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ANALYSIS OF THE POTENTIAL FOR HOUSING IMPROVEMENT IN HIGH RISK, VULNERABLE AREAS OF PERU

AGENCY FOR INTERNATIONAL DEVELOPMENT
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INTERTECT

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TABLE OF CONTENTS

	Page
I. INTRODUCTION: THE NEED	1
II. THE REGIONS OF PERU AND THEIR HOUSING TYPES	1
A. Housing Types	
B. Seismic Regions	
C. Vulnerable Areas	
III. THE PROBLEMS	3
A. The Economy	
B. Centralization in Lima	
C. Concentration of Resources in Other Sectors	
D. The Bureaucracy	
E. Technical Personnel and Skills	
IV. THE ACTORS	6
A. Offices of the Government of Peru	
B. Private Sector Groups in Peru	
C. Foreign Governments and International Organizations	
D. Voluntary Agencies	
V. CONCLUSIONS	10

FIGURES:
1. Traditional Housing and Vulnerability
2. Plate Tectonics of Peru
3. Seismic Map of Peru: Earthquake Locations
4. Seismic Map of Peru: Seismic Intensities
5. Seismic Zones of Peru
6. Demographic Map of Peru

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I. INTRODUCTION: THE NEED

Peru is one of the most seismically active countries in the world. Within the last ten years, two major earthquakes and one minor earthquake have struck the country. The casualties and widespread damage in each earthquake have underscored the vulnerability of the population and shown that the housing stock of the vast majority of the population cannot withstand the forces of the earthquakes which strike periodically. Almost 80% of the people in Peru live in non-engineered structures. Even within the larger cities such as Lima, Arequipa, Ica and Trujillo, engineering and architectural input into housing construction is minimal. It has been estimated by the Ministry of Housing and Construction that, in Lima alone, over three million people live in non-engineered structures that do not meet basic criteria for earthquake resistant construction.

Following the 1970 earthquake in the Chimbote/Huaraz region, the government, assisted by the nation's universities and several foreign development organizations, began a research program designed to develop ways to reduce the vulnerability of traditional housing in Peru. After almost a decade of research, most of which has been concentrated on ways to improve adobe structures, the results of these research programs are ready to be implemented. However, numerous problems must still be overcome before widespread improvement can be accomplished.

The purpose of this paper is to examine both the need and the opportunities which are present, to identify the problems that must be overcome, and to identify and review the operational capabilities of the various organizations that will participate in housing improvement activities.

II. THE REGIONS OF PERU AND THEIR HOUSING TYPES

A. Housing Types*

There is no single type of housing typical to the country. Even in a single region, there are many types of housing, each with variations. In general, however, there are five types of non-engineered structures found throughout the country. These are adobe (sun-dried earthen bricks), quincha (houses made of a wood frame with cane covered with mud as an infill for the walls), tapial (houses built using a rammed-earth process), unreinforced masonry structures (houses made of brick or block that do not use, or improperly use, concrete reinforcing systems), and wooden houses (wooden frame and timber houses built exclusively by the homeowner).

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*For the purposes of this paper, the only housing types that will be discussed are non-engineered structures.

Figure 1 is a map of Peru showing the various housing types and their principal roofing materials. To the side of each figure representing the predominant housing type in the area is a number which represents an evaluation of the potential for failure of each housing type in an earthquake. This map shows that the most vulnerable structures are located along the coast and in the mountainous (sierra) regions.

B. Seismic Regions

Peru is situated on the South American Plate, close to a major fault where the South American Plate abuts the Nazca Plate. At this juncture there is a subduction zone which means, in effect, that the faster-moving South American Plate is attempting to pass over the slower-moving Nazca Plate. It is this relative movement that causes the earthquakes which periodically affect the country.

A schematic of the subduction zone is shown in Figure 2. While earthquakes can occur anywhere along this subduction zone, as a general (although not absolute) principle the earthquakes will be stronger the closer they occur to the earth's surface. This means that the coastal region and western-most portions of the sierra will experience more ground motion than the more eastern portions of the country.

However, major fault systems exist throughout the sierra and any earthquake that occurs in the western-most regions can trigger movement along a par llel fault farther inland. One example is the earthquake that occurred near Chimbote in 1970. The epicenter was located in the ocean west of Chimbote, but its effect was felt in the sierra regions near the city of Huaraz which is located on one of the major parallel fault systems in the mountains.

By locating the major fault systems and recording the movement of the faults, as well as examining the history of earthquakes throughout the country, the Institute of Geophysics in Lima has been able to assemble maps showing where the greatest seismic activity occurs and to identify the relative potential for recurrence of seismic activity in each of the zones. This information is represented in Figures 3 and 4.

C. Vulnerable Areas

By comparing Figure 1 (which shows the housing types that are vulnerable) with Figures 3 and 4 (which show where earthquakes have occurred and the areas of high risk), the areas of Peru which are most vulnerable can be identified. These are illustrated in Figure 5.

By comparing Figure 5 to Figure 6 (which is a map of population concentration), the priority areas for housing improvement programs can be identified.

III. THE PROBLEMS

A. The Economy

Foremost among the obstacles to creating change in housing and reducing vulnerability is the economy. In the last five years, the economy of Peru has been very unstable. The inflation rate has soared and the value of the Peruvian sol against the dollar has fallen by as much as 130% within the last year alone. This economic instability and the high inflation rate have been reflected in the building sector. The price of commercial building materials has increased by 30% in the past year and, despite efforts at controlling prices, it is expected to increase by at least half that much again in the coming year.

The impact on any housing program attempting to modify existing housing or to promote change in new housing can be seen in the following ways. First, many of the materials that are needed to improve structural performance in earthquakes must be purchased through commercial sources. These include all the lightweight roofing materials, cement, wire and, in many cases, rock and gravel. With spiralling costs, the potential for low-income people to purchase these materials without financial assistance is substantially reduced.

