

NOTAS TECNICAS

MINERAL RESOURCE ASSESSMENT PROGRAM FOR COSTA RICA

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I. INTRODUCTION

Many South American countries, such as Chile and Peru, have a rich mining heritage and derive a large percent of their GDP's (Gross Domestic Products) from mineral production. However, in the Central American region, mining generally constitutes only 1% to 3% of GDP's, to a maximum of 6% of export values. This region contains significant gold, silver, and copper deposits, and the geologic diversity suggests the possibility of the existence of additional economic deposits of metallic minerals. If developed, new mines would provide employment, contribute to the national economies, reduce dependence on imports, and earn needed foreign exchange through exports.

In Costa Rica, mining contributes about 1% of the GDP. Although numerous mineral exploration surveys have taken place in parts of the country, unfortunately, most of these have been limited in extent and poorly documented. The results are largely unavailable, and show little continuity with previous or subsequent work. Consequently with the existing data, it is difficult, if not impossible, to make accurate predictions concerning mineral potential or to identify the most favorable areas for exploration.

To further develop the mineral industry in Costa Rica, we are conducting a nationwide mineral resource assessment. Detailed geologic studies will be conducted in the gold district, and regional geochemical reconnaissance will be undertaken for the San José and portion of the Talamanca 1:200,000 scale quadrangles. This assessment will ideally examine locations, geologic, geochemical, and engineering information on all known mineral deposits, descriptive and genetic models for known deposits, and results of exploration activities. Currently, such data is usually available only for a few active mines.

The limited and small scale mining industry in Costa Rica is caused in part by the lack of mining tradition and the absence of extensive systematic mineral exploration. A mineral resource assessment program would not solve these problems but it would provide a methodic approach to identifying mineral resources and

areas containing potential mineralization. Such a program will also develop descriptive and genetic gold deposit models useful for exploration. These new data, coupled with a favorable mining code, could provide Costa Rica with the tools to pursue development of the mining industry.

II. HISTORICAL DEVELOPMENT OF THE PRESENT MINERAL RECONNAISSANCE PROGRAM

In 1985, The U.S. Agency for International Development (A.I.D.) funded Los Alamos National Laboratory for a Central American Energy Resources Project. This project involves energy-related research and studies for many countries in Central America.

One part of this project is the Costa Rica Mineral Resource Assessment program. The Mineral Resource Assessment program involves Los Alamos National Laboratory and the U.S. Geological Survey (USGS). The counterpart organization in Costa Rica is the Ministerio de Industria, Energía, y Minas (MIEM), Dirección General de Geología, Minas, e Hidrocarburos (DGMH). The DGMH requested that the University of Costa Rica (UCR) also participate.

On December 26, 1985, the Costa Rica Resource Assessment program was officially approved by A.I.D. An official convenio and work plans were approved between MIEM, DGMH, Los Alamos and the USGS in early 1986.

III. PROGRAM DESCRIPTION

Geological evidence indicates Costa Rica has good potential for undiscovered gold-silver, base metal, and bauxite deposits. There are several gold mines and prospects associated with intermediate to felsic continental volcanism in the Corillera de Tilarán and Montes de Aguacate gold districts. Copper mineralization occurs in the vicinity of magmatic intrusions in the Cordillera de Talamanca. In addition, there are placer gold deposits on the Osa Peninsula, scattered lead-zinc occurrences, secondary iron deposits (mostly in beach sands), chromite occurrences on the Santa Elena Peninsula, manganese prospects on the Nicoya Peninsula, and bauxite (aluminum) deposits in the Valle del General. However, most mines have been intermittently exploited and operated by small companies or individual prospectors and gold is the only metallic mineral produced on a continuous basis for the last 100 years.

The objective of this project is to identify areas in Costa Rica that have high potential for mineral resources and which eventually may be mined. This will be accomplished by creating a mineral data base that consists of a compilation of previously

acquired data, new site-specific information, descriptive and genetic mineral deposit models, and stream sediment geochemical information collected and compiled as part of this study. The work by Los Alamos, the USGS, DGMH, and UCR will provide a comprehensive integrated approach to the identification of mineral resources.

