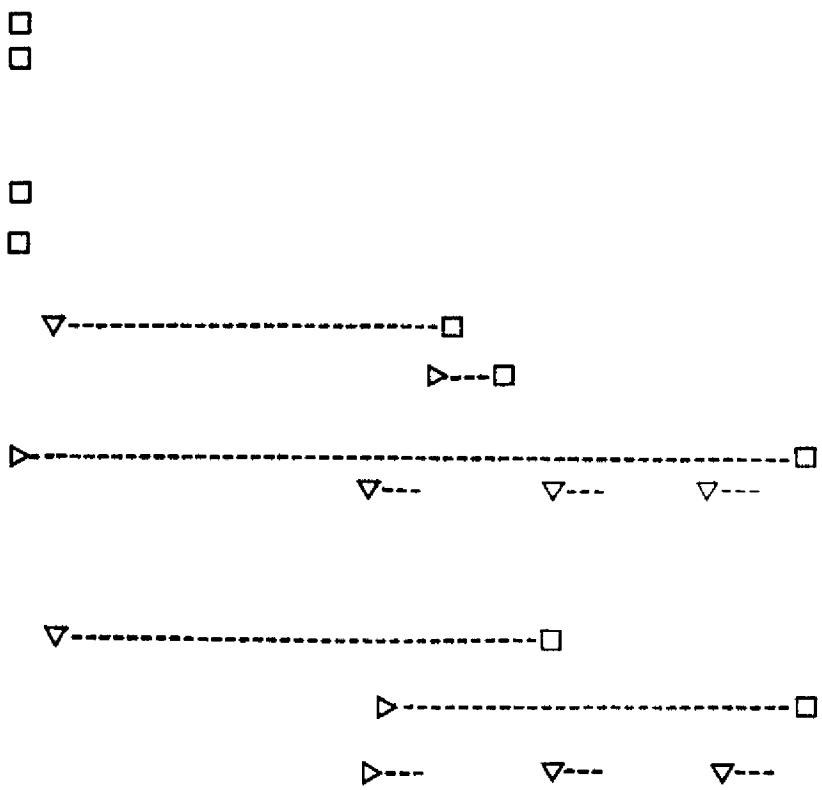
ATTACHMENT 1

TASK SCHEDULE FOR PLANNED FY89 MIRVYS ACTIVITIES

PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

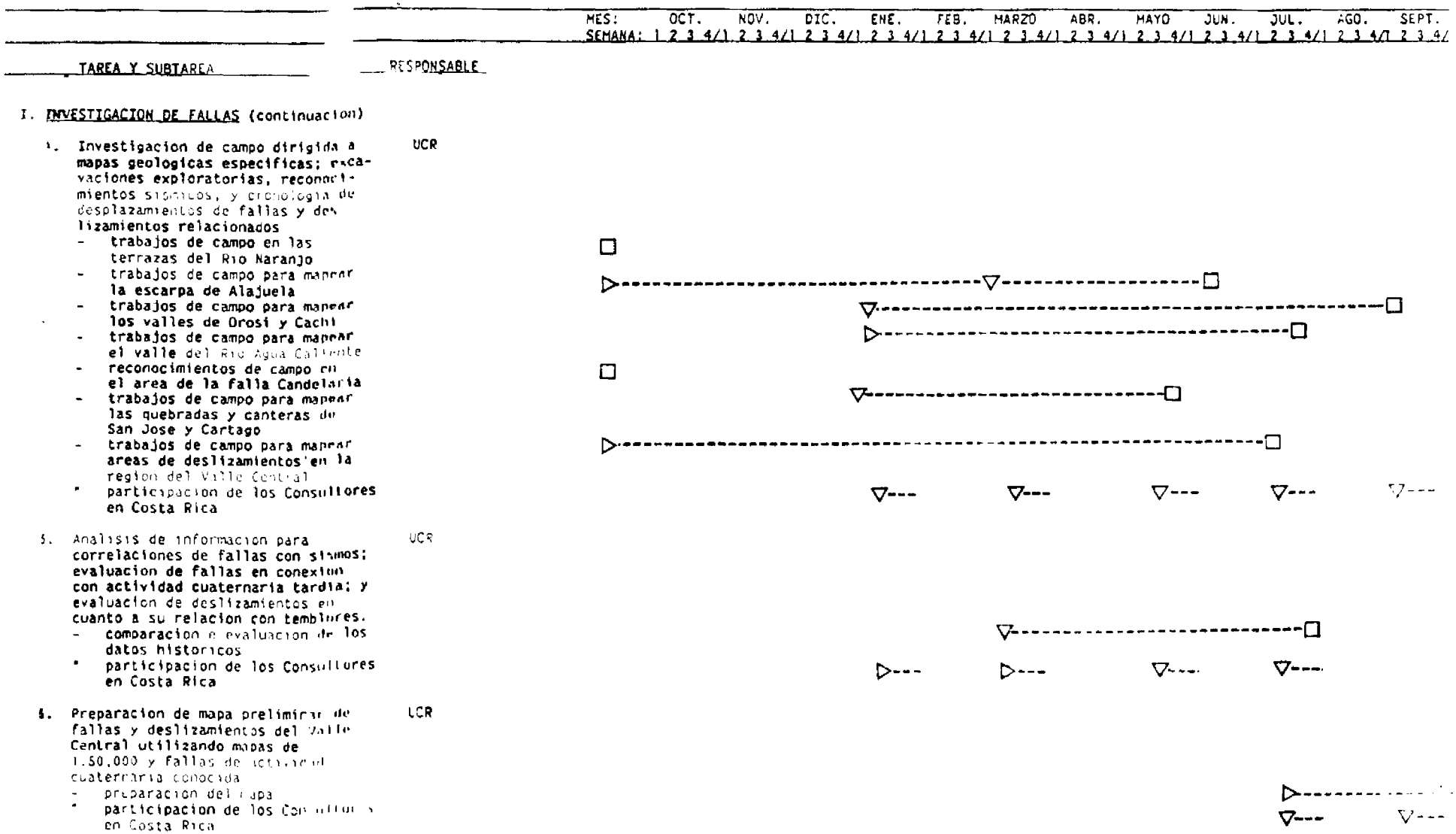
PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| I. INVESTIGACION DE FALLAS | |
| 1. Compilacion y revision de los datos existentes | UCR |
| - recompilacion bibliografica | |
| * participacion de los Consultores en Costa Rica | |
| 2. Preparacion de mapa preliminar de fallas y delineamientos utilizando aerofotografia y reconocimiento de campo | UCR |
| - mapa preliminar regional utilizando fotografia infrarroja | |
| - mapa preliminar del Valle Central utilizando fotos aereas de escala 1:60,000 (realizado por R. Madrigal) | |
| - comparacion/revision de mapas e intercambio de datos (realizado por R. Madrigal y M. Seeley) | |
| - mapa interpretativo preliminar (realizado por Madrigal, Denger, Montero, Alt y Cline) | |
| - comprobacion de campo de lineamientos y fallas seleccionados | |
| * participacion de los Consultores en Costa Rica | |
| 3. Preparacion de mapa preliminar de deslizamientos generados por temblores utilizando aerofotografia y reconocimiento de campo | UCR |
| - mapa preliminar utilizando fotos aereas escala 1:60,000 (realizado por R. Mora) | |
| - mapa interpretativo preliminar comprobado mediante reconocimientos de campo (realizado por Mora, Montero, Alt, y Cline) | |
| * participacion de los Consultores en Costa Rica | |



