SUMMARY.

This report summarizes an investigation of an earthquake swarm and ground cracking on the northwest flank of Tecapa Volcano in Usulutan Department. Earthquake data is being recorded at the office of the Centro de Investigaciones Geotecnicas (C.I.G.) by a recently installed network of high-gain radio-telemetered seismograph stations. A microcomputer provides the capability to rapidly determine earthquake epicenters.

Seismic activity began on 2 April and is still continuing at a low level. Ground cracking appears to have occurred only on April 27 coincidentally with the largest peak in the number of recorded earthquakes. Before starting our analysis this activity appeared to be volcanic in origin. - Normally earthquake swarms and surface faulting are indicators of shallow magma movement and that an eruption is imminent. Earthquake locations however, reveal that seismic activity began on tectonic faults northwest of the volcano near the San Lorenzo Dam and then later began occurring nearer the volcano. This is an unusual sequence and I know of no comparison.

I feel there are three possible future course for the - seismic activity.

1. The earthquakes will stop.
2. The seismic activity will lead to a volcanic eruption.
3. A larger, more destructive, earthquake could occur in the area.

Two meetings where held that included representatives -- from C.I.G. and the Comision Ejecutiva Autonoma del Rio Lempa (C.E.L.) to examine results of our investigation. Plans - were made for a cooperative effort to continue monitoring -- the geophysical and geologic aspects of this swarm.

I also include a few recomendations.

INVESTIGATIONS.

Figure 1 is a histogram of the number of earthquake -- per day that have been registered since April 21.

The largest Earthquake, so far, is a magnitude 4.7 -- event on April 23. Peak activity did not coincide with this event, however, but occurred on April 26, 27 and 28, during which time aproximately 50 earthquakes were felt. On April - 27, local residents reported ground cracking on the northwest flank of Tecapa Volcano that proved to extend for more that 8 Km in a Northwest direction. This activity was considered an emergency because earthquake swarms and surface -- faulting at volcanoes usually signify near surface magma movement and are considered harbingers of an imminent eruption. Further more, Tecapa has not Erupted in historic times or for at least 450 years. Because of this long repose time, renewed activity could be very explosive and endanger nearby cities and towns.

Earthquake locations, however, indicate that this seismic activity is both tectonic as well as volcanic in origin. The largest earthquake, and thus the locations of greatest - seismic energy release, are plotted on Figure 2. Circles represent activity before ground cracking was observed and - plus sign (+) are for events that followed. Most large earthquakes occurred before faulting was observed and they concentrate on tectonic faults near the San Lorenzo Dam on the rio Lempa. At the time ground cracking occurred, seismic activity shifted southeast to the area of area of Tecapa volcano - suggesting that this faulting is a secondary feature of the previous activity. Ground, cracking, extends over a distance of 8 to 10 Km and exhibits vertical offsets of up to 30 cm. The total energy released so far is not sufficient to account for the magnitude of this faulting. This, in turn, suggest - that near surface magma movement is responsible for driving the crack formation. This is an unusual combination of tectonic and Volcanic phenomena and I am not familiar with a - similar case. Because of this I feel there are three possible

future courses for this activity that need to be considered:

1. The seismic activity and ground faulting - will stop.
2. Both phenomena will continue and eventually lead to a volcanic eruption.
3. A much larger, destructive earthquake could occur in this area. (Up to magnitudes 6.5).

The last possibility must be considered because a 4 to 5 months of increased seismicity preceeded the magnitude 6.2 -- San Salvador earthquake on May 3, 1965 that severly damaged the city.

The present level of seismicity is the lowest since the begining of the swarm suggesting that the activity may end -- soon. Previously observed earthquake swarms, however, show - large fluctuations in seismicity levels preceeding an eruption. Therefore, I feel that for the inmediate future the potential for jumps in activity is still high and that efforts to monitor the area should continue. I also feel that an increase or continuing earthquake activity is cause for alarm.

ACTIVITIES.

Two meeting were held at C.I.G. offices with C.E.L. representatives to discuss the results of our investigations and to evaluate the previously presented courses the seismic activity might take. C.E.L. is concerned about these earthquakes because of this proximity to the San Lorenzo Dam and to a prospective geothermal energy field near the city of Berlin. The two -- agencies have decided to carry out the following tasks to monitor seismic and geologic activity in the Tecapa Volcano area. These tasks will be performed to the best of ther abilities - given that vehicles and perdiem funds are in short supply and that the political situation in Usulutan Department some what complicates fieldwork.

C.I.G. will:

1. Install permanent radio-telemetered seismograph station in the region so that more accurate -- earthquake locations can be determined.
2. Continue to keep a daily count of earthquakes from the area.
3. Put concrete markers on both sides of the ground cracks so that further displacement can be easily measured. Displacements increase rapidly just -- prior to volcanic eruptions.
4. Finish mapping the extend of and the offsets on the ground cracks.

C.E.L. will:

1. Rerun a gravity survey in the Berlin area. Gravity is sensitive to the movement of magma into shallow crustal depths.
2. Analyse the chemical content of hot springs in the area and compared them with an excellent - existing data base from the Berlin area.
3. Examine airphotos to determine if the current faulting is occurring on pre-existing structures.