The selection of study areas for this project was the result of several discussions between Los Alamos, USGS, DGMH, and UCR personnel. The Cordillera de Tilarán and Montes de Aguacte gold districts contain several gold mines and the only world-class gold deposit in Costa Rica. The Talamanca region contains the northern extension of porphyry copper province of Panama. Therefore these two areas are representative of two different metallogenic provinces typical of Costa Rican mineralization. These areas are also typical of the type of terrane encountered throughout Costa Rica.

The program schedule is:

- Conduct in-the-field, laboratory, and formal classroom training sessions.
- Perform a geochemical survey of the San José and the Provincia de San José part of the Talamanca 1:200,000 quadrangles.
- Produce a preliminary mineral resource assessment folio (scale 1:500,000) of Costa Rica that includes geologic, geophysical and interpretative maps.
- Conduct a detailed study of that part of the gold district that lies within the San José quadrangle.
- Perform an evaluation of the geochemical data, integrating the detailed investigation data and 1:500,000 scale maps, to determine what metallic metal commodities are present and where anomalous concentrations of such commodities are most likely to occur.

Although a nationwide geochemical survey and numerous site-specific studies are ultimately planned, initial field activities have concentrated in the San José and Talamanca quadrangles.

IV. ACTIVITIES

To achieve the objectives of this assessment the following activities are being performed.

1. Literature Survey and Synthesis of Prior Work

Before the actual project was designed, a survey was made of the existing geological literature of Costa Rica to determine how this project could complement past studies. Information on existing mines and known mineral deposits, and a better understanding of the geology have determined the direction and design of this program. From this information and in coordination with the Participants, the initial survey areas were selected.

2. Geochemical Survey

A stream-sediment geochemical survey is being conducted by Los Alamos. Such reconnaissance-scale surveys are rapid, cost-effective and offer a preliminary method of evaluating mineral potential in large areas. Although a variety of material can be sampled in geochemical surveys depending on the local geology, stream-sediment samples may provide the best overall coverage of areas being explored.

One stream-sediment sample provides an approximation of the geochemistry of most rock types and any mineralization in a drainage basin. If mineralization is at least partially exposed at the earth's surface, it can usually be detected in stream sediments several kilometers or more downstream from the occurrence.

A stream-sediment sampling program was developed and an orientation survey conducted to determine if sampling procedures and sample density were adequate to identify major mineralized areas. A. ARAUZ, a M.S. student at the Colorado School of Mines in the USA, helped conduct the orientation study in Costa Rica. Based on his work, a sample density of one sample/20 km² was found to be adequate.

At each sample site, sediment is collected from several spots and is wet sieved to -80 mesh. The sieving operation selectively retains metal-rich clay-sized sediment particles and allows a more reliable comparison of samples by examining a consistent particle size. The sample type, location, field measurements, possible contaminants, and geologic observations are recorded. This information is entered into a computerized data base and used in the interpretation of the analytical results.

a) Preparation of Sampling Manual. Based on the results of the orientation study, a sampling manual was written to serve as instructions for sample collection in the field.

b) Geochemical surveys of the San José and Talamanca areas. The San José 1° x 2° quadrangle (Fig. 1) was completely sampled during the dry season. Because sampling proceeded at a pace faster than estimated, sample crews were able to also complete the Quepos and Golfito and half of the Talamanca 1:200,000 quadrangles. The total area sampled covers about 50% of Costa Rica (Fig. 1).

c) Analysis of geochemical survey samples. About 1300 stream sediment samples were collected. All geochemical survey samples are being analyzed by neutron activation and atomic absorption for a total of 45 elements. The research reactor at Los Alamos provides a rapid, nondestructive, highly sensitive method for assaying materials for trace elements.

