Ancient and modern subduction and modern Volcanism in Guatemala

Diamond Exploration and Research Training School (DERTS)
2019 Field Trip

April 22- May 2, 2019

Organized and led by: 2018/2019 DERTS Trainees

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Sponsors

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1 Introduction

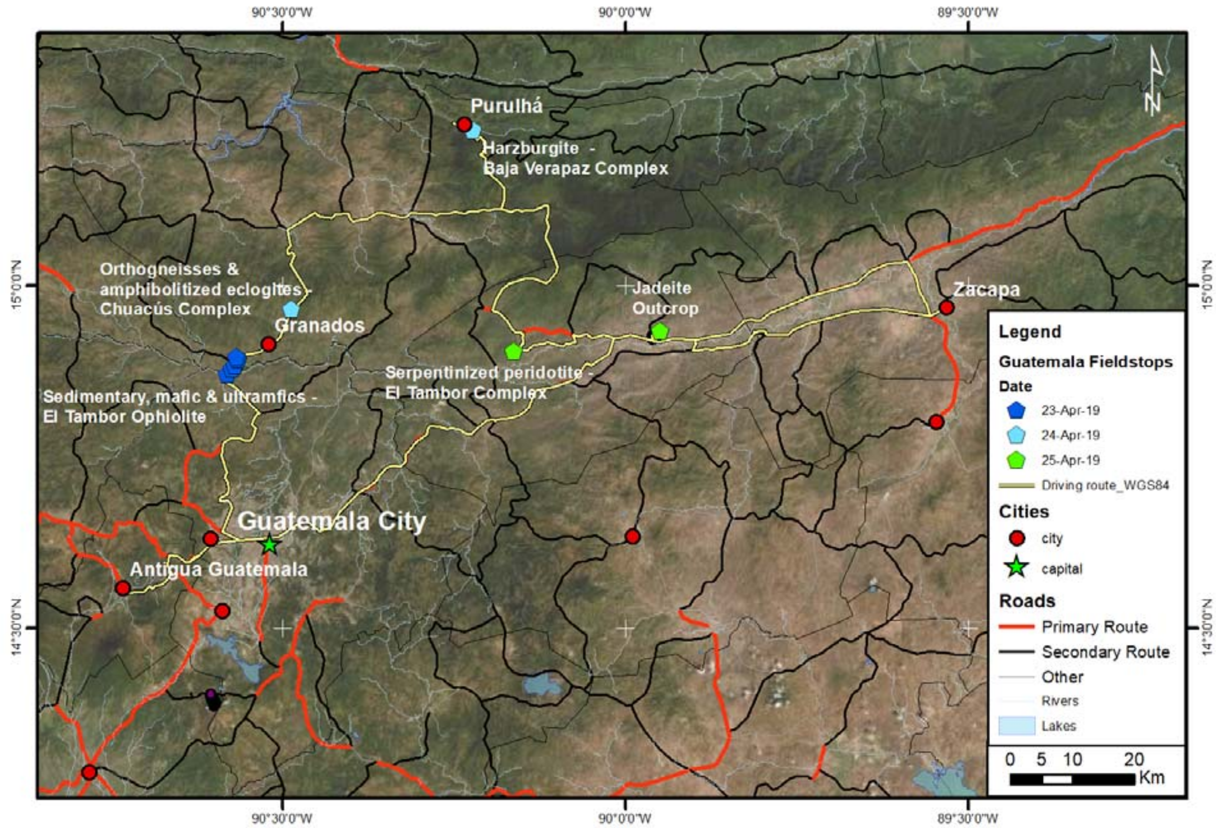
This field trip was part the NSERC CREATE funded Diamond Exploration Research Training School. The aim of the field trip was to introduce graduate students of the University of Alberta to ancient and modern subduction zones and examine modern geological processes to gain a better understanding of volcanology. The group consisted of 10 graduate students and 2 faculty members. The field trip was split into two parts: Part 1 focused on obducted arc assemblages from cretaceous aged subduction in central Guatemala and Part 2 examined modern arc volcanism in eastern Guatemala. The metamorphic geology portion (Part 1) of the trip was supported by Professor Sergio Moran from the University of San Carlos, Guatemala, and his students Carlos Ventura, Servin Aguilar, and Hugo Hernandez Cajas, to whom we are indebted. This portion of the trip visited the eclogite facies Chaucus complex and two ophiolite complexes: El Tambor and Baja Verapaz. The second portion of the trip (Part 2) included visits to the Acatenango, Fuego, and Pacaya volcanoes followed by a boat tour around the Lake Atitlan Caldera.