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989




| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| I. INVESTIGACION DE FALLAS (continuacion) | |
| 4. Investigacion de campo dirigida a mapas geologicas especificas; excavaciones exploratorias, reconocimientos sismicos, y cronologia de desplazamientos de fallas y deslizamientos relacionados | UCR |
| - trabajos de campo en las terrazas del Rio Naranjo | |
| - trabajos de campo para mapear la escarpa de Alajuela | |
| - trabajos de campo para mapear los valles de Orosi y Cachi | |
| - trabajos de campo para mapear el valle del Rio Agua Caliente | |
| - reconocimientos de campo en el area de la falla Candelaria | |
| - trabajos de campo para mapear las quebradas y canteras de San Jose y Cartago | |
| - trabajos de campo para mapear areas de deslizamientos en la region del Valle Central | |
| * participacion de los Consultores en Costa Rica | |
| 5. Analisis de informacion para correlaciones de fallas con sismos; evaluacion de fallas en conexion con actividad cuaternaria tardia; y evaluacion de deslizamientos en cuanto a su relacion con temblores. | UCR |
| - comparacion e evaluacion de los datos historicos | |
| * participacion de los Consultores en Costa Rica | |
| 6. Preparacion de mapa preliminar de fallas y deslizamientos del Valle Central utilizando mapas de 1:50,000 y fallas de actividad cuaternaria conocida | UCR |
| - preparacion del mapa | |
| * participacion de los Consultores en Costa Rica | |

PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

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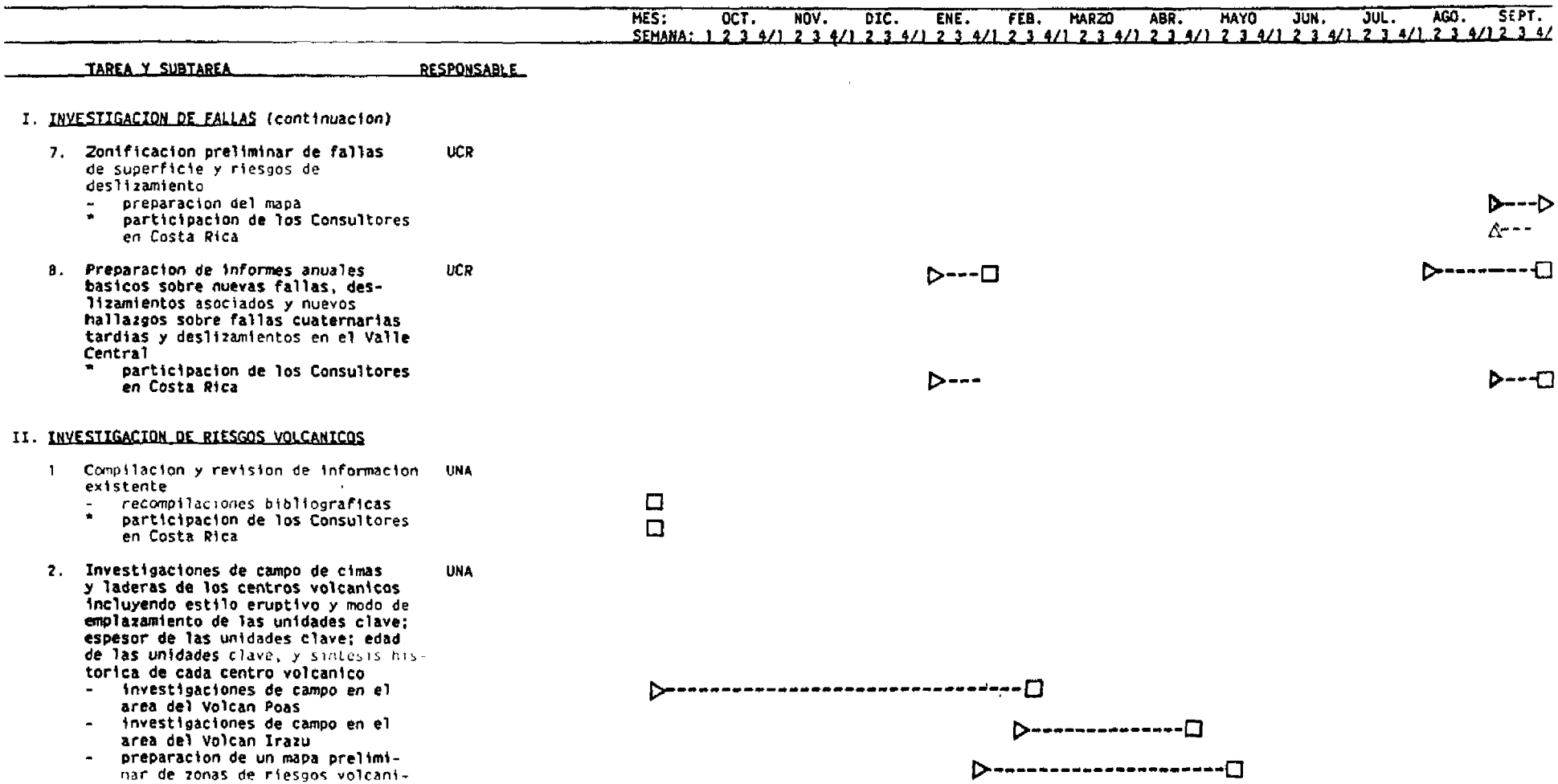
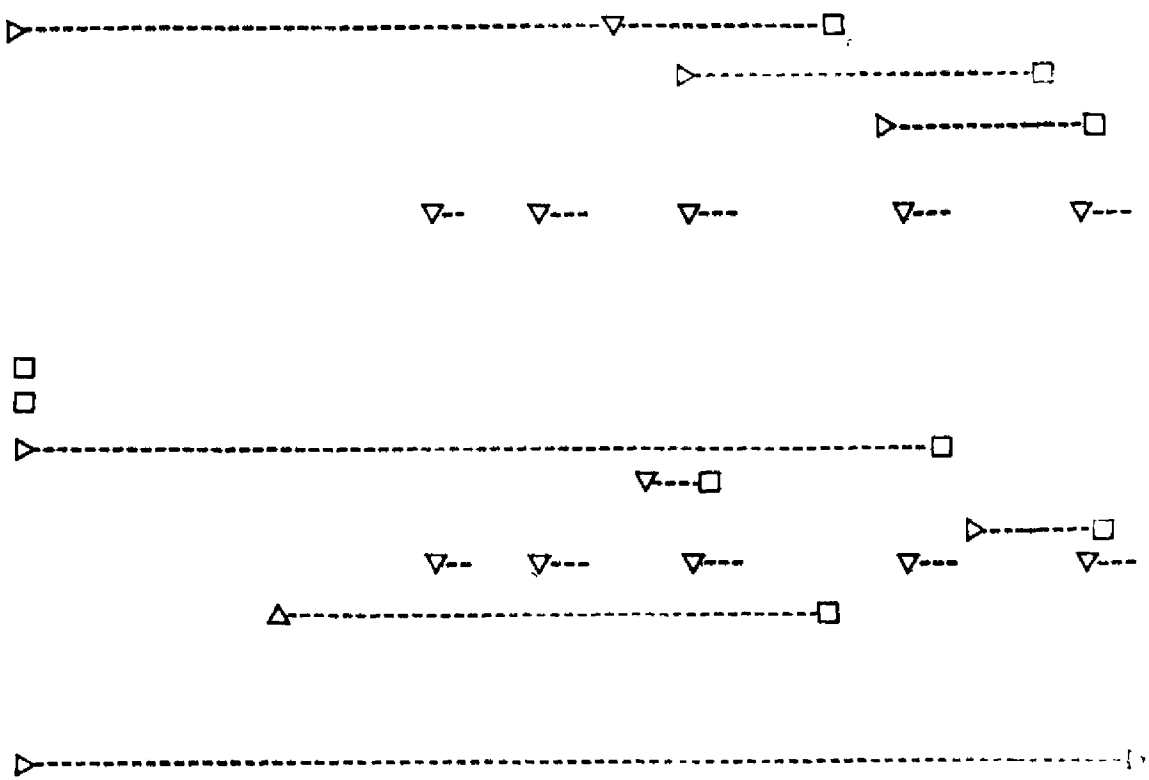


PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

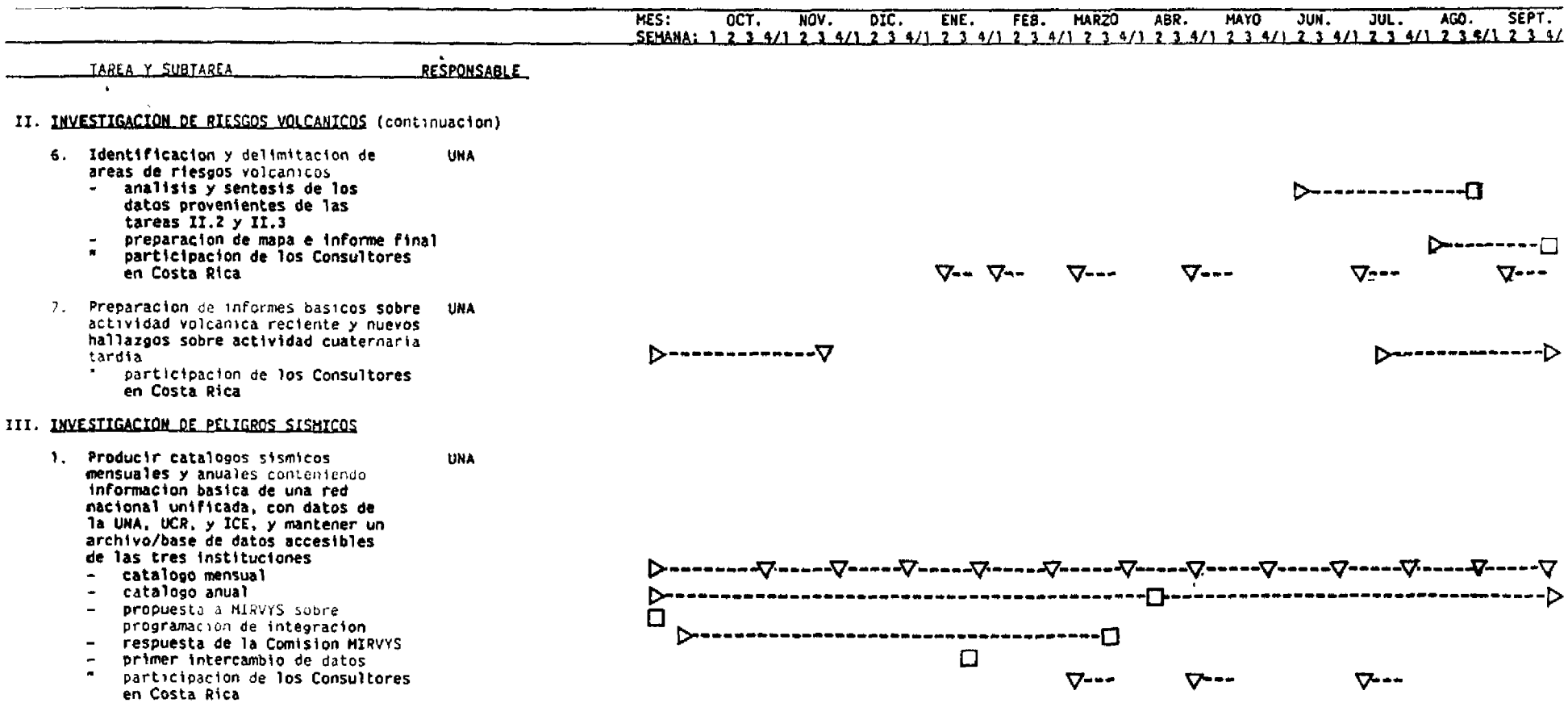
PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| II. INVESTIGACION DE RIESGOS VOLCANICOS (continuacion) | |
| 2. (continuacion) | |
| - investigaciones de campo en el area del Volcan Turrialba | |
| - investigaciones de campo en el area del Volcan Barva | |
| - preparacion de un mapa preliminar de zonas de riesgos volcanicos del Volcan Turrialba y del Volcan Barva | |
| * participacion de los Consultores en Costa Rica | |
| 3. Investigacion de campo de la estratigrafia volcanica del Valle Central en las proximidades de San Jose y Cartago | UCR |
| - recompilacion de datos existentes de pozos de perforacion de SENARA | |
| - reconocimientos de campo para identificar sitios de estudios | |
| - levantamientos de secciones estratigraficas | |
| - preparacion de un informe de progreso | |
| - preparacion de informe final | |
| * participacion de los Consultores en Costa Rica | |
| 4. Complementar la instrumentacion de volcanes seleccionados mediante la instalacion de inclinometros y sismografos | UNA |
| * participacion de los Consultores en Costa Rica | |
| 5. Continuar la supervision pasiva de volcanes seleccionados | UNA |