Along with the spiralling inflation rate, interest rates on loans have risen substantially, partly in an effort to control inflation. In some cases, interest on housing loans is as high as 30%. Even if low-income families could qualify for these loans, it is doubtful that many would be willing to so encumber their finances over any period of time. In addition, loans are generally available only for new construction -- not for housing improvement. Although several institutions (including the Banco de Vivienda and several cooperatives) have attempted to provide these services on a short-term basis, very few people have been able to meet the eligibility requirements.

Within the government agencies that are responsible for housing programs, the high inflation rate has severely cut into their ability to operate. All government agencies are under strict orders to curtail their activities and to reduce government spending, and recent moves by the International Monetary Fund to require greater governmental austerity have dried up many of the funds which are necessary to develop new programs. Thus, even though the techniques for modifying the housing are ready for implementation, there are no funds for development of the programs to put these modifications into effect.

Finally, the unstable economy and soaring inflation has fed urbanization. Hundreds of people daily leave the sierra regions and move to the coastal cities seeking higher paying jobs. These people move into squatter settlements known as pueblos jóvenes and build new houses on small allotted plots. While the move itself does not affect overall vulnerability, it does affect the ability to reduce vulnerability at this time, for most of the techniques developed for strengthening housing are aimed at the modification of the houses found in the rural areas. While the government does have numerous programs to

assist those moving into the pueblos jóvenes, few people actually receive any technical advice due to the rapidly expanding urbanization in every growth center. Furthermore, due to the cost of land and the demand for it, the plots that are parceled out are fairly small, necessitating the construction of structures abutting each other and forcing the very poorest people into areas that are unstable, salty, and sometimes subject to flash flooding. All of these factors increase vulnerability.

B. Centralization in Lima

One of the major obstacles to the reduction of vulnerability is the centralization of almost all developmental activities, especially those of the government, in Lima. While many of the government's ministries which would be involved in vulnerability reduction do have regional offices, the vast majority of resources and personnel are concentrated in the capital city. Only in the departments of Arequipa and Huaraz are there sufficient personnel within government ministries to undertake any type of vulnerability reduction, but even these are concentrated in and around the departmental capitals. The majority of the institutions which have been involved in the research programs on earthquake resistant construction are located in Lima and they have generally shown an unwillingness to leave the city for any extended period of time. Almost all political decisions are made in Lima. Agency programs are noted for their attempts to delegate responsibility for program conduct but not decision-making, and thus substantial confusion reigns.

The same problem exists among the private agencies, although it is not quite as troublesome because many of the voluntary agencies delegate more of the decision-making responsibility to their local working groups.

C. Concentration of Resources in Other Sectors

A major factor to be considered is that constant day-to-day problems have a much higher priority than programs designed to deal with sporadic disasters. In terms of social programs food, the economy and natural resource exploitation all have higher priorities than housing and disaster mitigation. (Unfortunately, like many developing countries, a tremendous portion of the national budget is allotted to defense expenditures. Thus sophisticated military equipment is afforded when no measurable military threat exists and while activities in all the social sectors go begging.)

It is also interesting to note that only within a small sector is the potential for a massive disaster recognized. Even within many of the agencies responsible for disaster preparedness and mitigation, the risk is often officially minimized. Despite a growing recognition that disasters and development are interrelated, that a massive disaster in Peru could set back the potential for development for many years, and that mitigation is cheaper than reconstruction, this awareness has not generally been demonstrated in the government's national planning activities.

D. The Bureaucracy

The bureaucratic problems of Peru are not atypical, but coupled with a duel civil and military governmental structure and the high degree of centralization in the capital, together with a scarcity of funds, it results in almost total stagnation of initiatives within governmental channels. Even emergency programs (which in other countries can be developed and approved often in a matter of days following a disaster) have never gotten beyond the talking stage in Peru, due to the long bureaucratic process necessary to delegate funds. Unless a foreign agency is willing to put up the money and, in many cases, to staff the emergency program, small-scale disasters generally receive no more than a superficial site visit by the appropriate agency.

E. Technical Personnel and Skills

Another problem, which again is not only typical of Peru, is that there are very few technicians available to work in housing modification programs. Although Peru is unusual in that it has an excellent research program in anti-seismic construction, most of the personnel involved are researchers rather than program implementers. If the government were more decentralized, personnel from the regional offices could be brought into Lima for training and, in turn, could be expected to carry out the bulk of the programs outside the capital. To date, however, this has not been done and all the skills continue to be located within the capital.

Another factor has recently caused a short-term dearth of trained personnel. In order to meet IMF requirements for refinancing the national debt, the government was required to reduce its number of employees by 25%. Rather than having to fire so many employees, the government developed a plan to encourage personnel to leave government service before the IMF deadlines. By offering continued salary for a period of eight months after resignation, and other bonuses and benefits, the number of government employees was whittled down. In many cases, however, some of the best and most experienced personnel left government service. In one office of the Ministry of Housing and Construction, all of the field personnel associated with development of techniques for demonstrating anti-seismic construction resigned.

At the present time, the government utilizes the services of young graduate engineers and architects who are required to complete nine months to one year of government service upon graduation from any technical university. As field work outside the capital city is considered "less desirable" than work in the capital, field-related activities such as community organization and demonstration projects are usually left to these young and inexperienced graduates. While in many cases the work they do is excellent, after one year they leave government service, and the skills and experience they have acquired leaves with them.

IV. THE ACTORS

The reduction of vulnerability in Peru could be carried out by over a score of organizations including various government agencies, private and non-profit organizations such as universities, development agencies, foreign and international organizations, and church organizations in the country. The following is a discussion of the capabilities and limitations of these varied groups.

