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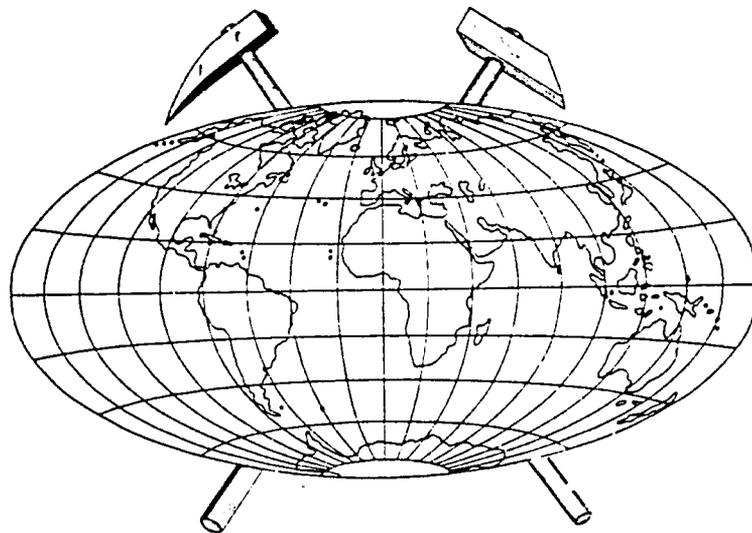


PROJECT REPORT  
Costa Rica Investigation  
(IR)CS-31

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DOCUMENTARY ON THE TECHNICAL ASSISTANCE PROJECT TO ASSESS  
COAL RESOURCES OF COSTA RICA

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Report prepared by the U.S. Geological Survey in cooperation with the  
Refinadora Costarricense de Petroleo, S.A. (RECOPE) under the auspices  
of the Agency for International Development,  
U.S. Department of State.

DOCUMENTARY ON THE TECHNICAL ASSISTANCE PROJECT TO ASSESS  
COAL RESOURCES OF COSTA RICA

by

Edwin R. Landis  
U.S. Geological Survey

The project report series presents information resulting from various kinds of scientific, technical, or administrative studies. Reports may be preliminary in scope, provide interim results in advance of publication, or may be final documents.

DOCUMENTARY ON THE TECHNICAL ASSISTANCE PROJECT TO ASSESS  
COAL RESOURCES OF COSTA RICA

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In the spring of 1981, the Instituto Costarricense Electricidad requested technical assistance in aspects of coal resource assessment from the U.S. Agency for International Development (USAID). Ralph L. Miller and Edwin R. Landis of the U.S. Geological Survey (USGS) provided the assistance under the auspices of USAID. Their visit resulted in a summary of the available coal information and a proposed coal resource assessment plan. With some variations, that proposed plan has been followed by subsequent workers.

During the winter of 1982-83, responsibility for investigation and development of the coal resources of Costa Rica was given to the Director of Coal Resources, Refinadora Costarricense de Petroleo, S.A. (RECOPE). Technical assistance was requested of USAID by RECOPE and in January and February 1983, a team composed of A. J. Sabadell of the Science and Technology/Energy group of USAID/Washington, D. P. Lijesen of Bechtel Group, Inc., and E. R. Landis of the Branch of Coal Resources, USGS, along with counterpart Costa Ricans, drew up a work plan for coal resource development to be funded by USAID/Washington and RECOPE with support from the Engineering Group of the USAID Mission in Costa Rica. The work plan was signed in July 1983, and technical assistance in coal exploration was initiated shortly thereafter under the USAID Conventional Energy Technical Assistance Project 936-5724.

In parts of July and August 1983, geologist K. Bolanos I. of RECOPE worked with USGS scientific and technical personnel engaged in exploration of a major, previously unstudied, coal deposit in the State of Wyoming. Bolanos participated

in logging of rotary drill cuttings, descriptions and sampling of coal and rock cores, the creation and interpretation of bore-hole geophysical logs, and the synthesis of the different forms of geologic information. He was also exposed to the concepts and procedures used to plan modern detailed coal exploratory drill programs.