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

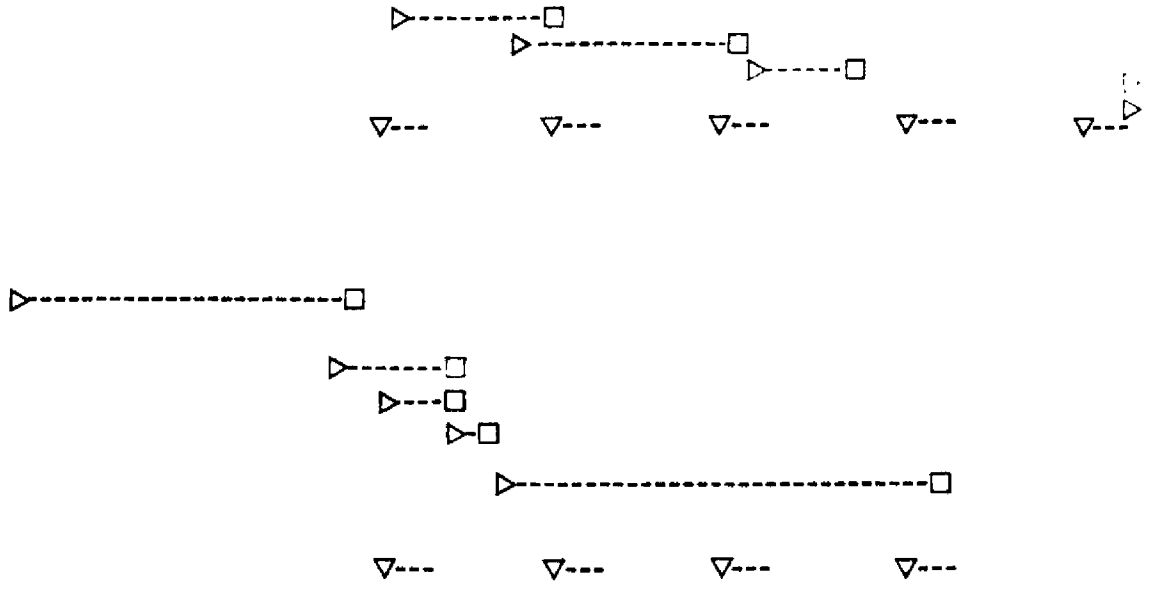



| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| II. **INVESTIGACION DE RIESGOS VOLCANICOS** (continuacion) | |
| 6. **Identificacion y delimitacion de areas de riesgos volcanicos** | UNA |
| - **analisis y sentesis de los datos provenientes de las tareas II.2 y II.3** | |
| - **preparacion de mapa e informe final** | |
| * **participacion de los Consultores en Costa Rica** | |
| 7. Preparacion de informes basicos sobre actividad volcanica reciente y nuevos hallazgos sobre actividad cuaternaria tardia | UNA |
| * participacion de los Consultores en Costa Rica | |
| III. **INVESTIGACION DE PELIGROS SISMICOS** | |
| 1. **Producir catalogos sismicos mensuales y anuales conteniendo informacion basica de una red nacional unificada, con datos de la UNA, UCR, y ICE, y mantener un archivo/base de datos accesibles de las tres instituciones** | UNA |
| - **catalogo mensual** | |
| - **catalogo anual** | |
| - **propuesta a MIRVYS sobre programacion de integracion** | |
| - **respuesta de la Comision MIRVYS** | |
| - **primer intercambio de datos** | |
| * **participacion de los Consultores en Costa Rica** | |

PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (M.RVYS)

PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

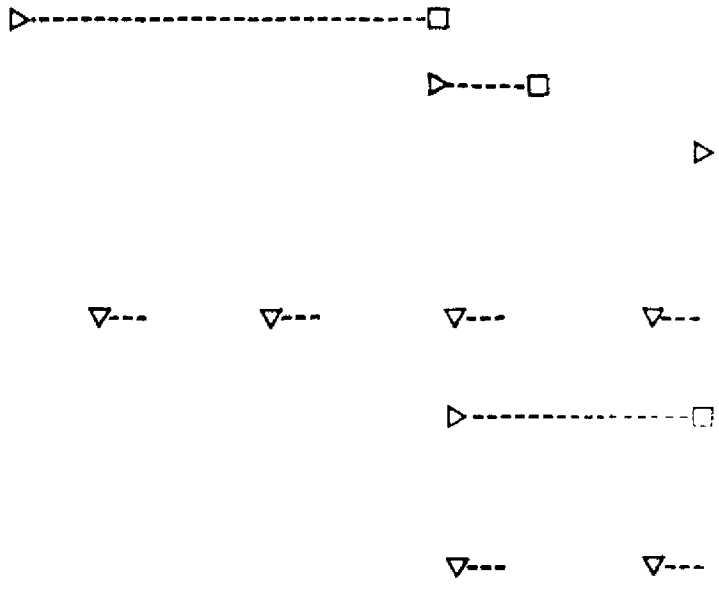
| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| III. INVESTIGACION DE PELIGROS SISMICOS (continuacion) | |
| 2. Producir un modelo de velocidades de la corteza y ecuaciones de magnitud aceptables para el analisis de datos en cooperacion con la UCR y el ICE | UNA |
| - revision de la propuesta | |
| - informe de factibilidad | |
| - informe sobre costos | |
| - preparacion de la red sismica | |
| - explosion | |
| * participacion de los Consultores en Costa Rica | |
| 3. Identificar fuentes sismicas en el Valle Central utilizando datos existentes y una red portatil para la evaluacion de fallas y actividad volcanica | UCR |
| - revision de datos historicos y seleccion de eventos superficiales | |
| - graficar eventos historicos en el mapa #I-2 (1:200,000) | |
| - presentar un informe identificando fuentes sismicos potenciales | |
| - seleccion de sitios para un red de estaciones portatiles | |
| - instalacion de un red de sismografos portatiles (incluyendo reparacion de equipos) | |
| * participacion de los Consultores en Costa Rica | |



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

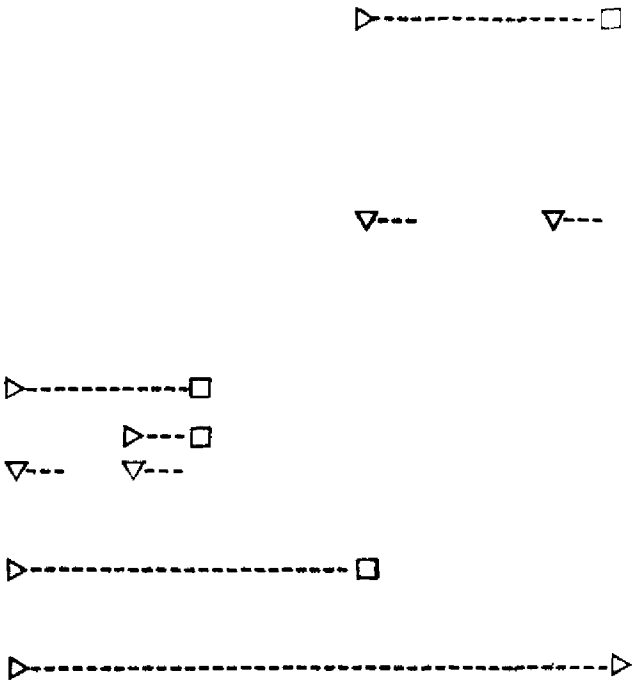
| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| III. INVESTIGACION DE PELIGROS SISMICOS (continuacion) | |
| 4. Identificar fuentes sismicas regionales utilizando datos existentes para la evaluacion de fallas y actividad volcanica | UNA |
| - revision de datos historicos y seleccion y re-evaluacion de eventos superficiales | |
| - graficar eventos historicos en el mapa regional #I-2 (1:200,000) | |
| - presentar un informe identificando fuentes sismicos potenciales | |
| - seleccion de sitios para un red de estaciones portatiles | |
| - instalacion de un red de sismografos portatiles (4-6 meses) (incluyendo reparacion de equipos) | |
| * participacion de los Consultores en Costa Rica | |
| 5 Preparar informes basicos que incluyan graficado epicentral basado en datos de la red portatil y otras estaciones del Valle Central; graficado epicentral de sismos registrados que puedan ser relacionados a fallas y/o zonas fuente; cortes de sismicidad; y reportaje sobre la sismicidad del Valle Central | UCR |
| * participacion de los Consultores en Costa Rica | |