RECOMENDATIONS.

C.I.G. and C.E.L. personnel should meet with civil defense officials to discuss "what if" scenarios. If earthquake activity should increase to dangerous levels again -- then some very difficult practical and political decisions would have to be made.

C.E.L. engineers should evaluate what potential damage would be sustain by the San Lorenzo Dam if a moderate sized magnitude 6.5 earthquake would occur nearly.

RECOMENDATION TO A.I.D.:

I urge A.I.D. to donate a 4 wheel-drive vehicle to - C.I.G. for their seismology Department, two vehicle were requested as part of an A.I.D. funded project that began 18 months ago. These vehicles are badly needed for station maintenance and an emergency like the recent seismic activity near Berlin accentuates their need. I strongly feel that future well being of this group depends on their getting another vehicle.

vfh/

ACTIVIDAD SISMICA EN LA ZONA BERLIN-SANTIAGO DE MARIA

C.I.G. DEPARTAMENTO DE SISMOLOGIA

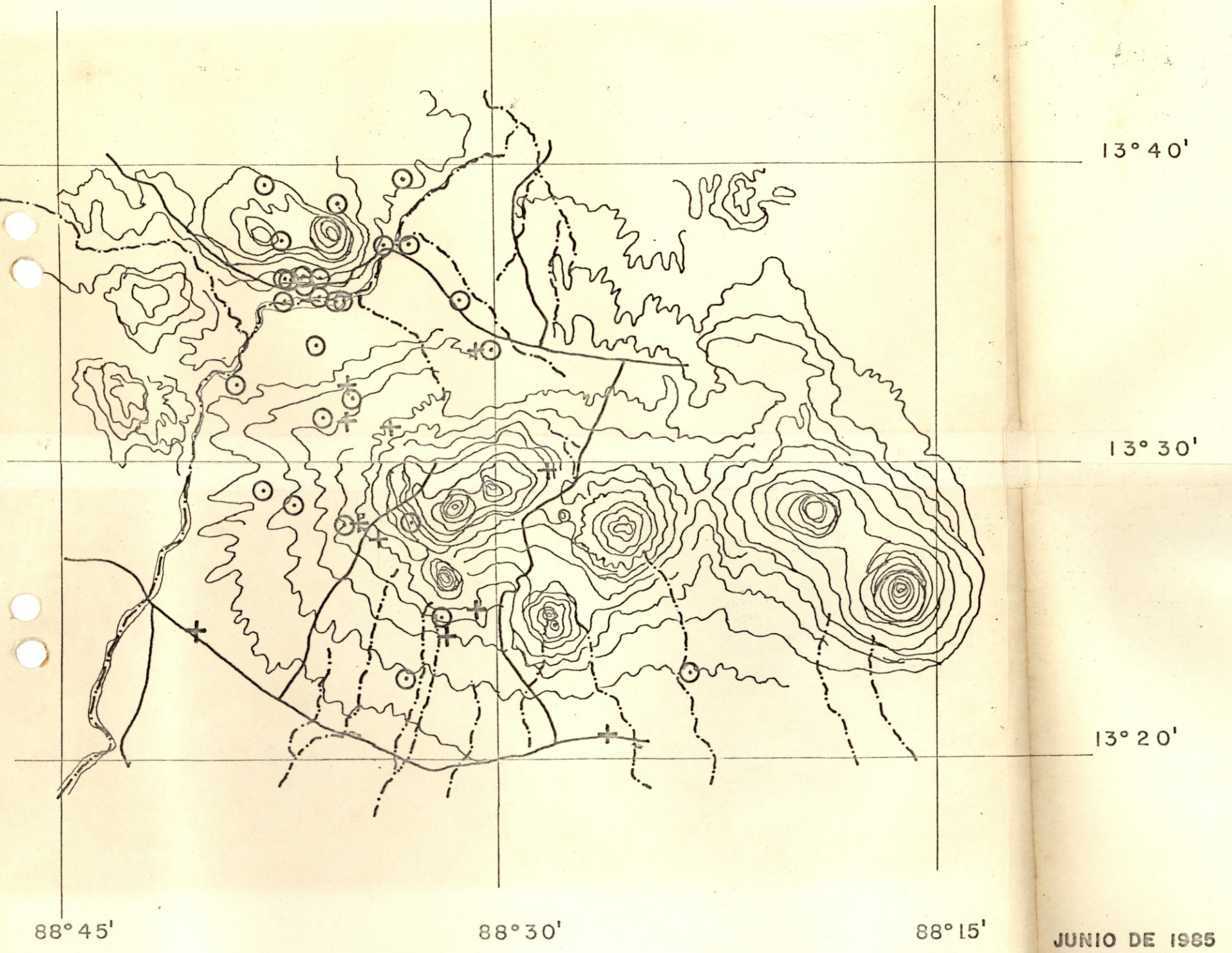
REGION INTERESANTE

BERLIN – SANTIAGO DE MARIA

DEPARTAMENTO DE USULUTAN

C I G | **DEPARTAMENTO DE SISMOLOGIA**

ESCALA: 1:300.000



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