The DERTS 2019 field trip was supported by NSERC, the University of Alberta, DeBeers Group and Prospectors and Developers Association of Canada.

2 Summary of Activities

2.1 Part 1: Metamorphic Geology of Central Guatemala

2.1.1 Map



Part 1 of the fieldtrip embarked from Antigua Guatemala and continued in a roughly clockwise loop to Granados, Purulha, Zacapa and ended back in Antigua Guatemala.

2.1.2 Part 1 Outcrop locations

Stops 1, 2, and 3: Sedimentary, mafic, and ultramafic rocks of the El Tambor ophiolite complex.

Location: Abundant roadside outcrops from south of Estensia Garcia on unnamed road at 14.878733N, 90.573160W to north of Estensia Garcia at 14.892488N, 90.565117W on RN-5.

Observations summary: Dismembered upper and possibly lower portion of the El Tambor ophiolite complex north of the Motagua fault zone. These outcrops consist of a melange of sheered mafic and marine carbonate blocks on a decimeter scale (Fig. 2.1A), sheered serpentinites (Fig. 2.1B to C), and more competent mafic blocks cut by pegmatitic dykes that are parallel to the Motagua Fault zone. These form portions of the El Tambor complex that is sandwiched between the North American and Caribbean plates along the Motagua fault zone.

Figure 2-1. Outcrops and hand samples from stops 1-4.
A) stop 1, tectonically intercalated carbonate and mafic blocks of the El Tambor ophiolite. B to D). Mafic block in a serpentinite melange of the El Tambor Complex, stop 2. E) Stop 4, garnet calcsilicate of the Chuacus complex. F) Eclogite from the Chuacus complex.

Stop 4: Eclogite facies boulders of the Chuacus complex.

Location: Entrance to small creek by bridge on RN-5 at 14.895970N, 90.565156W.

Observations summary: Meter-scale intercalated layers of phengite-garnet metasediments, garnet-calcsilicates, and eclogites of the Chuacus complex (Fig 2.1F). Some outcrops exist, but for the most part these are boulders. The eclogite facies rocks are quite spectacular and the group spent some time here.

Stops 5 and 6: Orthogneisses and amphibolitized eclogites at Rio Agua Caliente and El Chol (Chuacús Complex).

Location: At Rio Agua the entrance the river is at 14.934569N, 90.502123W and hiking NW along river for about 1km to outcrops. At El Chol these outcrops are located at creek in town at 14.964783N, 90.486764W.

Observations summary: Orthogneisses with garnet amphibolite lenses (Fig2.2). The amphibolite lenses contain remnants of omphacite and are interpreted to be retrogressed eclogites (Ortega-G, 2004).

Figure 2-2 Orthogneisses and amphibolitized eclogites at Rio Agua Caliente and El Chol (Chuacús Complex).

Stop 7: Baja Verapaz ophiolite complex.

Location: Large harzburgite quarry along the side of the road at 15.227100N 90.221945W.

Observations summary: Ultra-fresh orthopyroxene-rich massive harzburgite. Large lateral extent indicated by abundant outcrops for many km's along roadsides (Fig. 2.3). Fresh olivine that has not been serpentinized can be observed in reddish (rusty) blocks in the quarry.

See Section 7: Baja Verapaz ophiolitic complex for additional info.

Figure 2-3 Ultra-fresh orthopyroxene-rich massive harzburgite observed at roadside quarry near Purulha.

Stop 8: Serpentinized peridotite of the El Tambor Complex.

Location: Roadside outcrop near El Progresso at 14.904400N, 90.163070W.

Observations summary: Orthopyroxene-rich serpentinized peridotites (Fig 2.4). Some areas are highly serpentinized.

Figure 2-4 Roadside outcrop exposing orthopyroxene-rich serpentinized peridotites.

Stop 9: Jadeite blocks near Pica Pica

Location: Requires a guided hike through a protect nature reserve.