d) Data Processing and Evaluation of Geochemical Data. The geochemical analyses and geologic data collected from this study and from existing maps and reports will be integrated and displayed graphically as color images using computer graphics facilities at Los Alamos. Basic statistics, such as mean, median, and standard deviation, for each study area are included with each image. Selected elements are displayed as three-color combinations to identify significant interelement correlations. Finally, areas will be identified that have potential for more detailed exploration based on the occurrence, distribution, and size of geochemical anomalies in relation to known geologic features. Los Alamos, USGS, DGMH, and UCR personnel will identify areas favorable for mineralization and recommend follow up work. The data generated and the interpretation of the results will be documented in a written report.

3. Production of Preliminary Mineral Resource Assessment Folio

To serve as a data base for future mineral resource assessment work in Costa Rica and as a background for the interpretation of results of the regional geochemical survey, the USGS will produce a Mineral Resource Assessment Folio of the Republic of Costa Rica. This folio (scale of 1:500,000) will encompass the entire country of Costa Rica. A synthesis and evaluation of the results of prior geologic investigations in Costa Rica was performed. A geologic compilation including these results and the results of recent field studies by the USGS and DGMH, and including gravity and partial aeromagnetic data are also being prepared for publication. In addition, a mineral occurrence map and a domain map for mineral resource assessment by ore deposit models is being developed. The necessary accompanying text figures, and tables will form part of a map folio that will also contain the results of activity 4 (below).

