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Use of the Auxiliar Seismic Station APG (AS-037) for the analysis of a seismic sequence in the North region of Guatemala

Yani-Quiyuch, R., Castro, D.
Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología, INSIVUMEH

INTRODUCTION

On 4 and 5 January, 2018, two moderated earthquakes were recorded in the northern region of Guatemala with the National Seismological Network (RSN), however another thirty nine earthquakes of smaller magnitudes could only be recorded by APG station (AS-037)

METHODS/DATA

The earthquakes was characterized (arrival times seismic waves, epicentral distances, magnitude and possible location) and associated with possible local geological faults.

START

RESULTS

The mainshocks and the sequence of aftershocks may be associated with a segment of the Chixoy-Polochic fault in northern of Guatemala. Its production over time suggests a mainshock + aftershocks type seismic sequence.

CONCLUSION

Results provided important information about the active seismic fault and the subsequent proposal to improve the RSN in the region. APG has been integrated into permanent monitoring routines, being one of the ones with the highest detectability of both local, regional and distant earthquakes

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INTRODUCTION: Tectonic Frame of Guatemala and location of Auxiliary Seismic Station APG

Guatemala is located in a geographic region where three major tectonic plates interact, these are: Cocos, Caribbean and North America. This interaction represents a high seismic hazard and has been demonstrated throughout history, with the regular occurrence of catastrophic earthquakes in the country (Figure 1).

The Auxiliary Seismic Station APG (AS-037) of the International Monitoring System (IMS) is located near the Motagua-Polochic fault system and is in charge of the *Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología (INSIVUMEH)* of Guatemala.

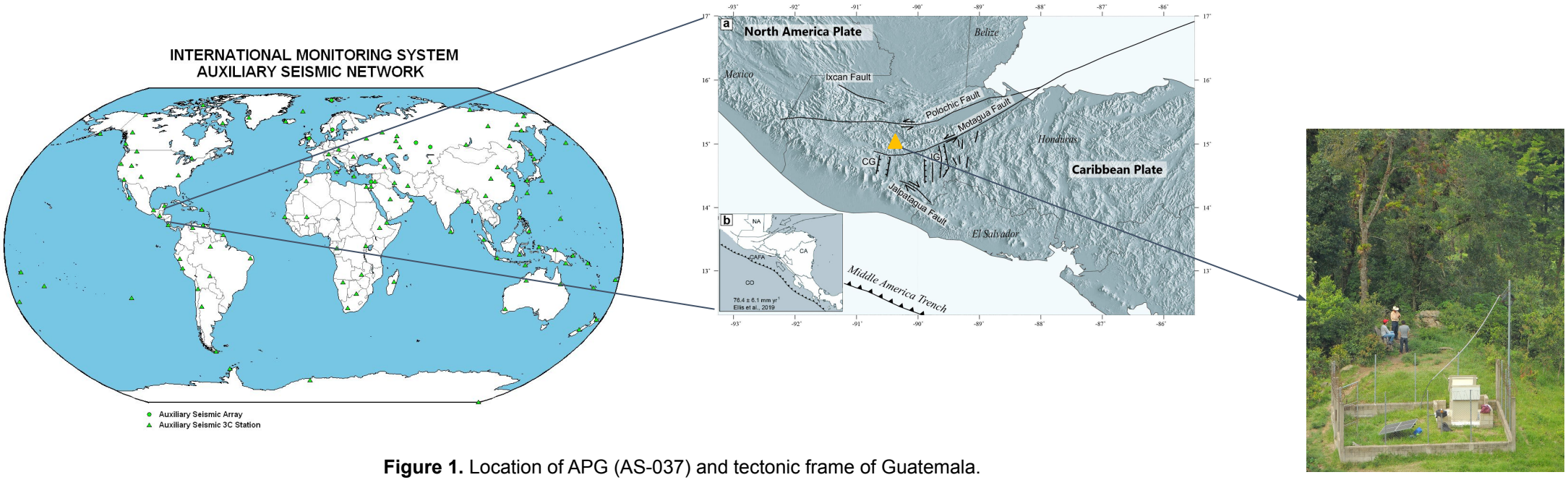

Figure 1. Location of APG (AS-037) and tectonic frame of Guatemala.