Observations summary: Several meter-plus scale jadeitite boulders were observed throughout the area. The boulders are found as float in the serpentinite melange (Fig. 2.5). The Jadeite was a whitish-green colour typical of jadeite observed north of the Motagua Fault zone. The observed specimens had a granoblastic texture and comprised mainly monomineralic masses of jadeite. Abundant garnet-amphibolite and minor serpentinite cobbles were found on the hike to the location.

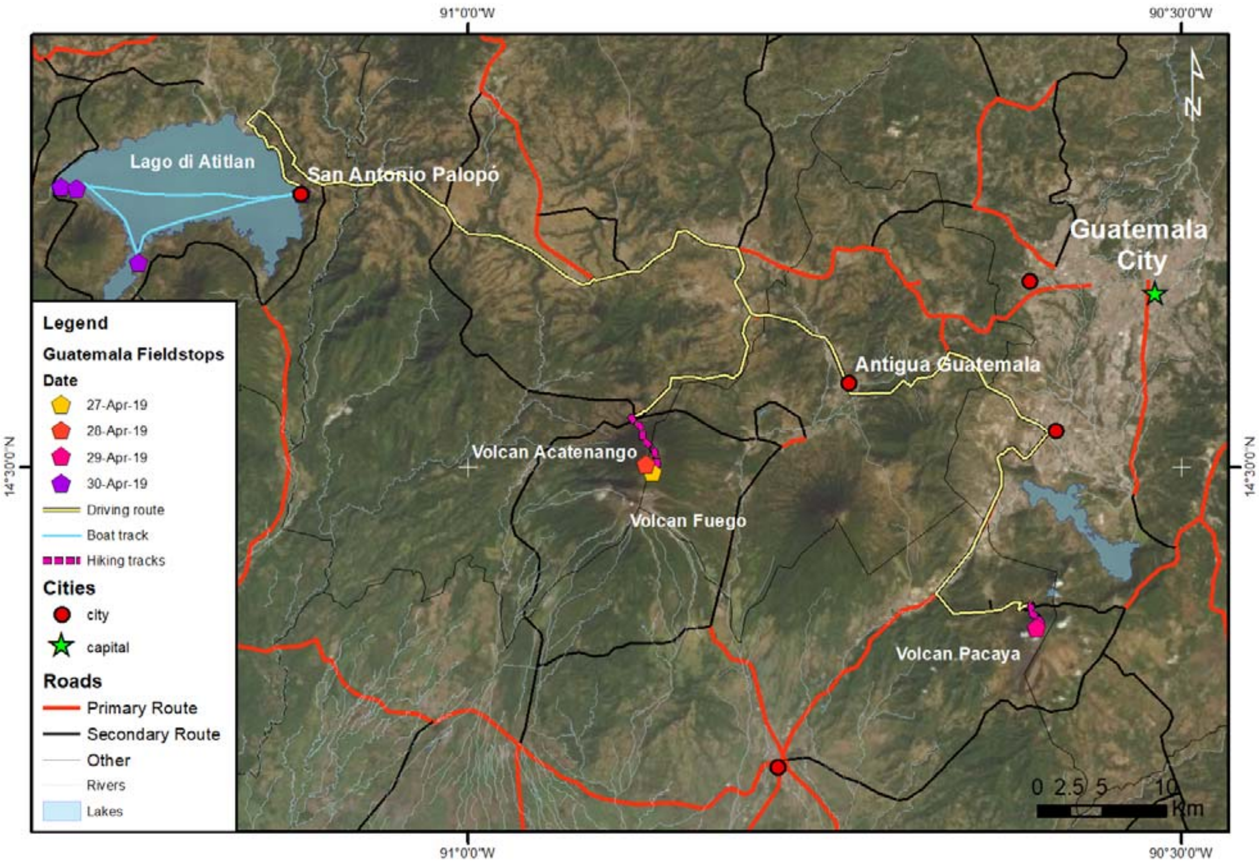
Figure 2-5 Light green-white coloured meter-scale jadeite boulders.