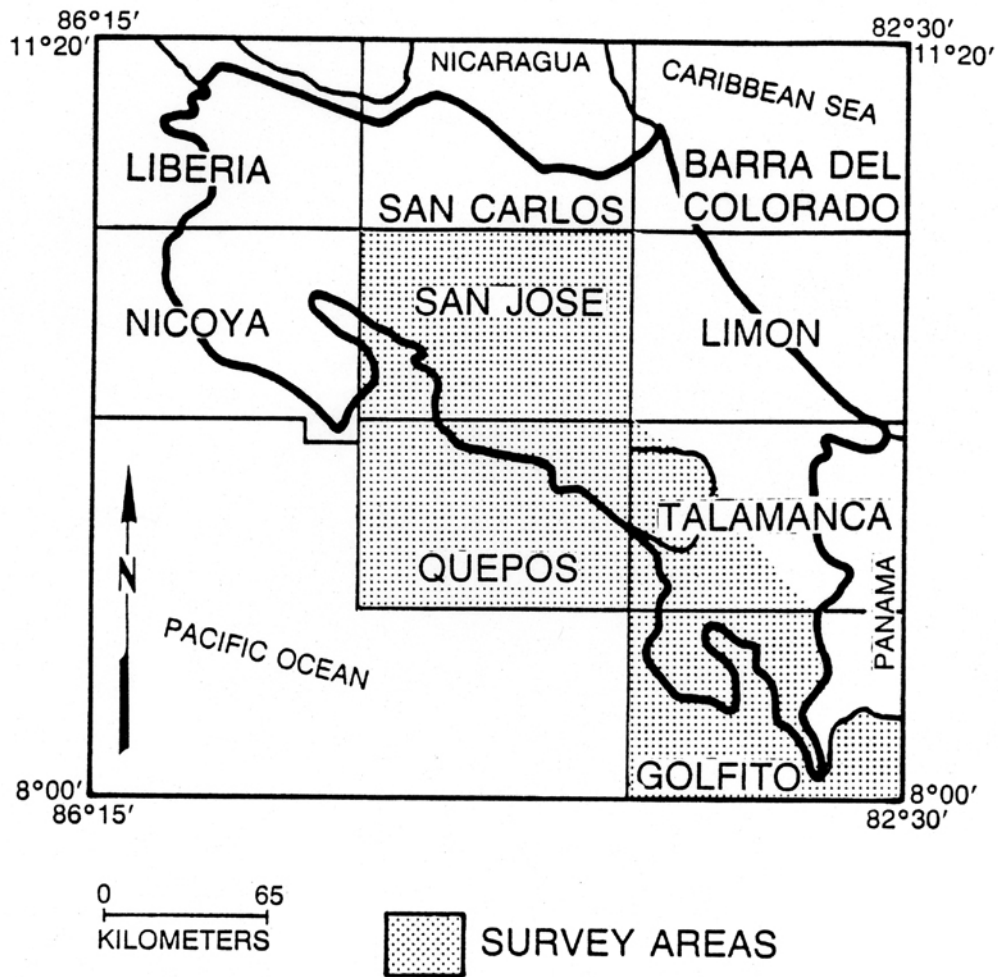


Figure 1.

Area sampled during the geochemical reconnaissance study for Costa Rica.

4. Detailed Gold District Study in the San José Quadrangles

The USGS and DGMH have carried out detailed geologic and geochemical studies of gold deposits (mined and unmined) in that part of the northwestern Costa Rica gold district within the San José 1:200,000 quadrangle. Included within these studies are geologic mapping (scale 1:100,000 to 1:200,000), geological and geochemical characterization of the deposits, and the development of ore deposit models. These results will be used to produce the maps, texts, and tables describing the specific characteristics of the gold deposits.

5. Training

Both informal (field and laboratory) and formal (classroom) training were conducted. Los Alamos staff trained personnel from DGMH and professors and students from UCR in appropriate techniques of stream sediment sampling, sample analysis, and data processing during a 5-week field course. The USGS conducted two 2-week formal courses in economic geology. One, held in March 1985, was an ore deposits modeling course and the other, held in October 1986, was a mineral resource assessment course. Lastly, counterpart personnel visited Los Alamos and USGS facilities in November 1986 for a one-week evaluation course and one-week for examining deposits.

V. DELIVERABLES

Upon termination of this project, the following deliverables will be completed by the cooperative efforts of DGMH, UCR, USGS, and Los Alamos:

- Geochemical map folio for the San José and the Provincia de San José portion of the Talamanca 1:200,000-scale quadrangles and accompanying bilingual report.
- Mineral resource assessment folio (scale 1:500,000) for Costa Rica that includes a geologic map, geophysical maps, mineral occurrence map, and domain map. Included in this folio will be maps and a bilingual report of the gold district study in the San José quadrangle.
- Geochemical sampling course.
- Ore deposits modeling course.
- Data evaluation and resource assessment course.

VI. BENEFITS TO COSTA RICA

Both DGMH and UCR will benefit from this study. Both institutions will retain copies of all data forms and maps. The DGMH will also retain all rock samples and a split of all stream sediment samples. This will allow follow-up studies to be conducted in Costa Rica.

The above items are a valuable resource for Costa Rica. The data forms were compiled by geologists and contain information on the geology and mineralization for areas that either have not been examined previously, or only have been describe in general terms. For example, the occurrence of volcanic rocks in the Talamanca area appears much more extensive than indicated in Costa Rican literature. The information on the data forms alone could advance the geological data base for the areas sampled.

All Costa Rican participants involved in this study were exposed to the joys (and sorrows) of conducting large-scale reconnaissance exploration and detailed geologic studies. The participants were involved in the logistical arrangements, planning and actual implementation of these programs. This exchange of ideas will benefit all the geologists involved, both local and foreign. This experience will also help the UCR students when they graduate and apply for employment.

The final report for this project will contain a list of recommendations. These recommendations will help to identify what mineral commodities exist in Costa Rica and where they are most likely to be discovered. The gold district descriptive and genetic models will also identify criteria that will aid in gold exploration. This information will hopefully provide encouragement to the mining industry for future development.

Lastly, the courses and actual field experience gained by the participants will eventually be used to foster the development of geologic ideas and concepts throughout Costa Rica. As the participant transfer their knowledge to their employers and coworker, the undestanding of the geology of Costa Rica will increase.