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Description

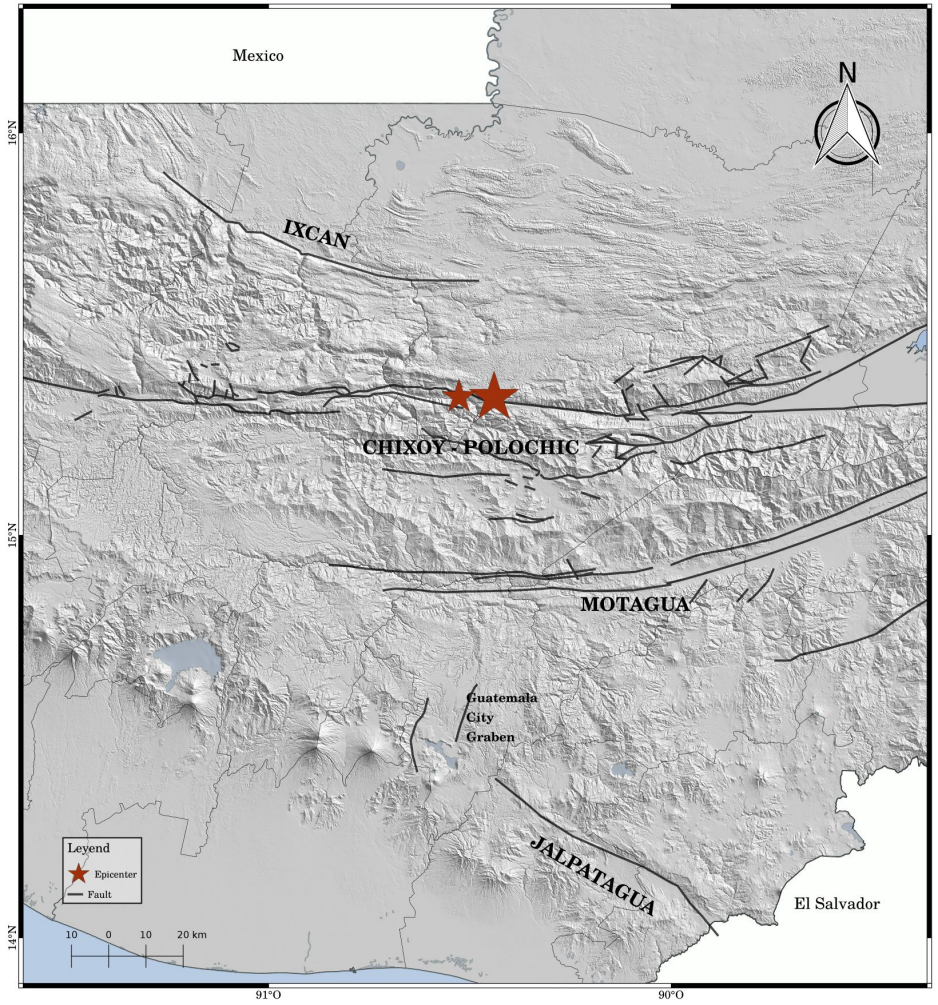

Figure 2. Detail of main seismic faults and epicenters of the January 2018 earthquakes in Guatemala.

On 4 and 5 January 2018, two moderated earthquakes reported by the population were recorded in the northern region of Guatemala. These were characterized with the National Seismological Network (RSN), which had a small number of noisy seismic stations in that year, however another thirty three earthquakes of smaller magnitude could only be recorded by the Auxiliary Seismic Station APG (AS-037) due to the high standards that its facility meets for its use in monitoring of possible nuclear explosions.

- We describes the use of APG (AS037) for the characterization of these earthquakes and their possible association with local geological faults
- We highlight the importance of APG in applications for scientific use for a better understanding of the seismic hazard in the northern region of Guatemala.

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METHODS/DATA
Seismic Network and Characterization of Earthquake Sequence