In Antigua:
Most Jade factories and polishing centres, along with numerous retail outlets are found in Antigua. At Casa Del Jade located at 4a Calle Oriente we went on a tour of the polishing facilities which included an introduction to the different colours of Jade that are found in Guatemala and the exploration and mining techniques currently used. Commercial Jade mining in Guatemala is still quite a rudimentary, small-scale process. Large Jadeitite boulders and lenses are broken up into smaller pieces using jackhammers and the pieces are moved to the cutting and polishing factories in Antigua. Guatemalan Jade is found in a variety of colours including various shades of green from light to dark, “blue”, lavender, white and black.

Figure 2-6 Various Jade colours from Guatemala (left); mining methods used to recover jade in Guatemala as displayed at Casa Del Jade in Antigua (right).

2.2 Part 2: Active Modern Volcanism

2.2.1 Map



Part 2 of the fieldtrip was largely based out of Antigua Guatemala with trips to Acatenango and Pacaya returning to Antigua. The trip concluded with an overnight stay at Lago di Atitlan before spending a night in Guatemala City prior to an early morning departure on May 2, 2019.

2.2.2 Part 2 Locations

Volcan Fuego/Acatenango:

Summary of activities: This part of the trip consisted of an overnight hike up Volcan Acatenango to camp at 3,500 m elevation. The camp is located ~2 km from Volcan Fuego where the group was able to observe abundant eruptions (~20min eruption frequency) at night and during the day (Fig 2.6). At night the group could observe the strong incandescence from the erupted magmas, while during the day the eruptions showed spectacular gas columns. At 3am the group hiked up to the peak of Volcan Acatenango at ~4000m elevation to view the sunrise and further eruption of Volcan Fuego (Fig 2.6).

Figure 2-7 An eruption at Volcan Fuego seen from the top of Volcan Acatenango. The group at the summit of Volcan Acatenango.

Volcan Pacaya:

Summary of activities: At Volcan Pacaya the group had a guided evening hike of the volcano and its active and cooled lava flows. The group was able to closely observe active a'a flows cascading down the side of the volcano (Fig. 2.7c). The group walked on recent a'a (Fig 2.7a) and pahoehoe flows (Fig. 2.7b).

Figure 2-8 A'a (A) and Pahoehoe (B) lava flows observed on the flank of Volcan Pacaya. C) & D) Active lava flows were observed during the hike.

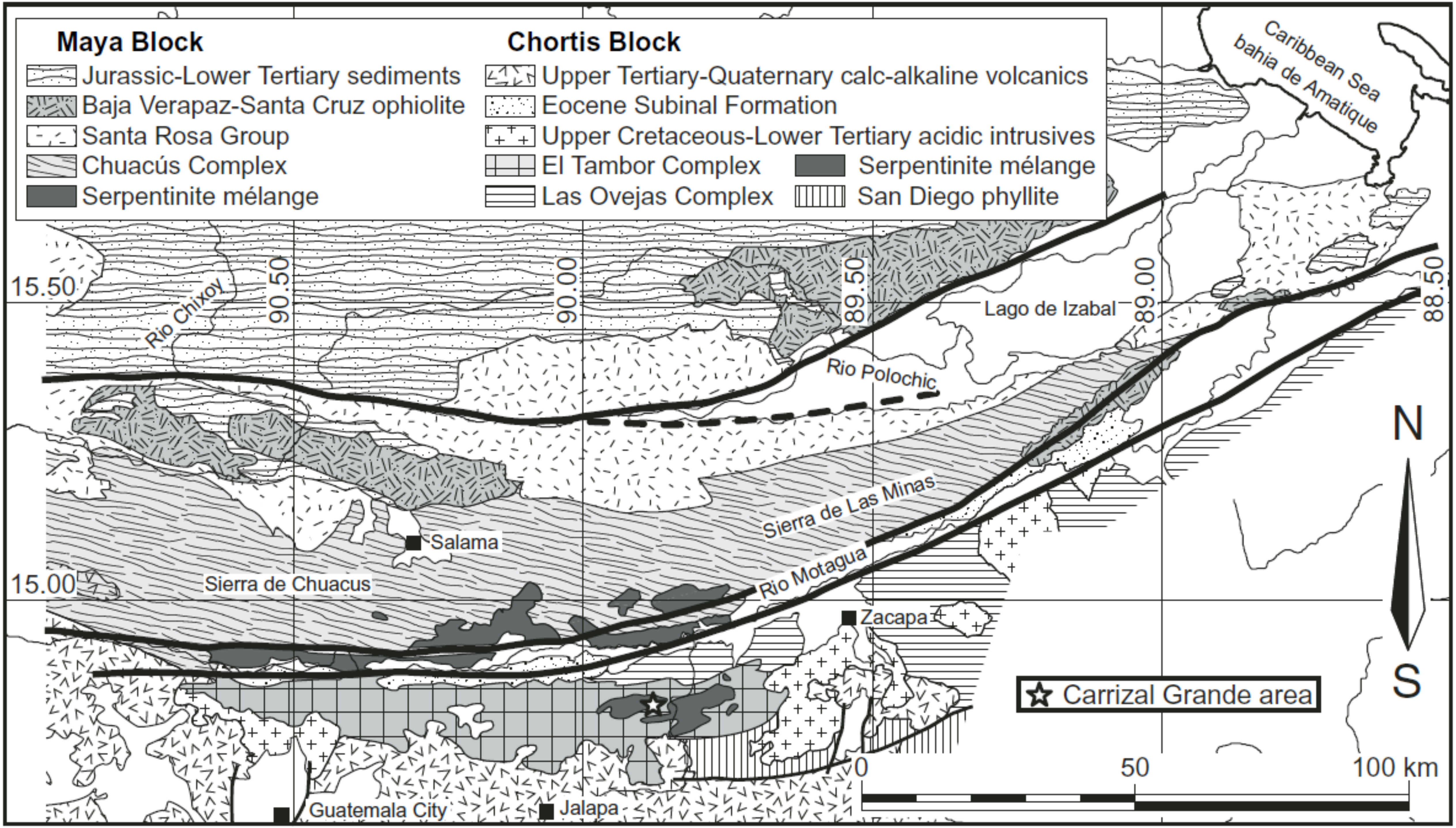
Lake Atitlan Caldera:

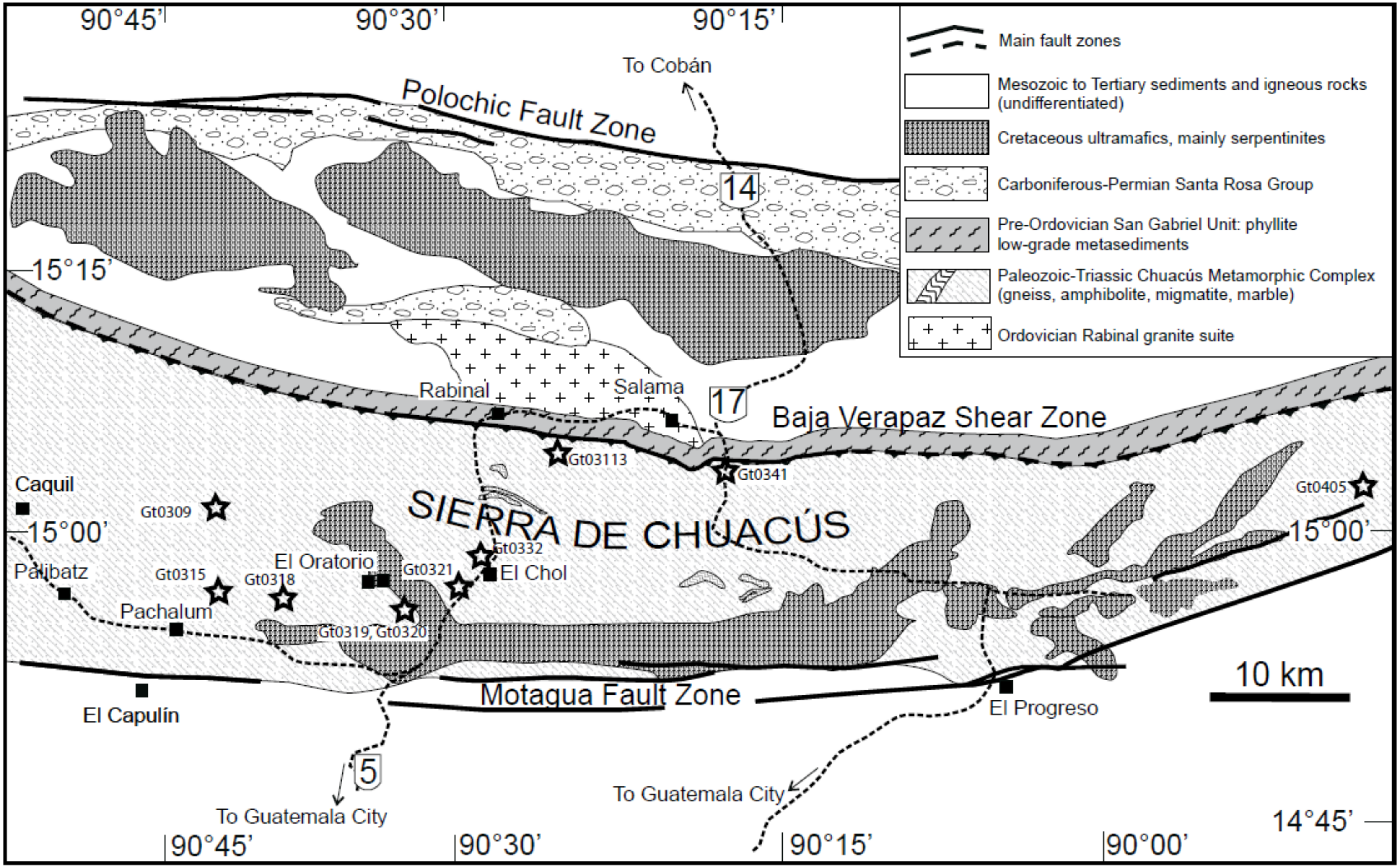
Summary of activities: On the drive to Lake Atitlan the group was able to observe the extensive ash deposits (Fig 2.8a and b) formed during the eruption of the Lake Atitlan Caldera (Fig 2.9). The group then took a day tour by boat to the communities of Santiago Atitlan, San Juan, and San Pedro. During this portion of the activities the group was able to observe modern life and culture of the Mayan people around Late Atitlan.