In early September 1983, E. R. Landis and F. O. Simon visited Costa Rica to 1) plan technical assistance activities with RECOPE for the remainder of the calendar year 1983, and 2) plan the creation of a coal analytical laboratory and ascertain the training and equipment requirements of such a facility. Subsequently, chemist Lourdes Quesada of RECOPE spent several months in the United States working in the laboratories of Geochemical Testing, Inc. in Pennsylvania preparatory to establishing a coal analytical laboratory for RECOPE in San Jose, Costa Rica.

In October 1983, Landis returned to Costa Rica and was joined by S. B. Roberts, J. D. Sanchez, and D. A. Coates, all of the USGS, who provided cooperative technical assistance to Costa Rican counterparts for several weeks in the Baja Talamanca and Venado coal areas. Roberts was engaged primarily in training counterparts in use of the geophysical logging equipment loaned to RECOPE by the USGS and in planning initiation of the Exploration Stage I activities in the Uatsi Project area of the Baja Talamanca coal field. A major feature of Exploration Stage I is the coal exploratory drill program--the first modern detailed program of that type ever conducted in Central America. In addition, Roberts provided extensive consultation (technology transfer) regarding drilling practices, equipment, and exploration concepts. No holes were drilled in 1983, but trenching and road-building were initiated.

Sanchez and Coates assisted in the Reconnaissance Exploration Stage in the Venado coal area in San Carlos Province in northern Costa Rica. A preliminary geologic study of a 286 km<sup>2</sup> area was completed, and the presence of coal in the area was confirmed. An Early Exploration Stage study in about 160 km<sup>2</sup> was started and has continued at a low level of effort since. Preliminary indications are that the quality of the coal in the Venado area may not justify a greater level of effort at this time. During early December 1983, Landis helped counterparts to plan the technical assistance program needed in the next 6 months.

The technical assistance program was effectively recessed from January to May 1984. During that time, the Costa Ricans continued the activities initiated in 1983 and began others, for example, drilling in the Uatsi Project area.

In May 1984, S. B. Roberts returned to Costa Rica to assist in planning activities in the Baja Talamanca, Venado, and Zent coal areas, to alleviate problems with geophysical equipment, and to plan a safety course in radioactive source handling. Though not required in Costa Rica, USA and USGS practice requires that personnel involved with, or near, radioactive sources used in geophysical bore-hole logging take a course emphasizing safe handling practices.

In June 1984, Landis, R. G. Hobbs, and W. L. Smith (USGS) spent varying amounts of time on technical assistance. Hobbs was active in assistance and consultation in many aspects of coal resource evaluation, including coal exploratory drilling and coring, geophysical log interpretation, and feasibility of recovery operations. During the last 2 weeks in June, Smith, the Radiological Safety Officer in the Central Region, USGS, presented a well-attended safety course in handling radioactive sources. Landis continued liaison with counterparts to review progress and plan further activities.

Landis again visited Costa Rica in early August 1984, primarily to assist with the Exploration Stage I in the Uatsi Project area in Baja Talamanca. By that time, three drill rigs were active and much information was being obtained. In addition, he was available for consultation about the Venado and Zent areas and the analytical laboratory, and helped plan the assistance program for the remainder of calendar year 1984.

D. A. Coates spent late August and much of September 1984 assisting in the Venado coal area where stratigraphy of the coal-bearing sequence is quite complex and new approaches to attaining understanding needed to be planned and initiated.

J. N. Weaver (USGS) assisted in initiation and conduct of the Reconnaissance Stage studies in the Zent coal area during September and early October 1984. Reconnaissance of all the Zent area has not been completed to date, but the 1984 efforts resulted in selection of the Corina subarea for more detailed study, including drilling. The fact that the Zent coal area is located close to major transportation and communication facilities makes evaluation of those coal resources of utmost importance.