A. Offices of the Government of Peru

1. Ministry of Housing & Construction: The Ministry of Housing & Construction is the principal agency of the government responsible for reducing vulnerability by promoting safer construction methods. To date, the Ministry has sought to meet that responsibility in two ways.

   First, within the pueblos jóvenes, they have developed a series of standard designs for housing using reinforced brick, block and, in Arequipa, rock construction. These are offered to homebuilders and, when possible, technical assistance is provided. In general, however, the designs are considered to be overly sophisticated and beyond the ability of most homebuilders to afford. Steps are being taken in various regional offices to correct this problem and to provide increased technical assistance through participation of the Secigristas; but unless additional personnel are made available for this activity, results will continue to be minimal. The concept is workable on a small scale, however, and if emphasis could be shifted toward training people in the community such as the albañiles and giving more responsibility to these people, the results would be greater.*

   The second activity of the Ministry of Housing & Construction has been to designate the Office of Research and Standards (OIN) as the coordinator for housing research activities, assigning that office the responsibility of investigating methods for improving seismic resistance in non-engineered structures. Since 1971 OIN has coordinated all adobe research in Peru under a program known as the COBE Program. OIN is now the central source for all of the information developed by the various research programs on adobe and block construction, and in upcoming years they will expand into other research activities on other housing types.

   OIN is primarily a research institution and does not have, nor does it desire to have, any field-related activities. Officially their role is to work through the other offices of the Housing Ministry, particularly the regional offices. But in fact, due to personnel problems and funding, long-term commitments to other agencies are not made. The office has also lost many of its field personnel recently (through the governmental program designed to encourage resignation which was described earlier) and now has few people with any field experience in actual construction activities.

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* Secigristas: graduate engineers and architects in government service for up to one year; see Section III-E, p. 5. Albañiles: masons.

Regional offices of the Housing Ministry are located in each of the departmental capitals and often have small offices in the district capitals. A potential does exist for training regional personnel in improved construction methods, but generally the regional offices rely upon sesegristas for all field work and, as mentioned earlier, they are in a constant state of turnover due to the short time commitments of the staff.

2. ORDEZA: Following the 1970 earthquake in Huaraz, a coordinating organization was formed to handle reconstruction and development activities in the earthquake-affected area. This organization, known as ORDEZA, probably has more actual reconstruction experience than any other single organization in Peru. The primary role of ORDEZA has been to coordinate the reconstruction efforts of other organizations and to provide a plan for reconstruction of the affected area.

   Most of the reconstruction activities carried out in Huaraz in the housing sector have been designed to replace traditional housing with housing using commercial materials such as brick or block. However, ORDEZA and its predecessor (an organization known as CRYRZA) did prepare a series of booklets on how to build safer adobe housing, and they did conduct one stabilized adobe project in the area.

   ORDEZA is generally considered to be a rather controversial organization and many other governmental offices prefer not to work with ORDEZA for fear of losing some of their autonomy. At various times the government has announced intentions to form other similar coordinating groups, but to date none are operational to the same extent as ORDEZA.

   There exists some controversy within ORDEZA as to the best approach for reducing vulnerability in the rural areas. Despite this controversy, there is no doubt that the people within the organization are committed to vulnerability reduction and improvement of the housing stock, and within the department of Ancash the organization remains the major resource for continued efforts in this field. In any future disaster, personnel who have had experience within ORDEZA will probably be recalled or transferred to the affected area. Thus a resource of experienced personnel is available.

3. Civil Defense: The Civil Defense Agency in Peru is assigned primary responsibility for emergency response following a disaster. To this extent, they are involved in disaster preparedness activities but generally stay out of any activities which they consider to be involved in longer-term reconstruction. Within the organization, there are a number of architects and engineers, and these personnel are concerned with disaster mitigation. However, the office does not have the resources to undertake a program designed to reduce vulnerability in the housing sector.

Civil Defense personnel are, however, a good resource for technical information and see as one of their primary duties the encouragement of activities in all aspects of disaster mitigation, preparedness, response and reconstruction. They are also active in promoting seminars to discuss disasters throughout the country and, because of this, they may be a good starting point for any organization wanting to initiate a vulnerability reduction program.

4. Cooperatives: Strictly speaking, the cooperatives in Peru are not governmental organizations, but they are supported to a large extent by various governmental agencies. The rural co-ops in particular receive heavy support from the Ministry of Agriculture. The co-ops are mentioned here because they do become involved in housing activities for members and, in the past, they have shown an interest in developing plans for low-cost earthquake resistant housing for co-op members. This work has been encouraged by members of the engineering faculty at the National Agricultural University at La Molina. Several pamphlets have been developed for distribution through the co-op system. In 1979, a videotape program on how to build a safer house was developed by an office of the Agricultural Ministry called CEPAC, for use in co-op training programs. This program was produced with assistance from OIN.

   In the rural areas where the co-op movement is strong, such as in Ayacucho and Huancayo, they offer an excellent base for a housing improvement program. The co-ops can provide technical and financial assistance and have access to building materials at better prices than other organizations.

B. Private Sector Groups in Peru

1. Universities: Several of the universities in Peru have been involved in the COBE Program. Foremost among these are the National Engineering University and the Catholic University, both located in Lima. While the engineering departments in other universities throughout the country have participated, it has usually been on an individual basis rather than as a concentrated research effort.

   The work undertaken by the National Engineering University has concentrated primarily on ways of stabilizing adobe blocks, and most of this research has been focused on chemical stabilization. The work at the Catholic University has involved researching methods for reinforcing adobe walls. Both institutions are excellent resources for technical information and can provide limited technical assistance to activities outside Lima if funds are made available. Of the two, the work at the Catholic University appears to be more complete and is more heavily documented. The research team is small but has stayed together for a number of years, and the results of this cumulative experience are obvious.