Figure 2-9 Massive ash deposits several ten's of meters thick have been exposed along roadcuts.

Figure 2-10 Lake Atitlan partially fills the caldera which formed during the Los Chocoyos eruption. The caldera is surrounded by 3 volcanoes: Volcan Toliman, Volcan Atitlan, and Volcan San Pedro (left to right although obscured largely by the mist).

3 Supplementary Maps


Maya Block
Jurassic-Lower Tertiary sediments
Baja Verapaz-Santa Cruz ophiolite
Santa Rosa Group
Chuacús Complex
Serpentinite mélange
Chortis Block
Upper Tertiary-Quaternary calc-alkaline volcanics
Eocene Subinal Formation
Upper Cretaceous-Lower Tertiary acidic intrusives
El Tambor Complex
Serpentinite mélange
Las Ovejas Complex
San Diego phyllite
Caribbean Sea
bahia de Amatique
15.50
15.00
90.50
90.00
89.50
89.00
88.50
Rio Chixoy
Lago de Izabal
Rio Polochic
Sierra de Las Minas
Salama
Sierra de Chuacus
Rio Motagua
Zacapa
Guatemala City
Jalapa
N
S
Carrizal Grande area
0
50
100 km



Main fault zones
Mesozoic to Tertiary sediments and igneous rocks (undifferentiated)
Cretaceous ultramafics, mainly serpentinites
Carboniferous-Permian Santa Rosa Group
Pre-Ordovician San Gabriel Unit: phyllite low-grade metasediments
Paleozoic-Triassic Chuacús Metamorphic Complex (gneiss, amphibolite, migmatite, marble)
Ordovician Rabinal granite suite
90°45'
90°30'
90°15'
90°00'
15°15'
15°00'
14°45'
To Cobán
Polochic Fault Zone
14
17
Rabinal
Salama
Baja Verapaz Shear Zone
Gt03113
Gt0341
Gt0405
Caquil
Gt0309
SIERRA DE CHUACÚS
Gt0332
El Chol
El Oratorio
Gt0321
Gt0315
Gt0318
Palibatz
Pachalum
Gt0319, Gt0320
10 km
Motagua Fault Zone
El Progreso
El Capulín
5
To Guatemala City
To Guatemala City