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

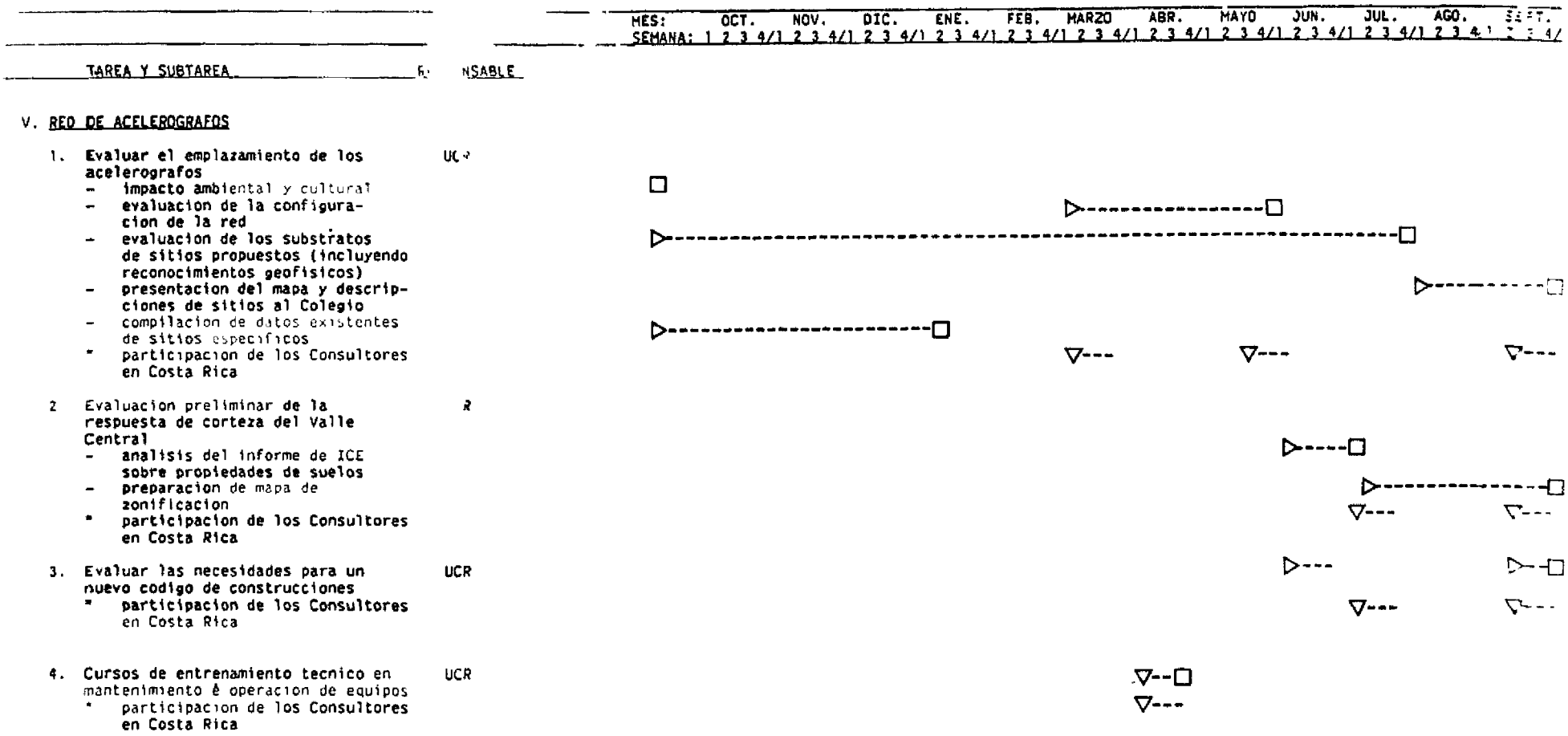
**PROGRAMACION DE TAREAS**
**OCTUBRE 1988 - SEPTIEMBRE 1989**

| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| III. INVESTIGACION DE PELIGROS SISMICOS (continuacion) | |
| 6. Preparar informes basicos que incluyan graficado epicentral basado en datos de estaciones de la region; graficado epicentral de sismos registrados que puedan ser relacionados a fallas y/o zonas fuente; cortes de sismicidad; y reportaje sobre la diferentes zonas fuente de la region | UNA |
| * participacion de los Consultores en Costa Rica | |
| IV INGENIERIA GEOTECNICA | |
| 1. Compilar datos de las propiedades fisicas de la subsuperficie del Valle Central | ICE |
| - compilacion y sintesis de datos existentes (pozos y geofisica) | |
| - preparacion de un informe de propiedades de suelos | |
| * participacion de los Consultores en Costa Rica | |
| 2. Proveer servicios de excavacion | ICE |
| - excavacion de las trencheras | |
| 3 Proveer apoyo a las investigaciones en geologia, volcanologia, sismologia e ingenieria sismica a las instituciones participantes | |
| - proveer apoyo tecnico | |



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS Y SISMICOS (MIRVYS)

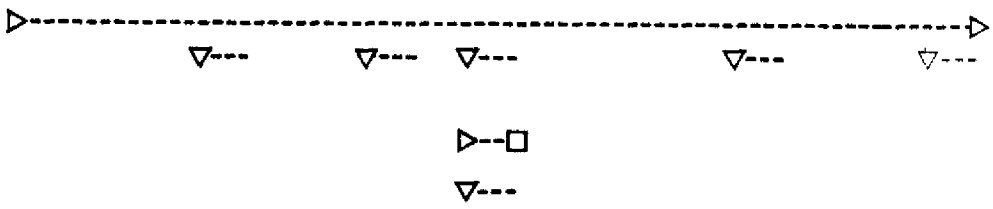
PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989



PROYECTO DE MITIGACION DE RIESGOS VOLCANICOS / SISMICOS (MIRVYS)

PROGRAMACION DE TAREAS
OCTUBRE 1988 - SEPTIEMBRE 1989

| TAREA Y SUBTAREA | RESPONSABLE |
|---|---|
| V. RED DE ACELEROGRAFOS (continuacion) | |
| 5. El procesamiento de los datos generados por los instrumentos. Digitalizacion, correcciones, analisis y publicacion | UCR |
| - digitalizacion, correcciones, analisis y publicacion | |
| * participacion de los Consultores en Costa Rica | |
| 6. Estudio de factibilidad para la integracion de los datos de UCR/ INII/ICE | |
| * participacion de los Consultores en Costa Rica | |



ATTACHMENT 2

# PRELIMINARY REGIONAL LINEAMENT ANALYSIS AND DESCRIPTION OF LINEAMENTS IDENTIFIED FROM 1:80,000 SCALE INFRARED AERIAL PHOTOGRAPHY

# PRELIMINARY REGIONAL LINEAMENT ANALYSIS
# COSTA RICA GEOLOGIC HAZARDS STUDY
# VALLE CENTRAL, COSTA RICA

## 1.0 INTRODUCTION

The study of lineaments can be useful in detecting the presence of faults, but lineament studies are only one of several methods of detecting faults, and the usefulness of such studies varies from area to area. Factors such as type and scale of imagery, terrain, geology, vegetative cover, climate, and cultural development all affect the usefulness of the method. In this particular study area the youthfulness of some of the geologic formations is an additional limitation. Widespread late Quaternay volcanic deposits can mask some active and potentially active faults.

This Basic Data Report presents an evaluation and documentation of lineaments detected during a preliminary analysis of large scale (1:80,000) color infrared (IR) aerial photography of the Valle Central region of Costa Rica.

## 2.0 OBJECTIVE OF TASK

The objectives of this task were 1) to conduct a preliminary lineament analysis of regional color IR air photos, 2) identify regional lineaments that are potentially fault related or warrant further evaluation from through air photo analysis or field reconnaissance, and 3) to document the lineament analysis method. Each lineament that was identified on the color IR photographs was evaluated in a preliminary way with regard to its potential for being fault related.

