); (C, T, B) - formations of the island arc: C - volcano-sedimentary (Cabaiguan K_1^{a-al} , Provincial - $K_1^{al}-K_2^{cm}$, La Rana and Dagamal - K_2^{cp-mt}); (T, B) - sedimentary (T - Taguasco - Pg_1 , olistostrome, B - Bijabo - Pg_2^{1-2} , molasse).

NEOAUTOCHTHON: Ch - post-Cuban formations (Pg_2^{3-Q}).

PRINCIPAL FAULTS: 1 - thrust (obduction) plane of Las Villas allochthon; 2 - "dead" subduction zone transformed in obduction plane of Zaza allochthon; 3 - detachment faults.

The presence of specific resedimented rocks in the zones of Camajuani and Placetas implies the existence of two other zones – Paleo-Camajuani and Paleo-Placetas as feeding provinces. The first one should be searched for beneath the Las Villas allochthon. It belongs to the paraautochthon. The second one should be situated beneath the Zaza allochthon. It is a part of the Las Villas allochthon.

The flyschoid sediments of the zones of Camajuani (Vega Formation) and Placetas (Vega Alta Formation) have been used as lubricators facilitating the thrusting.

With respect to plate-tectonics, the planes of thrusting of the two allochthons could be interpreted as planes of obduction. In fact, the thrust plane of Zaza allochthon coincide with a “dead” subduction zone, marked by serpentinite mélangé. There is a plane of detachment above the mélangé. Reduction of the upper, more competent parts both of the ophiolite complex and the island arc is observed at some places along it. Such a plane is supposed to exist between the basement and the folded cover as well.

Paleogeodynamic reconstruction

At the end of Cretaceous, the geodynamic environment was as follows (Fig. 2, A): island arc lying on oceanic crust of

Caribbean plate moving to northeast; oceanic crust (Las Villas zone) subducting beneath, on which the sediments of Paleo-Placetas zone settle down; continental slope on which Paleo-Camajuani and Remedios zones terminate. On the K/Tr boundary the island arc collided with the continental lithosphere somewhere to the north of the region studied. This led to thrusting (Fig. 2, B) of Las Villas zone together with the overlying Paleo-Placetas zone over the continental slope (Paleo-Camajuani). Thus the Las Villas allochthon was formed. In front of the thrusting a flyschoid basin (Camajuani zone) fed by Las Villas and Paleo-Camajuani zones occurred. Another sedimentation zone (Placetas) formed at the back of the allochthon. Resedimented formations derived from the Paleo-Placetas and Las Villas zones settled down in it. Upon the moving to northeast island arc (Zaza zone), Taguasco and Bijabo formations were deposited. Resedimentation phenomena fed by the same zones as a result of quick uplifting and denudation took place.