Roberts spent part of September and October 1984 assisting counterparts in interpretation and correlation of geophysical well logs, repairing and maintaining geophysical logging equipment, and helping plan the continuing exploration program in Baja Talamanca. By that time, eight drill holes had been completed, and work on interpretation was critical to continued success.

Landis and Hobbs returned to Costa Rica in latest November 1984. Landis helped plan subsequent stages of assistance, reviewed progress, and consulted on overall aspects of the exploration program. He returned to the USA in early December, while Hobbs remained for 2 more weeks, during which he was primarily

engaged in consultation and assistance on drilling, geophysical logging, and sampling already underway or planned on the Exploration Stage I study in Baja Talamanca. He assisted in interpreting and evaluating data from geophysical logs and recommended changes in plans. In addition, he consulted about coal utilization with personnel of the cement plant at Cartage and with geophysicists of RECOPE regarding repair and calibration of recently-acquired equipment.

Coates spent late February 1985 in Costa Rica working with counterparts on interpretation of surface geology in part of the Venado coal area, and helping plan a program of seismic exploration and drilling.

During March, 1985, Landis, Hobbs, Roberts, and Weaver, along with R. N. Babcock, a Geophysical Technician with the Branch of Coal Resources, USGS, spent varying amounts of time in technical assistance activities in Costa Rica. Landis was engaged in various duties as USGS team leader, including assistance in planning activities during subsequent periods. These USGS personnel, with assistance from Oldemar Ramirez, K. Bolanos, Azdrubal Delgado, and other RECOPE personnel engaged in the Uatsi area drill program, presented lectures and a field excursion during a week-long course on "Well site geology and basic borehole geophysical log interpretation" for personnel of RECOPE, ICE, and DGMH (Direccion Geologia, Minería e Hidrocarburos). Three days of lectures in San Jose were followed by a 4-day excursion (2 days were spent traveling to and from the Uatsi Project area, and 2 days were spent observing drill rigs in action, recording and interpreting geophysical logs, and describing drill-cuttings and cores). Other activities by USGS personnel during the March visit included 1) Hobbs assisting with interpretation of geophysical logs and geologic data and preparing an outline for the report on the Exploration Stage I study that would be finished shortly, 2) Roberts assisting with the drilling program and geophysical logging

in Baja Talamanca, 3) Weaver assisting in evaluation of field work results in the Corina subarea of the Zent coal area and helping to plan drilling and seismic studies for Corina, and 4) Babcock conducting maintenance and calibration on the USGS geophysical logging equipment on loan to RECOPE, assisting in attempts to render existing RECOPE equipment operable, and conducting a training exercise for ICE personnel in the use of a four-conductor geophysical logging system.

In latest May and early June, 1985, Roberts and Landis worked with Bolanos and Ramirez on progress and plans for the report on Exploration Stage I and early plans for further assistance during the remainder of the technical assistance program.

Landis returned to Costa Rica in late July 1985 to review the Exploration Stage I report, which was largely completed. It was decided that complete translation of the report for USAID was unnecessary. The report by that time included about 120 manuscript pages and 30 large-scale maps and figures. The complete report is necessary for planning and conducting the next stage of exploration and development work in the Uasti Project area and the other parts of the Baja Talamanca coal field. In addition, 17 splits of samples analyzed in the RECOPE laboratory were submitted for analyses by USGS laboratories and contract laboratories. Some of the results will provide comparative data, but most results will be information that cannot presently be provided by the RECOPE laboratory. The resulting information will also be needed in evaluating the utilization possibilities of the coal.