## 3.0 METHOD

The images used during this task were color IR stereo-pair transparencies at a scale of 1:80,000 taken in March, June and July 1984. Analysis was made by a geologist experienced in air photo interpretation using a light table and a Leitz/Sokkisha MS-27 mirror stereoscope with 3X power optics. During analysis of the photos, lineaments were identified, and the "significant" and "possibly significant" lineaments were selected for further analysis. Those lineaments that appeared to have a high to moderate potential for being faults were plotted on the transparencies, numbered and documented on lineament analysis forms (attached). Those lineaments are recommended for additional aerial photo analysis or for field reconnaissance to determine the origin of the linear features and to further evaluate whether or not they are faults.

This preliminary analysis is not intended to be definitive in scope but rather to select target areas for further more detailed study.

## 4.0 SCOPE

The lineaments were evaluated based on geomorphic expression and color tone contrasts and alignments. No trenches were excavated across any of the lineaments nor were any geophysical surveys conducted across the lineaments. Mapped geology was not available and so it was not used in the evaluations. The evaluations in this Basic Data Report are based entirely on geomorphic and vegetative evidence as interpreted from the imagery. Lineaments that were very subtle and/or apparently cultural were not plotted or documented. Likewise very short lineaments, not part of a longer regional trend were not plotted or documented. The specific air photos interpreted for this study are as follows:

| | | | |
|---|---|---|---|
| R-4, L-8 SE, | Frames 5 through 11, | July 4, | 1987 |
| R-5, L-6 SE, | Frames 27 through 31, | March 4, | 1984 |
| R-5, L-7 N, | Frames 65 through 71, | March 4, | 1984 |
| R-5, L-9 N, | Frames 117 through 124, | June 4, | 1984 |
| R-5, L-10 SE, | Frames 132 through 141, | June 4, | 1984 |

The photo quality was excellent and there was no cloud cover. The lineaments were plotted directly on the air photo transparencies and numbered sequentially from L-1 to L-8. The attached Lineament Analysis forms document observations and interpretations. The lineaments were not plotted on topographic maps at this time.

## 5.0 DATES OF WORK ON TASK

The task commenced on June 1, 1988 and was completed on June 10, 1988. Approximately 32 man hours were required to complete this task (logistics, interpretation documentation and report preparation).

## 6.0 LINEAMENTS

There were basically two types of lineaments evaluated and documented during this task. These included lineaments with geomorphic expression such as breaks in slope, linear valleys, aligned notches, and linear stream segments. The second type of lineaments were those defined by vegetative contrasts and alignments which were observable on flat terrain as well as on hillslopes. Most of the lineaments are complex and include segments of both types of lineaments. Short lineaments (less than 1 km in length) were not considered important unless they were part of a longer structural trend. Generally only lineaments comprising zones longer than about 2 km were plotted

and documented. As described below only "significant" lineaments were evaluated.

The "significance" of a lineament in this study was based on evaluation of the six characteristics:

1. The length of the lineament and its relationship to other lineaments in a regional trend.

2. The prominence of the lineament (the strength of its geomorphic and/or vegetative expression).

3. The photogeologic interpretation of the lineament (i.e. not cultural and likely related to structure).

4. The relationship of the lineament to the geology as interpreted from the air photos.

These characteristics are discussed in more detail in the following paragraphs.

### 6.1.1 Length

Lineaments as short as 1 km were studied in the photo analysis for this task. However, the shortest lineament plotted was approximately 4 1/2 km long and it was part of a longer regional trend (L-5). In general, the longer the lineament the more significant it is because of the potential for it being related to a significant seismic source. For this reason, length of the lineament was chosen as one criteria in determining the significance of the lineament.

### 6.1.2 Prominence

The prominence scale is an important characteristic used for this study in the evaluation of the significance of lineaments. The scale consists of three ratings; "subtle", "moderate", and "strong". These ratings are brief verbal descriptions of the visual prominence of the lineaments as observed on the imagery. This classifications scale is, of course, subjective, as are almost all air photo interpretation classifications. Since many subtle lineaments are often no more than unrelated alignments of tone contrasts and/or topographic features, this part of the evaluation is useful in helping to identify and screen out lineaments that are fortuitous alignments, and not in any way related to structure or to fault caused soil developments or vegetative contrasts.

Identification of subtle lineaments is often very subjective. Different image analysts may not detect the same subtle lineaments, or may interpret the same subtle lineaments in

different ways. Strong lineaments are the most distinct lineaments which show up readily on the imagery, sometimes without the aid of a stereoscopic view. The identification of the "strong" lineaments is the least subjective. "Moderately" pronounced lineaments are judged to be more significant than "subtle" lineaments. In regional interpretations subtle lineaments are usually not considered important. If they are short and isolated their significance is even less.

### 6.1.3 Photogeologic Interpretation

The third characteristic used in this lineament analysis (and one that is given somewhat more weight than the prominence scale) is the photogeologic interpretation. This characteristic considers the interpretation of what the lineament is caused by. If, for example, the lineament is, with a great deal of certainty, determined to be purely an erosional feature along a lithologic contact, this would have a strong impact in determining the lineament to be either "not significant" or only "possibly significant". However, if the photogeologic interpretation suggests that the lineament might be jointing or some other structural feature, this might (depending on its relationship to other regional trends) result in the lineament being categorized as either "significant" or "possibly significant". Thus, it can be seen that the photogeologic interpretation characteristic is subjective, but at the same time it is useful because it sometimes attaches quantitative or definite causes to the lineament. If a definite cause can be determined then the significance of the lineament can be more readily determined.

### 6.1.4 Relationship to Interpreted Geology

The fourth characteristic used in determining "significance" of lineaments for this study is the relationship of the lineament to the geology. In this study, mapped geology was not available, however interpretation of geology was possible to a certain extent. For example, volcanic flows, Quaternay alluvium, and sedimentary bedrock terrains could be differentiated.

The relationship to geology is both significant and useful in selecting lineaments to be studied further on larger scale air photos or in the field. For example, if a lineament is crossed by a marker bed or by a geologic contact and the marker bed or the contact is not displaced and in no way affected by the lineament, then the potential for the lineament to be fault related is low and it would have a low priority to be field checked. Lineaments which are not interpreted to have such relationships to the geology are generally considered to be either "possibly significant" or "significant", depending on the other criteria.

## 6.2 Criteria for Determining "Significance" of Lineaments

Since all regional lineaments judged to be "possibly significant" or "significant" were plotted on the photos and documented, whether they were categorized as either "possibly significant" or "significant" is not of critical importance. However, it is important to note that lineaments could only be categorized as being "not significant" if they met a set of very conservative criteria.

The criteria for determining lineaments to be not significant are outlined below.

A. Lineaments were categorized as being "not significant", and were not plotted on the photos, nor documented if any of the following criteria were met:

   1. The lineament is less than 1 km long and is not part of a lineament trend.

   2. The lineament is crossed by a marker bed or geologic contact that is not displaced and shows no geomorphic or photogeologic expression indicative of faulting.

   3. The lineament is interpreted to be cultural in origin.

   4. The lineament is along a geologic contact and there is no evidence of the contact being disconformable or otherwise fault related.

All lineaments categorized as "significant" or "possibly significant" are recommended for further study.