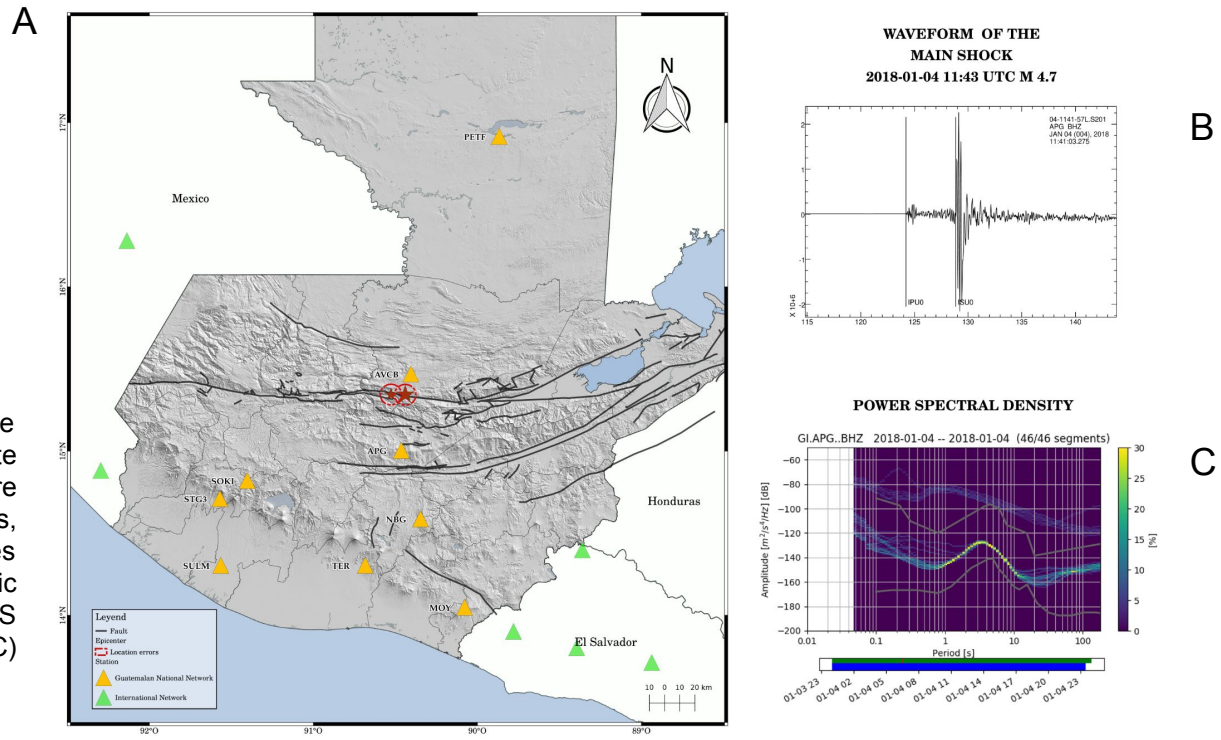

Figure 3. A) Red stars shows the epicenter of the two moderate earthquakes. Orange triangles are the national seismic stations, including APG and green triangles are Mexico and El Salvador seismic stations. B) Identification of P and S waves for the main earthquake. C) PSD for APG station.

The two largest earthquakes (M 4.7 and 3.2) of the sequence were characterized (origin time, epicentral coordinates, depth and magnitude) with the National Seismological Network of Guatemala, APG and some seismic stations in Mexico and El Salvador (Fig. 3A).

The other 33 smaller earthquakes were registered only by APG, whose seismic noise is considerably low (Fig 3C). To characterize these earthquakes, the arrival times of the P and S waves were identified (Fig. 3B), with which an epicentral distance was approximated. Taking this approximate epicentral distance and the duration of the transient seismic record, a magnitude of duration was estimated.

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RESULTS
Seismic Characterization and Active Seismic Fault

The approximate epicentral distances from APG are shown in Figure 4B, from which an average distance of approximately 35 km is obtained (dashed orange line in Figure 4A), similar to the epicentral distances obtained with the locations of the two largest earthquakes. The mainshocks and the sequence of aftershocks can be associated with a segment of the Chixoy-Polochic fault.

With the magnitudes obtained from the smallest earthquakes and their production over time, a sequence with a mainshock + aftershock behavior can be observed (Figure 4C), which is not usually observed for earthquakes of moderate magnitudes in Guatemala, especially with a seismic network with low detectability.