2. INAVI: INAVI is a private foundation sponsored totally by the largest engineering and construction company in Peru. Their activities have been limited to assisting in the various adobe research projects by helping to assemble information on adobe construction from other countries. In 1977, INAVI published a booklet on how to build an earthquake resistant house, with information gleaned from a number of sources both inside Peru and from other Latin American countries (principally Mexico and Guatemala). At present, INAVI has no ongoing adobe research program, although many of the personnel within INAVI's parent group would make excellent technical resources and, as the organization is a private organization, it is more flexible in its ability to operate outside the capital.

C. Foreign Governments and International Organizations

1. U.S. Agency for International Development: Within the USAID Mission, there are two offices involved in housing-related activities: the Office of Housing & Urban Development and the Office of Engineering. Both offices have had a continuing interest in the ongoing research activities of the Peruvian Government concerning traditional construction, and the Mission has supplied funding for large portions of this activity. Traditionally, the Housing & Urban Development Officer of the Mission is also the designated disaster officer and is therefore usually receptive to ideas relating to hazard reduction.

   Unfortunately, both offices are small and USAID does not maintain an in-country staff of technical advisors upon which housing improvement programs can draw. However, in its role as a funding agency, USAID is a potential resource for funding housing improvement programs and through its contacts can often arrange for the provision of technical assistance, either by providing financial support or by identifying personnel through its information sources.

2. United Nations Offices: There are several U.N. representatives in Peru, although none are involved in hazard reduction activities at the present time. Several U.N. housing experts are also working in the country, but these are currently involved in historic preservation and the development of prefabricated housing systems. None are known to be working in the field of earthquake resistant housing for non-engineered structures.

3. Others: The only other foreign or intergovernmental organizations currently working in the housing sector are involved in reconstruction activities around Huaraz. Most, however, are simply providing financing and do not have technical assistance components. Yet all are potential sources of financial assistance for any hazard reduction program and should not be ruled out. Among the leading organizations which might possibly provide funding for housing improvement programs are: Inter-American Development Bank, Canadian International Development Agency, Overseas Development Ministry/U.K., and Swedish International Development Authority.

D. Voluntary Agencies

Currently, there are several voluntary agencies active in Peru. Among these are OXFAM, CARE, World Neighbors, Church World Service, Catholic Relief Services/CARITAS, Lutheran World Relief, and the Summer Institute of Linguistics/Wycliffe Bible Foundation.

Of these only CARE, CRS/CARITAS and Lutheran World Relief have extensive experience in housing-related activities in Peru, although each of the above-mentioned organizations has had a history in other countries of becoming involved in housing programs following large-scale disasters. OXFAM, CARE and World Neighbors in particular are excellent resources for technical information regarding housing, as each has been involved extensively in reconstruction activities in Guatemala, and copies of technical information on earthquake resistant construction has been stockpiled in the home offices of each organization.

Informal discussions with the regional directors of most of these organizations, however, have shown that housing improvement programs are not a priority for any of them. Thus, it is unlikely that they would become involved in instigating a program for housing improvement in high risk, vulnerable areas.

V. CONCLUSIONS

After examining the problems and obstacles which must be overcome in order to carry out a general improvement of the housing stock, as well as looking at the capabilities of those organizations upon whom the task would fall, the following conclusions can be derived:

A. Nowhere within the government, nor within the non-governmental organizations, is improvement of housing to a minimum earthquake resistant standard a high priority.

B. Various infrastructures do exist whereby vulnerability could be reduced were an effort made to do so.

C. The potential for housing improvement within certain areas does exist and, if funds and technical assistance were made available, limited objectives could be reached.

D. The probability of widespread housing improvement activities designed to reduce housing vulnerability in the high risk areas is rated overall as low.