## 6.3 Conclusions

Although the study accomplished for this task was not able to determine the exact cause of many of the lineaments which were identified, it did determine that there are at least eight regional lineaments in the Valle Central area that have a reasonable potential to be faults. This does not imply that there are no other such lineaments that could be faults. Nor does it imply that the eight identified lineaments are active faults. As discussed in the introduction, there are limitations to the methodology. The use of other types of imagery, correlation of interpretations with mapped geology, and field and/or air reconnaissance could result in the identification of additional lineaments that are potentially fault related. Such studies are also needed to evaluate further the origin of the eight documented lineaments.

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-1

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5 #66, Image Date: 3-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Map Measure: NW,
LENGTH: Photo measure: 5 1/2" (6.9 mi, 11 km),
Comments: appears to parallel regional geologic structure
FORM: linear

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: contrast and alignment
Comments: both types in various places

2. Veg. Tone: contrast
Comments: in some places

3. Topographic: break in slope
Comments: along the side of a linear valley

4. Springs: none observed
Comments:

5. Groundwater Barrier: none observed
Comments:

6. Displacement: not known
Comments: none apparent

7. Other: Strong to moderate expression

IV. PHOTOGEOLOGIC INTERPRETATION

Fairly prominent feature, potentially related to bedding and or regional jointing.

V. PLACES TO FIELD CHECK

There are a number of places where roads and streams cross it. There should be good exposures in these cuts. After plotting on map these locations can be identified.

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-2

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5 #65-#69, Image Date: 3-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Map Measure: NW
LENGTH: Photo measure: 13", (16 mi, 26 km)
FORM: Sinuous,

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: contrast and alignment
Comments: varies along the lineament

2. Veg. Tone: contrast and alignment
Comments: varies along the lineament

3. Topographic: linear valley(s), depression, break in slope
Comments: breaks in slope are most common, there are also a few depressions and linear valleys

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: ?
Comments: Evidence of displacement not readily observable

7. Other: The expression of the lineament varies from strong to moderate.

IV. PHOTOGEOLOGIC INTERPRETATION

Appears to be structural, possibly a fault

V. PLACES TO FIELD CHECK

After plotting on map, select accessible river/stream banks and road cuts.

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-3

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5 L-9N0 #118, Image Date: 6-4=84
Image Scale: 1:80,000

II. ORIENTATION:

Measure: SW,
LENGTH: photo measure: 3 1/2" (4 1/2 mi, 7 km),
FORM: sinuous,

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: contrast and alignment
Comments:

2. Veg. Tone: contrast
Comments: only in a few places

3. Topographic: Break in Slope
Comments: Notches in spur ridges

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: not observed
Comments:

7. Other: Moderate Expression

IV. PHOTOGEOLOGIC INTERPRETATION

Possible fault

V. PLACES TO FIELD CHECK

After plotting on map, look at road map for road cut locations; There appear to be a few stream cuts where exposures may be found

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-4

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5 L-9NO #118, Image Date: 6-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Measure: SW,
LENGTH: photo measure: 2 1/2" (3 mi, 4.8 km),
FORM: linear

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: no contrasts on alignments
Comments:

2. Veg. Tone: contrast
Comments:

3. Topographic: break in slope
Comments: notches in ridge

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: possible
Comments: possibly in deflected drainage

7. Other: possible deflected drainages, moderate to weakly expressed

IV. PHOTOGEOLOGIC INTERPRETATION

Possible branch fault of a longer structure

V. PLACES TO FIELD CHECK

Stream cuts

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-5

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5 L9NO#122-123-124,
Image Date: 6-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Measure: NW
LENGTH: photo measure: 11" (14 mi, 22 km)
FORM: linear

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: contrast and alignment
Comments: subtle, discontinuous

2. Veg. Tone: contrast and alignment
Comments: discontinuous

3. Topographic: break in slope
Comments: alignment of notches in spur ridges; discontinuous

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: possibly vertical
Comments:

7. Other: Complex series of parallel to subparallel, mostly subtle lineaments, pattern is suggestive of tectonic range front structure. Overall moderately expressed.

IV. PHOTOGEOLOGIC INTERPRETATION

Could be a regional fault structure and/or related to jointing.

V. PLACES TO FIELD CHECK

Numerous road/stream cuts

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-6

I. AREA: Valle Central, Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R5-L9 NO#124, Image Date: 6-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Photo Measure: NW
LENGTH: Photo measure: 3 1/2" (4.4 mi, 7 km)
FORM: linear

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: no contrasts or alignments
Comments:

2. Veg. Tone: contrast
Comments: slight

3. Topographic: break in slope
Comments: predominant break in slope

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: possible vertical
Comments: may be associated with foldingas well as faulting.

7. Other: Appears to be Alajuela escarpment. There are a number of short branch lineaments. Down slope is a parallel lineament and between the two, there appears to be graben.

IV. PHOTOGEOLOGIC INTERPRETATION

This appears to be a structural feature, probable fault. It might be structurally related to L-7.

V. PLACES TO FIELD CHECK

Numerous road cuts, quarries, stream cuts; needs closer look with larger scale air photos.

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-7

I. AREA: Valle Central Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-5,L6-SE, #29, Image Date: 3/4/84
Image Scale: 1:80,000

II. ORIENTATION:

Photo Measure: NW, Comments: strong, prominent feature
LENGTH: Photo measure: 13" (16 mi, 26 km), Comments: may be longer.
FORM: linear, Comments: sinuous in places

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: not observed
Comments:

2. Veg. Tone: contrast
Comments: in some places

3. Topographic: linear valleys, break in slope
Comments: break in slope near base of slopes and higher up along side of range front slopes, aligned drainage.

4. Springs: not observed
Comments:

5. Groundwater Barrier: not observed
Comments:

6. Displacement: vertical ?
Comments: possible

7. Other: Major structural lineament, strongly expressed.

IV. PHOTOGEOLOGIC INTERPRETATION

Possible jointing and/or fault

V. PLACES TO FIELD CHECK

Possibly along river, few roads, access does not look good.

LINEAMENT ANALYSIS FORM LINEAMENT NO. L-8

I. AREA: Valle Central Costa Rica, IMAGE ANALYST: MWS
Image Type: Color IR
Image No.: R-4, L8SE #9, Image Date: 7-4-84
Image Scale: 1:80,000

II. ORIENTATION:

Photo Measure: NW
LENGTH: Photo measure: 6"(7 1/2 mi, 12 km)
FORM: linear and arcuate, Comments: form varies along trend.

III. NATURAL FEATURES DEFINING LINEAMENT

1. Veg. Type: not observed
Comments:

2. Veg. Tone: contrast
Comments: in flatter area (valley) and along base of slopes

3. Topographic: linear valleys and notch in ridge
Comments: appears to parallel bedrock structure

4. Springs: possibly
Comments:

5. Groundwater Barrier: possibly in valley
Comments:

6. Displacement: not observed
Comments:

7. Other: Trends toward San Jose, should be looked at more closely with larger scale air photos, and in field reconnaissance.

IV. PHOTOGEOLOGIC INTERPRETATION

May be longer (appears to extend off of air photos), possibly a fault or mega joint.

V. PLACES TO FIELD CHECK

Bedrock outcrops in ridges, road cuts

ATTACHMENT 3

MINUTES OF THE JUNE, 1988 TASK III SUBCOMMITTEE MEETINGS
TO DEVELOP PLANS FOR INTEGRATION OF SEISMIC DATA

MINUTES OF MEETINGS ON MIRVYS TASK III: JUNE 21/22, 1988
San Jose, Costa Rica

PURPOSE: To finalize subtask contents and schedules for Task III, described in the draft Programacion de Tareas for the Mirvys Project.