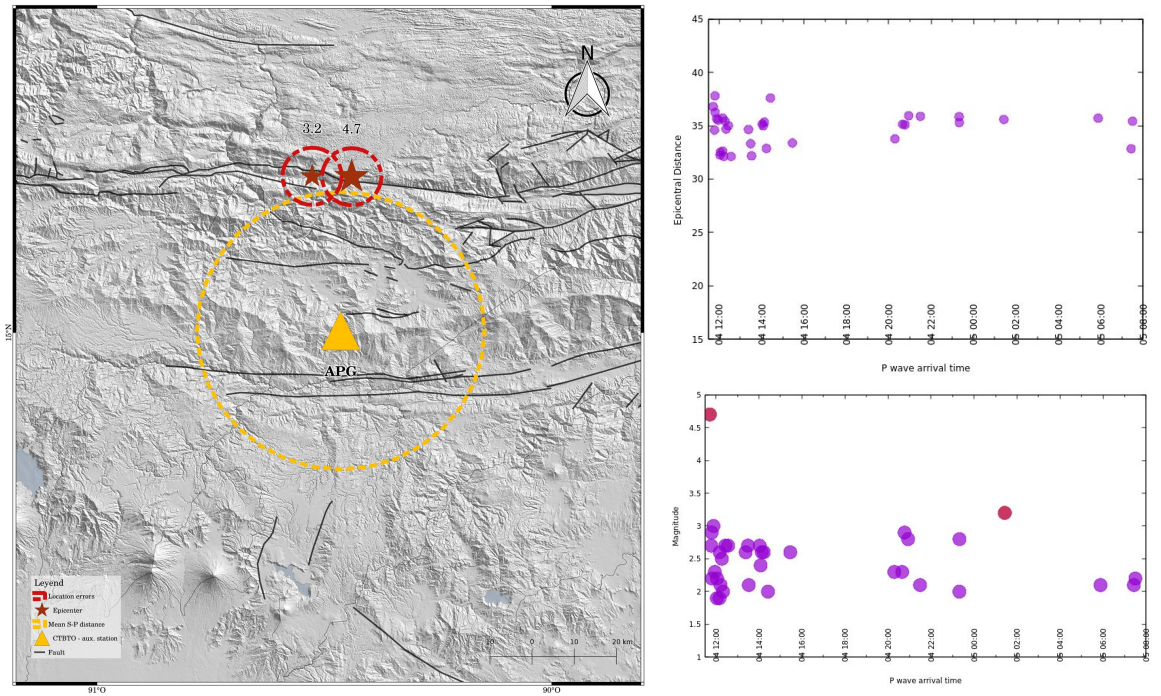

Figure 4. A) Dashed orange line represents the average distance of the aftershocks from APG, which reaches the error ellipses of the largest recorded earthquakes (red dashed line). B) Epicentral distances of the sequence in time. C) Evolution of sequence in time.

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CONCLUSION
Use of APG in Current Seismic Monitoring in Guatemala

These results provided important information about the active seismic fault and the subsequent proposal to improve the RSN in the region.

From 2019 to the present, INSIVUMEH has expanded its network of seismological stations, of which APG has been integrated into permanent monitoring routines, being one of the ones with the highest detectability of both local, regional and distant earthquakes. In addition, cooperation with seismological networks from neighboring countries continues.

Consequently, the seismic catalog has increased the number of registered earthquakes, with a better quality of information and knowledge of the seismic hazard in the region.

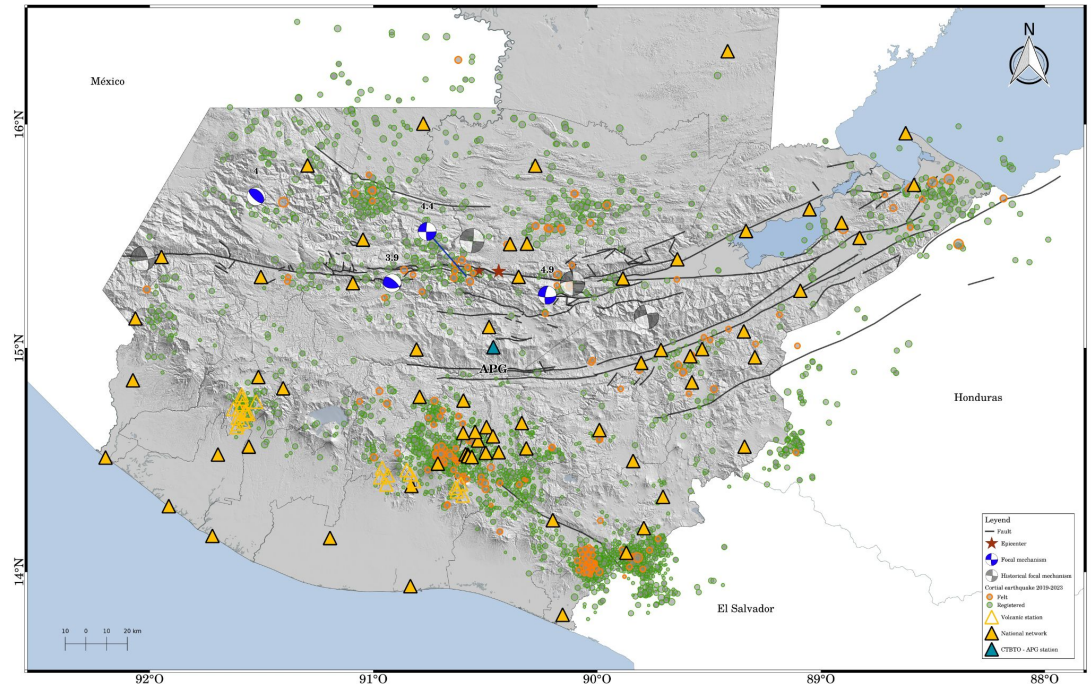

Figure 5. Shallow cortical seismicity in Guatemala, filled triangles are the current tectonic seismic network and unfilled triangles represents volcanic seismic stations. Some focal mechanisms of earthquakes related to Chixoy-Polochic fault are shown. The 2018 earthquakes are in an active segment of the fault (red stars).

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References

For this work, we used seismic waveforms from the following seismic networks:

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