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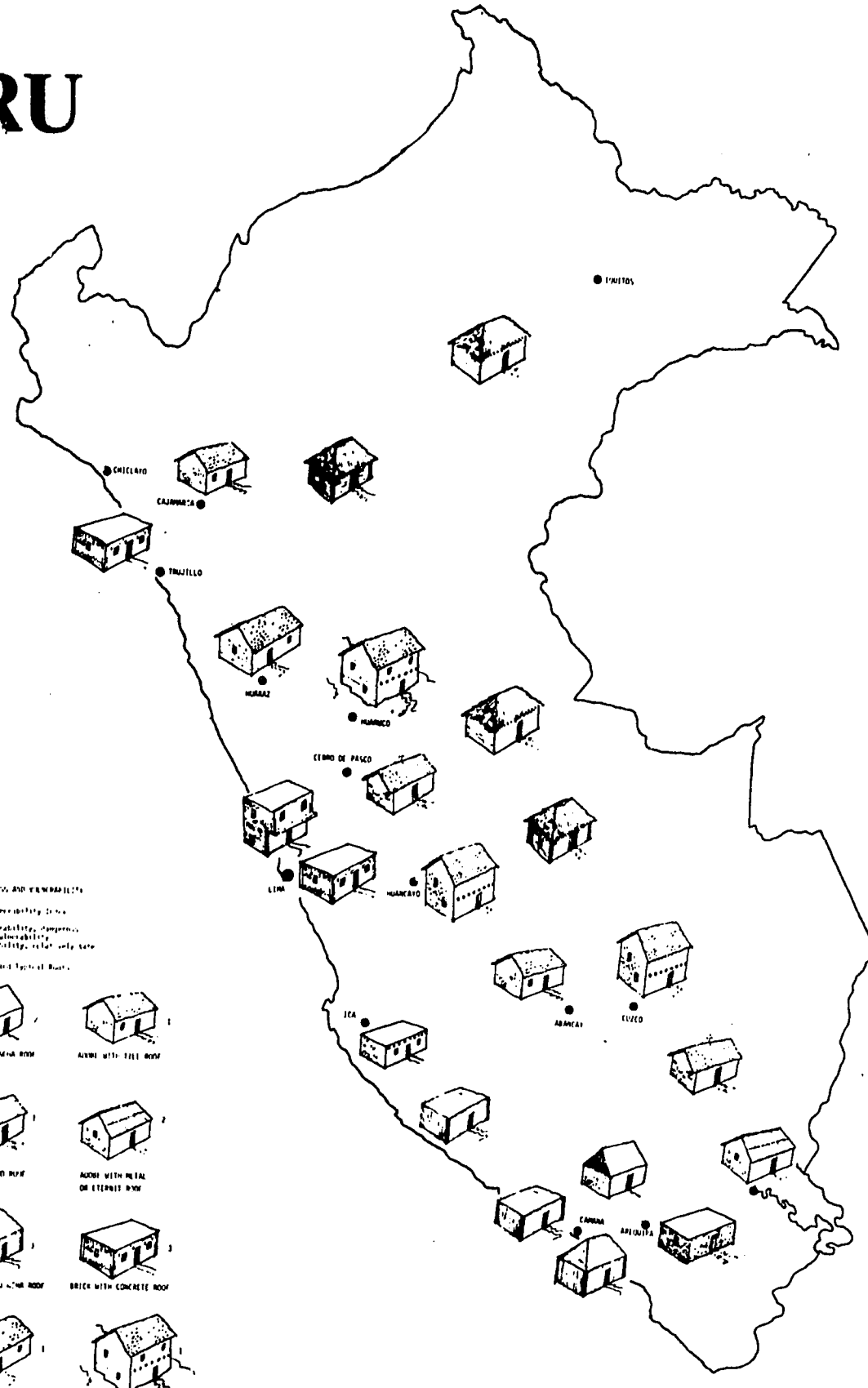
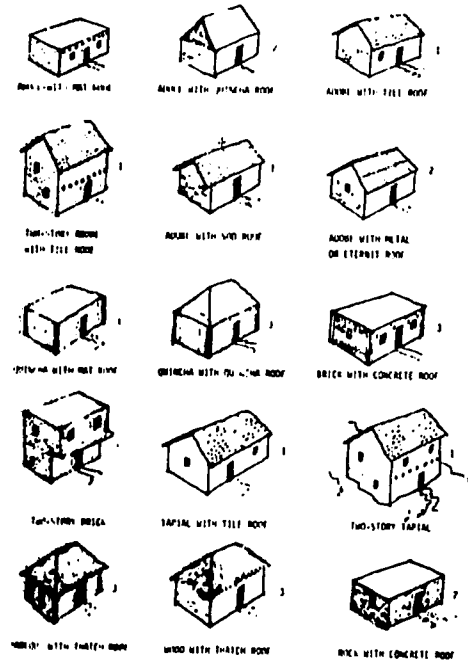
FIGURE 1

PERU





Prepared by: James Viets

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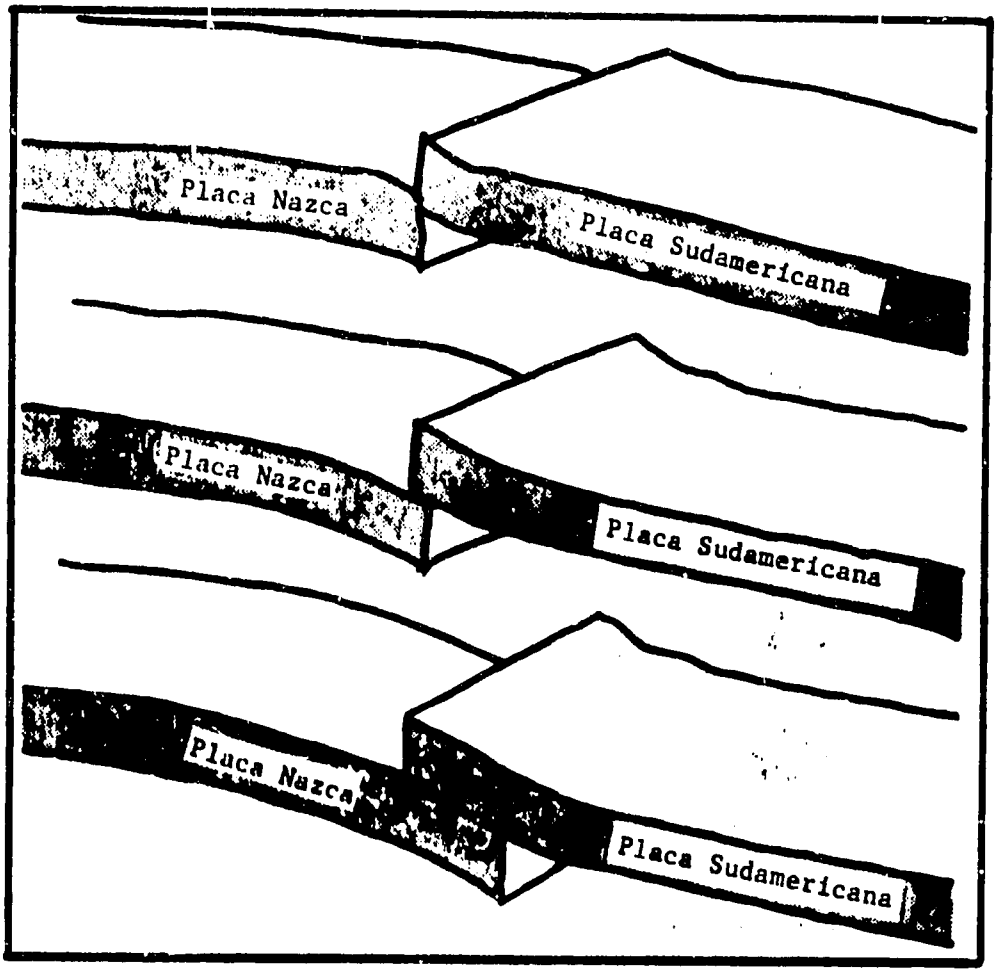
Figure 2