It was decided that a condensed, English-language, executive summary and overview would be prepared for USGS and USAID requirements. The overview would be derived from the report being prepared for RECOPE, but would also include comparative contributions by the involved USGS authors. In late September,

Landis traveled to Costa Rica to review the draft executive summary and overview with Ramirez and Boianos (see attachment 1). The Exploration Stage I report had been completed by RECOPE about the end of August, and 15 copies were prepared. Landis feels that the number of copies, 15, will prove to be inadequate, thus making the summary report in English more necessary than previously thought.

The technical assistance program will be completed when the geophysical logging equipment now on loan to RECOPE is returned to the USGS in Denver. Ramirez has requested that the equipment be left on loan until RECOPE acquires its own geophysical logging equipment and has submitted a formal request to that effect to USGS (Landis) through the Engineering Officer, Heriberto Rodriguez, of the USAID Mission/Costa Rica. The USGS realizes that RECOPE is dependent on the borrowed equipment to expedite its coal exploration program. However, the equipment must return to Denver soon so it can be readied for use in domestic exploration programs. Of great importance is the necessity to retain enough funds from the existing project balance to 1) cover expenses of USGS personnel in packing the equipment for shipment, 2) cover the actual shipping expenses of the equipment from Costa Rica to Denver--the equipment is not too large, but shipping such items as the radioactive source requires expertise and escort, and 3) the cost of overhauling the equipment--it has now been in use in Costa Rica for almost 2 years with a minimum of maintenance (a tribute to its basic durability and the ability of the Costa Ricans to maintain sophisticated equipment under difficult field conditions). The solution to the geophysical equipment problem is obvious; RECOPE must obtain its own geophysical logging equipment as soon as possible.

## Conclusions

The following conclusions near the end of the technical assistance project are those of E. R. Landis.

The basic objectives of USAID in sponsoring the technical assistance project conducted cooperatively by the USGS and RECOPE have been achieved. Training and technology transfer in coal resource exploration and assessment have been effectively achieved. RECOPE now has a group of professional and technical personnel trained and experienced in modern coal exploration. This is the only such group in Central America. The project to date has produced a great number and variety of results, and many more results will be forthcoming. From some standpoints, the most important, or interesting, result to date is the reasonable probability that a minimum of about 13 million metric tons of subbituminous coal are present in an area of about 6 km<sup>2</sup> in the Uatsi Project area of the Baja Talamanca coal field, and that development studies to determine the recovery and utilization of the coal should be initiated.

The basic objectives of RECOPE have been met. With intelligence, industry and willingness to learn, the geologists, engineers, and support personnel of RECOPE have attained a high level of competence in coal exploration in a very short time. Although general consultation and specific assistance in particular problems may need to be requested in the future, routine exploration from Reconnaissance through Exploration Stage I studies can now be competently planned and conducted by RECOPE with a minimum of outside assistance. Indeed, the RECOPE personnel could be a major part of training and technology transfer programs for counterparts from other Latin American countries.

The objectives of the USGS, although not so clearly definable as those for USAID or RECOPE, were achieved for the most part. Long-standing involvement

of the USGS in international activities rests on several factors. One is the belief that as the U.S. Government's prime earth science agency, the USGS should, when possible, provide geologic expertise needed by other federal agencies or counterpart organizations. Less altruistic is the firm belief that geologists themselves learn while training and assisting others, that a broad experience base is very desirable, and that geologic expertise attained abroad can and will be used to increase the individual's effectiveness in domestic programs of the USGS. There can be little argument with these articles of faith, which are based on past experience.

The technical assistance project in Costa Rica has been conducted effectively from most standpoints. Most training and technology transfer has been done through personal communication, and the short administrative reports that have been prepared are required, timely, effective, and necessary. However, there has been little opportunity to prepare the polished scientific research reports that assist the authors in their quest for advancement in the U.S. Geological Survey and recognition in the profession.