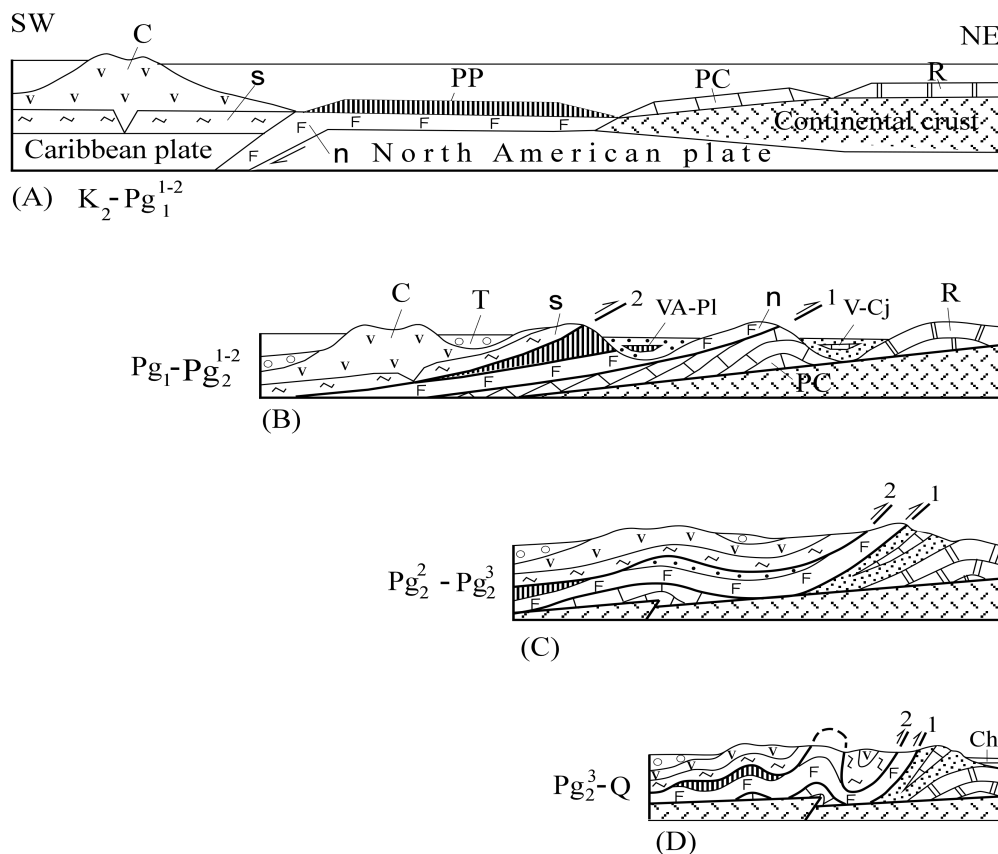


Fig. 2. Paleogeodynamic reconstruction of Las Villas region, Central Cuba (out of scale)
V-Cj – Camajuani zone, VA-Pl – Placetas zone; n – Las Villas zone; s – ophiolite complex of Zaza zone; T – Taguasco and Bijabo Formations. The rest of symbols are the same as on Fig. 1. (The stages of formation of the Cuban collisional orogen are explained in the text).

At the end of the Middle Eocene (Cuban phase) the island arc here also reached the continental crust of the North American plate (Bahamas platform) and began to slide together with the ophiolite complex over the continental slope upon the Placetas zone and Las Villas allochthon and in some

places covered them entirely (Fig. 2, C). In that way the Zaza allochthon was formed. In fact, the thrust zone coincides with serpentinite subduction mélangé.

The continuing compression led to almost isoclinal folding of the platform cover including the allochthons. Most probably this

process was related to the formation of a plane (zone) of detachment between the cover and basement.

Thus the Cuban collisional orogen was formed and the accretion of the subducting North American plate was accomplished. This disturbed the isostatic equilibrium and led to the emergence of the Cuban island.

After the Middle Eocene, local shallow-water basins transgressed on the island and formed the neoautochthon.

Conclusions

What's the news in this interpretation?

- All carbonate and terrigenous-carbonate formations as well as metabasites of Camajuani zone are olistoplasmas included in the Lower-Middle Eocene flyshoid matrix.
- The boundary between Remedios and Camajuani zone is not faulted.
- Two zones (Paleo-Camajuani and Paleo-Placetas) are supposed as feeding provinces of the zones of Camajuani and Placetas respectively, which should be searched for beneath the allochthons.
- Las Villas tecto-unit of Hatten et al. (1958) which has been lately ignored is rehabilitated. Here it is interpreted as Las Villas allochthon.
- The great number of faults established on the surface (Kanchev et al., 1975; Mossakovsky et al., 1988, Vassilev et al, 1989 and others) is reduced to two allochthons (Las Villas and Zaza) and a detachment fault situated between the serpentinite mélangé and the upper parts of the ophiolite complex and the island arc. Such a plane is supposed to exist between the basement and the folded cover as well.
- The two thrusts are interpreted as obduction planes. Moreover, the thrust plane of Zaza allochthon is interpreted as a "dead" subduction zone.
- A paleogeodynamic reconstruction with addition of the new data to the existing models is proposed.

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