Plate Tectonics of Peru

A. Principal Fault



B. Schematic of the Subduction Zone near Peru

Figure 3

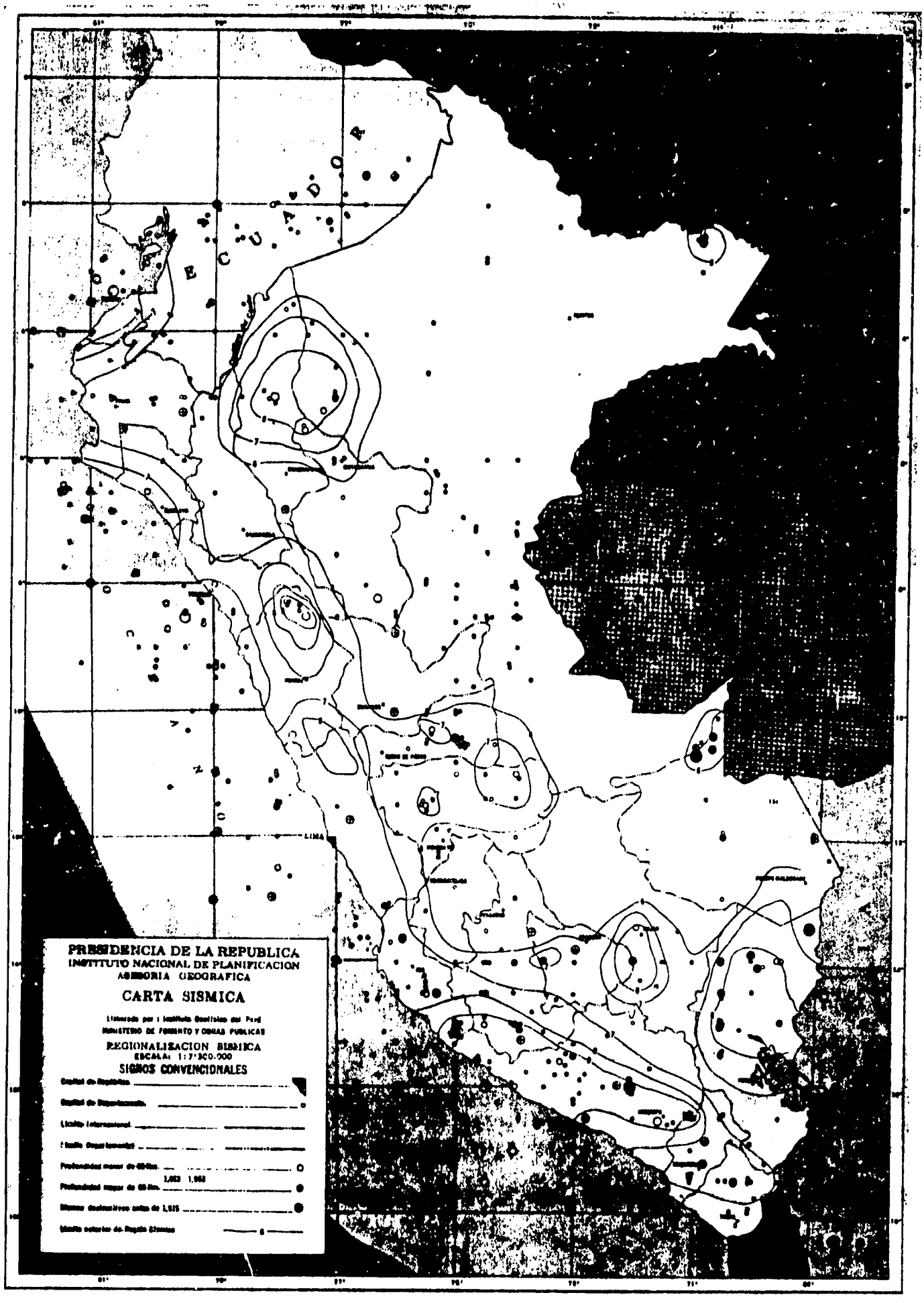
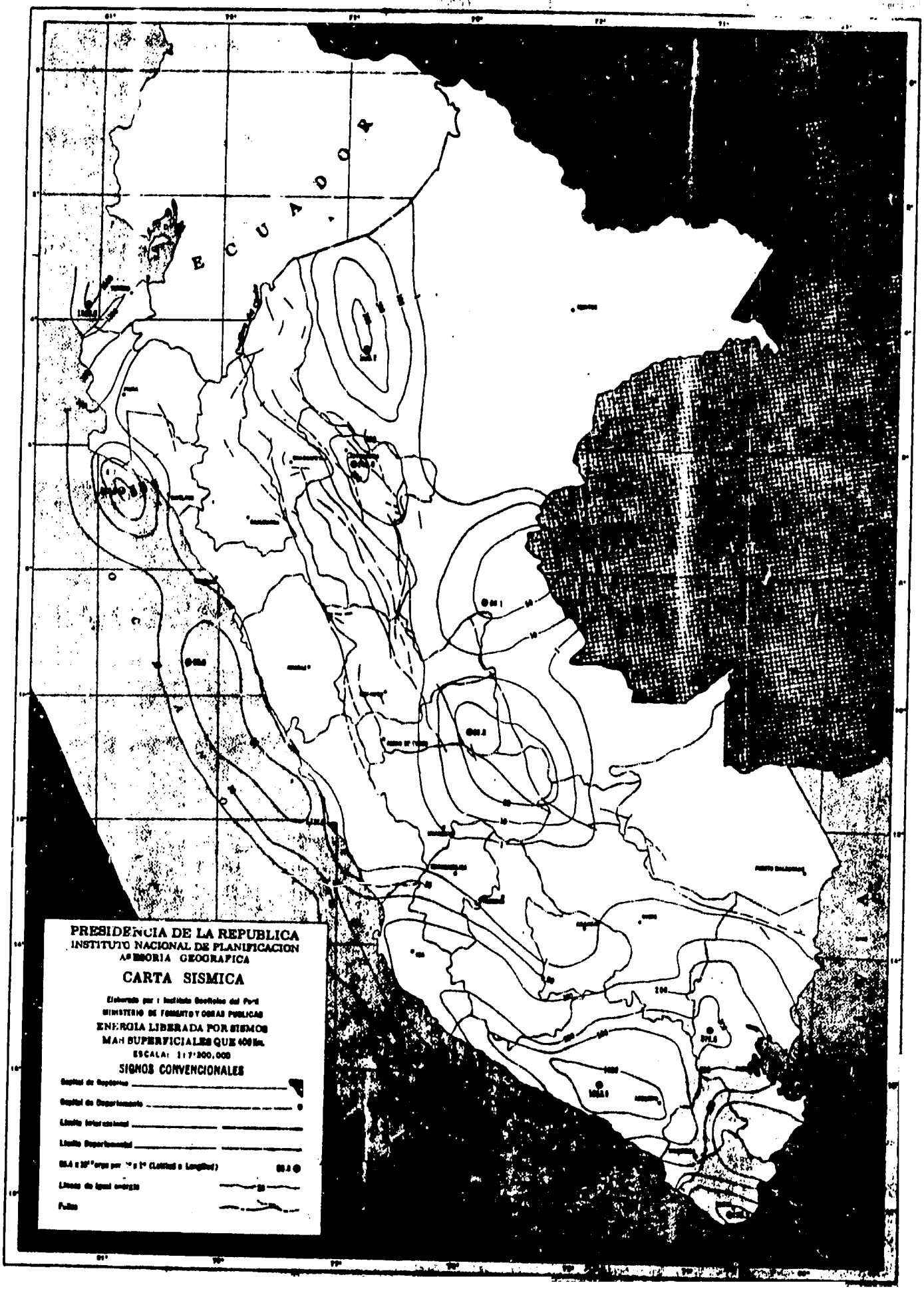