Finally, this has been an interesting and educational project. Though many things might be done differently if the project were repeated, the basic objectives of the sponsors and recipients of the technical assistance have been achieved in a very cost-effective manner. The project would not have succeeded without the patient support of A. J. Sabadell (USAID Washington), Heriberto Rodriguez (USAID Costa Rica), and M. J. Bergin (USGS Reston). Three pioneer coal geologists of RECOPE, Oldemar Ramirez E., Luis Malavasi R., and K. Bolanos I. deserve hearty congratulations for their accomplishments.

Trip Report, Sept. 25-Oct. 6, 1985

Technical Assistance Project

Coal Resources of Costa Rica

The main objective of Edwin R. Landis' trip to Costa Rica, September 25-October 6, 1985, was to terminate the USGS part of the USAID, S&T/EY technical assistance project on the coal resources of Costa Rica. Planned tasks were: 1) final review by the Costa Rican participants of the report "Exploration Stage I - Results and Recommendations" (an English-language summary and overview of the large comprehensive report "Factibilidad Fase I, Investigacion y Desarrollo de los Recursos Carboniferos, Proyecto Uatsi, Baja Talamanca, Provincia de Limon"); 2) to discuss the various areas being studied, review progress, and assist in planning further activities; 3) to visit field areas as requested, if possible; 4) to discuss the coal laboratory situation, and arrange for more coal sample-split exchange; and 5) prepare a documentary report on the project.

All of the listed tasks were accomplished, as well as a few more. For example, Mr. Daniel Chavez, Consultant to Los Alamos National Laboratory, was, we hope, impressed with the necessity of supplying RECOPE with geophysical logging equipment for coal exploration because the equipment in use, and vitally needed, is only on loan from the USGS and must be returned soon. During a site visit in Baja Talamanca, some samples of black beach sands were collected at Puerto Viejo and Cahuita; another black sand beach, previously unreported, was found and sampled near Manzanillo. The black sands appear to be largely magnetite.

In the Venado area, RECOPE is continuing studies on quantity and quality of the coal resources. However, the low apparent quality of the coal as expressed

by the samples collected to date is discouraging, and RECOPE may look at other coal areas in the northern part of the country, such as Upala or Rio San Carlos.

In the Zent area, activities are concentrated in the Corina subarea, where two deeper drill holes made with the single B-80 drill rig have been completed, and a third is more than halfway (ca 145 m) to its planned depth (ca 250 m). Many shallow holes--40 m or so in depth--have been drilled as extension of information from outcrops, trenching, and the deep drill holes. Both the stratigraphic and structural frameworks of the Corina subarea are beginning to be defined. A lower coal bed, or zone, called the Capa del Indio, and an upper coal bed, or zone, called the Capas de los Presidentes have been tentatively correlated at several localities. RECOPE plans a recovery demonstration (Explotacion Piloto) before the end of December at some site in the Zent area. The demonstration has been called for by higher authorities, presumably to show the existence of recoverable coal in the Zent area.

The Valle de Estrella south of the Zent area and north of the Baja Talamanca area may receive increased study in the future on the basis of the results of reconnaissance studies to date.

In the Uatsi Project area (see attached map) at the south end of the Baja Talamanca coal field, 24 exploratory drill holes had been completed by October 1. Twenty of these holes had been completed as part of the Exploration Stage I study; the newer holes are part of Exploration Stage II. Three rigs are drilling at present. One of these rigs is deepening a previously completed hole in order to better define the stratigraphic column and structural attitude near the axis of the Sand Box Syncline (see map). The drill program planned to date in the Exploration Stage II study has exploratory holes sited to provide additional

information in the area included in the Exploration Stage I program (two rigs) and exploratory holes in adjoining but as yet unexplored subareas (one rig). This is a good plan and distribution of effort.

At this time, it appears that the coal resource exploration program in Costa Rica is operating well. The Costa Ricans feel that they will need some technical assistance in further exploration activities. In the Uatsi Project area of the Baja Talamanca coal field, they need, now, technical assistance in evaluating development, recovery and utilization possibilities and planning further activities.