JUNE 21, 1988

PARTICIPANTS: Geol. Ileana M. Boschini - ICE
Dr. Federico Güendell - UNA
M.Sc. Luis Diego Morales - UCR
Mr. Bill Foxall - RET/Weston

The meeting convened at 14:00 at the CNE office in San Jose.

Subtask 1

Güendell stated that the next meeting with the Vice-Minister of Science and Technology will be on July 7, when it is expected that significant progress towards agreement upon integration of the ICE, UCR and UNA seismic networks will be made. Following that meeting, a proposal for integration of the networks will be prepared by the three institutions for the MIRVYS Commission. The schedule for reconfiguration of the networks will be determined at that time.

It was agreed that the process of integrating data from the three separate networks to produce a single National Earthquake Data Base is to begin immediately. The primary objective of this process is to standardize data processing and analysis procedures in order to produce data of uniformly high quality.

It was agreed that F. Güendell will prepare a detailed plan for integration of the data for submission to the MIRVYS Executive Committee on June 31, 1988. The plan will be based upon the following items of agreement:

1. A Supervisory Panel, composed of I. Boschini (ICE), F. Güendell (UNA) and L.D. Morales (UCR), is to be responsible for executing the integration plan. The Panel will subsequently meet on a regular basis to evaluate data processing and analysis procedures, and to decide upon modifications to the procedures.

2. For as long as the seismic networks are operated separately, each institution will be responsible for reading the seismograms recorded by its network. P- and S-wave readings and time corrections will be transmitted to UNA on a weekly basis.

3. UNA will be responsible for computing earthquake hypocenters and other data that will be included in the National Earthquake Data

Base, for maintenance of the Data Base, and for publishing monthly and annual National Earthquake Bulletins.

4. The computerized Data Base will be freely available to the three institutions. To facilitate efficient transmission of data to UNA and access to the Data Base by UCR and ICE, RET will plan the installation of telephone data links and associated software (e.g., Kermit). Meanwhile, data will be transmitted on Diskettes.

5. The National Earthquake Bulletin will acknowledge the three institutions equally.

6. UCR and ICE will continue to publish a separate bulletin containing data from the LCR broad-band station.

7. The program HYPOINVERSE is adopted as the standard hypocenter location program. A modified (see Subtask 3) form of the HYPOINVERSE summary output format will be used for the Data Base.

8. The Supervisory Panel will decide upon standardized procedures for data processing and analysis, and the members of the Panel will work together to implement the standard procedures at each institution.

9. Copies of computer programs developed at each institution to manipulate the data base will be made available to the other institutions.

10. Seismograms from each network will be made freely accessible to the other institutions for research purposes, etc.

The plan for integration will be implemented immediately upon its approval by the MIRVYS Executive Committee.

Subtask 2

It was agreed that the deep seismic refraction experiment should be divided into two phases. The first phase will be a reversed profile along the Valle Central, the second an offshore-onshore profile. F. Güendell has already identified potential shot points for Phase 1, and has made preliminary contact with property owners.

Güendell committed seven UNA MEQ-800 seismographs plus seven UC Santa Cruz MEQ-800s to the experiment. UCR and ICE will each provide five MEQ-800s plus a twelve-channel shallow refraction seismograph. Some of the ICE and UCR seismographs need repairs, which should be completed before the experiment.

F. Güendell will revise the original proposal to provide a detailed description and cost estimate for Phase 1, and an outline of Phase 2. The proposal will be submitted to RET by July 5. B. Foxall will provide a cost estimate for explosives by June 30.

In the meantime, the Matumoto (1977) crustal velocity model as modified by UNA is adopted as the standard for analysis of regional data, and the model

developed by UCR for the Valle Central as the standard for Shallow Valle Central earthquakes.

L.D. Morales and I. Boschini left the meeting at 16:30. E. Güendell and B. Foxall discussed sources of data for Subtask 3.

June 22, 1988

PARTICIPANTS: Geol. Ileana Boschini - ICE
M.Sc. Luis Diego Morales - UCR
Mr. Dan Haymond - RET/Weston
Mr. Bill Foxall - RET/Weston

The meeting re-convened at 14:30 at UCR.

Subtask 3

L.D. Morales summarized progress to date on this subtask. UCR has assembled Costa Rican and international sources of data for significant Costa Rican earthquakes and produced a catalog of historical earthquakes. Magnitudes of earthquakes that occurred during the period 1822-1904 have been estimated from intensity data. Recent locations of larger events by F. Güendell and intensity studies by ICE will be added to this data set. UNA has USGS/NOAA/ISC teleseismic locations for Costa Rican earthquakes for the period 1904-1985 on diskette, a copy of which will be given to UCR.

Various seismic networks have been operated in Costa Rica for various periods of time since 1968, data from which have been compiled into separate catalogs. Different computer programs have been used to analyze the data, and the formats of the catalogs vary. It was agreed that a very important element of Subtask 3 is to make these data sets consistent by: (1) relocating the earthquakes, whenever possible, using the standard velocity models and computer program specified under Subtask 1, above, and (2) reformatting the catalogs to the standard format (see Subtask 1). These data can then be incorporated into the Data Base.

UNA has relocated all the earthquakes in their catalog since 1984 according to (1) above. It was agreed that the entire UNA catalog for the period 1984-present will be incorporated into the Data Base, with the addition of events contained in the UCR/ICE catalog that were not located by UNA. The latter events will be relocated as described above by UNA, using the original phase data (P and S arrival times) supplied by UCR/ICE.

Phase data and/or the catalogs themselves for some of the pre-1984 data sets have not been preserved as computer files. Therefore, to relocate some of the earthquakes the printed phase data would have to be re-entered into a computer manually. I. Boschini will investigate the availability and form of each of the data sets and catalogs, in consultation with UCR and UNA, in order to assess the practicability of relocating the events, and reformatting the

catalogs (see below).[1] It was agreed that UNA will be responsible for relocating events for which phase data can be produced in computer-readable form.

Catalogs that currently exist in computer-readable form (i.e., computer files) will be reformatted into HYPOINVERSE summary output format with the addition of entries for maximum felt intensity and the data source, using reformatting software that will be developed by UNA. I. Boschini will work with F. Güendell to determine the format.

Epicenter plots and cross-sections will be produced by computer to overlay 1:100,000 base maps. I. Boschini will discuss with ICE computer personnel the software requirements for plotting on ICE's MV-1000 system by June 31. F. Güendell and B. Foxall will look for suitable programs to manipulate the Data Base.

It was agreed that ICE will take the lead in investigating volcanic seismicity, in collaboration with UNA and UCR. Initial work will include review of existing studies, creation of a seismicity baseline for volcanoes of interest, based upon data and analyses available at all three institutions, and correlation of earthquake activity with other volcanological observations.

The siting of the portable micro-earthquake network will be selected based upon the preliminary results of Tasks I and III. It is anticipated that the network will be installed during January, 1989. The five UCR MEQ-800s will be available for the portable network. Availability of the ICE instruments will depend upon other ICE requirements at the time of installation. Seven UNA MEQ-800s will be available.

Various details of Subtask 3 were discussed. B. Foxall will produce an amplified description of this subtask to accompany the modified Task Program.

The meeting was closed at 17:00.[2]

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[1]It is suggested that this task be completed by July 13.

[2]The concurrence on items of agreement from the June 22 meeting was obtained from F. Güendell during a telephone conversation with B. Foxall on June 23.