ECUADOR
LIMA
PRESIDENCIA DE LA REPUBLICA
INSTITUTO NACIONAL DE PLANIFICACION
ASESORIA GEOGRAFICA
CARTA SISMICA
REGIONALIZACION SISMICA
SIGNOS CONVENCIONALES

Figure 4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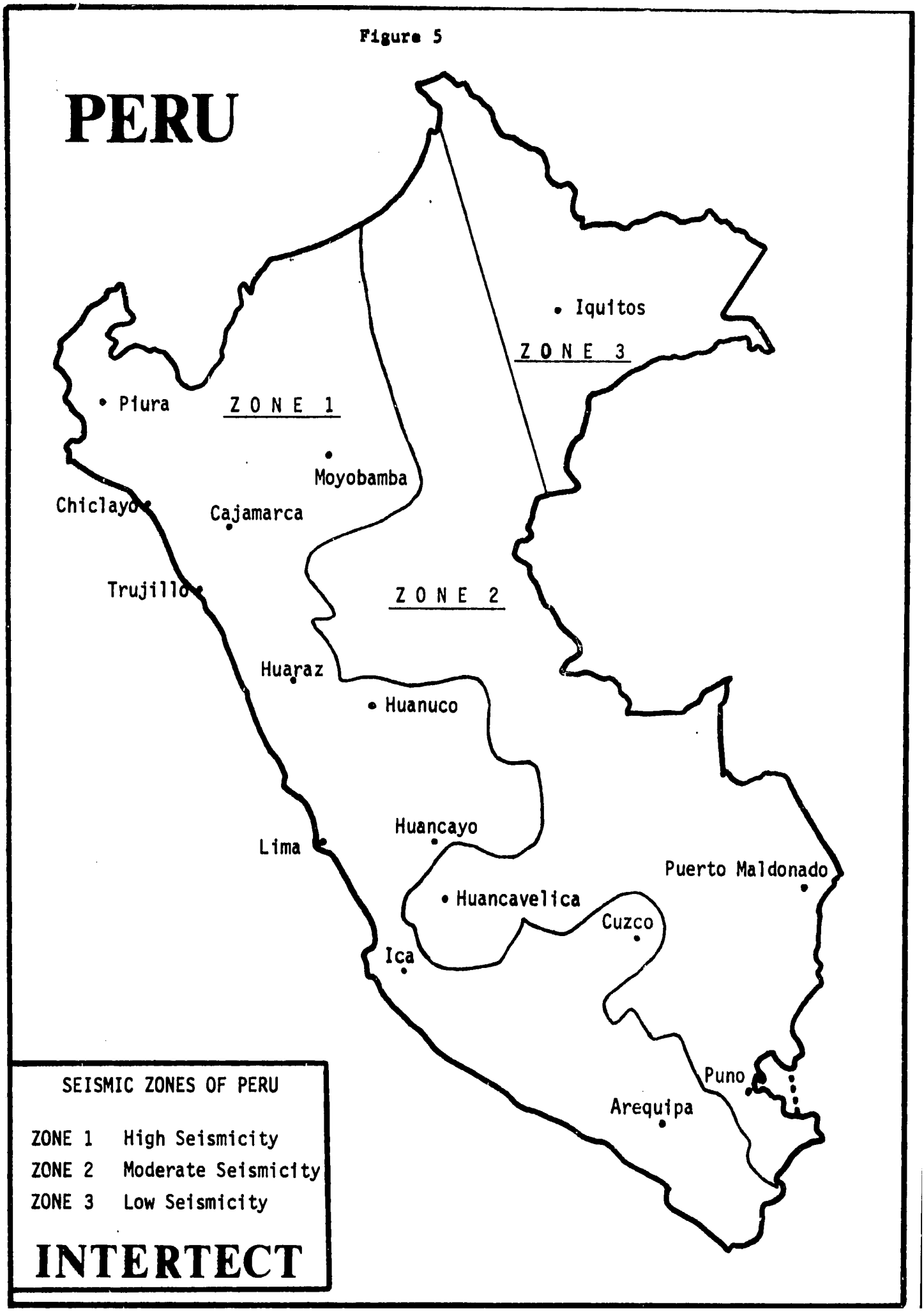
PRESIDENCIA DE LA REPUBLICA
INSTITUTO NACIONAL DE PLANIFICACION
ASESORIA GEOGRAFICA
CARTA SISMICA
MINISTERIO DE FOMENTO Y OBRAS PUBLICAS
ENERGIA LIBERADA POR SISMOS
MAS SUPERFICIALES QUE 400 km.
ESCALA: 1:7'500,000
SIGNOS CONVENCIONALES

Figure 5


PERU
Iquitos
ZONE 3
Piura
ZONE 1
Moyobamba
Chiclayo
Cajamarca
Trujillo
ZONE 2
Huaraz
Huanuco
Huancayo
Lima
Puerto Maldonado
Huancavelica
Cuzco
Ica
Puno
Arequipa
SEISMIC ZONES OF PERU
ZONE 1 High Seismicity
ZONE 2 Moderate Seismicity
ZONE 3 Low Seismicity
INTERTECT

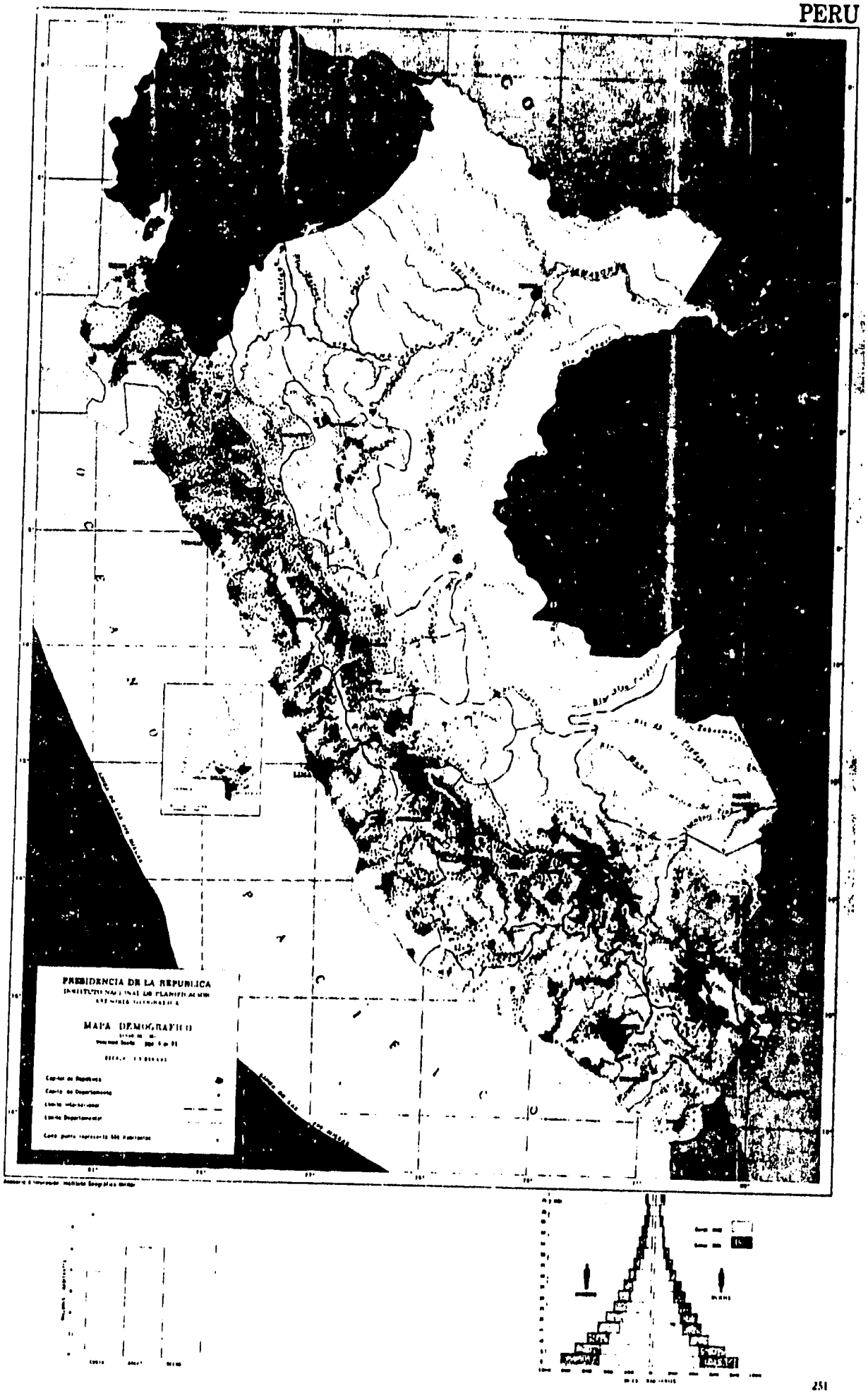



Figure 6