

# **Mining Districts: Exports & Transportation Infrastructure**

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## INTRODUCTION

In last few years the Colombian mining activity, in particular the one related to coal, gold, and ferronickel, has shown an important growing dynamics, both in its production and exports. Several products based on mineral supplies such as cement, coke and jewelry, in particular, have also shown a similar trend.

Being conscious of the country's potential for reaching a relevant mining development, the Unidad de Planeación Minero Energética - UPME, has assumed the task of evaluating the transportation infrastructure conditions used by the mining center and identifying the projects to be implemented for them, to be able to improve their productivity and competitiveness, and therefore, to increase their participation in national and international markets.

Throughout the development of this task, it was necessary to revisit the concept of mining district which had been used without enough rigour in several documents on the sector; consequently, the two first chapters of this text have been devoted to define the definition scope and to characterize the country areas that might be classified as districts. This subject is of high importance since in the latest economy statements, the role of the geographical regions has been outlined as an active and determining in the economic development processes as far as it has been stated that a country might compete in the globalization context provided that it has the region productive concentrations that include a range of interrelated and supplementary activities which contribute as a whole for the competitiveness of a region.

From the third chapter on, the subject of the transportation and port infrastructure has been addressed, by analyzing its incidence on the country's mining products competitiveness and evaluating the infrastructure conditions regarding roads, railroad, fluvial lines and ports, associated to the country mining developments. Then, the potential of the national territory coal district or regions were analyzed with regard to volume of reserves, production and marketing in order to build a possible market scenario for year 2010. After concluding that the coal offer in such scenario would rise to 76 mt with export of 69 mt, the main limitations and infrastructure alternatives that would be available for this product are identified and the highest priority projects are reported in order to facilitate and ensure the coal exports for the next two decades.

Lastly, it is important to highlight that most of the mining production figures used in this study correspond to year 2002 and not to a latest one, since it is about statistic data that are not generated periodically but of production figures per product and mining district obtained for this study directly from the mining contract files. For this reason, the updated production and export figures have been included as an attachment, consolidated per mining product and producer department.

We have thus met our purpose of sharing with the mining community the results of the analysis on a highly significant issue for the mining products exporters.

**CARLOS ARTURO FLÓREZ PIEDRAHITA**  
General Director

# 1. CONCEPT OF MINING DISTRICTS

The term “mining district” has been managed in Colombia in a very informal manner for making reference to a municipality or group of municipalities where a significant number of mining producers is located. In such sense, the objective of this chapter is to introduce some criteria that lead to define the scope of the concept “mining district”.

## 1.1. REGIONAL DEVELOPMENT AND MINING AGGLOMERATES

In commercial terms the primary products or basic commodities are those that come from the agriculture or mining that used to be traded in their natural form or with some degree of preparation. To a large or lesser extent all these products have been determining in the economy of the Latin American countries. Subsequently, and in particular in the 1950s and 1960s the analysts together with the governments believed that the Latin America exporter profile based on primary products was part of the problem to be corrected. It was believed that the future of the region was on a different the import substitution and exporting specialization profile, with emphasis on manufactured products, intensive workforce and technology use.<sup>1</sup>

However, many countries other than the so called third-world countries have opted decisively for the exploitation and the development of natural resources, improving their competitive advantages with increases in the productivity by means of technology incorporation. Also, it is clear that the producer and the less efficient countries shall get out of the market before than the more efficient ones.

### 1.1.1 The new economic geography

The question on why some countries are capable to grow faster and pull themselves up by the bootstraps and others don't has been one of the more studied and discussed concerns since the beginning of the economic history itself. With the globalization and the inconsistent behavior of the so-called emerging countries in the past, the economic development has been place again in the forefront as a discipline. In fact, the National Bureau of Economic Research of the United States, one of the most worldwide prestigious centers of economic research has emphasized on three growth defining basic aspects: foreign trade, economic geography and the institutions quality.

The latest theoretical concepts that have been developed in the last two decades outline the role of the worldwide space, geography and politics. For instance, they state that the

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<sup>1</sup> Ocampo, José Antonio. *Agglomeraciones Mineras y Desarrollo Local en América Latina (Mining Agglomerations and Local Development in Latin America)*. November, 2001

territory is no longer a simple passive scenario of economic activities but, on the contrary, an active and determining factor of the development processes; however, they warn that such trends have not arisen by spontaneous generation since they require clear, definitive policies and efficient institutions. It is more visible each time that in the globalization context the regional dimension gets as much importance as the supranational for it is regarded that the globalization processes have strong territorial basis.<sup>2</sup>

In practice, the “winners” territories of the global economy have been characterized by being spaces or urban-region hubs that have achieved agreements among their local agents on three main aspects of the territorial competitiveness:

- The creation of favorable conditions for investment and productive employment in a sustainable development frame.
- The generation of a favorable environment for innovation and technological development.
- The integration of policies and actions with regard to infrastructure and regional, national and international connectivity.

Consequently, the definition of productive regions and their treatment through a specific legal regime should become the instrument for taking advantage of the opportunities offered by both the enlarged market and the new agreements of commercial release that are being performed in the continent. In such order, the concept of “New Economic Geography” states that the economy growth of certain location obeys to the circular cause logic in which the scale growing yields and the backward and forward chaining of companies lead to the activities concentration that is reinforced progressively. According to experts, the worldwide experience shows that once the region obtains a high productive concentration, such pattern tends to be cumulative: the dominant regions acquires one location advantage, i.e., it generates an attractive for the companies due to the large number of producers that already have production there. In other words, the success explains the success. However, the cumulative processes have a limit due to the fact that the time comes when, against the efforts that work in favor of the agglomeration (external economies, chaining and dense labor markets) contrary forces start acting such as land prices and transportation costs, and also the external diseconomies (congestion and pollution). The interaction of these two forces gives shape to the economy space structure. The importance of the self-organized space processes based on the effects of agglomeration and externalities has been captured in the focus that outlines the importance of the physical geography or the natural surrounding in the territory economic growth. From such theoretical perspective, factors such as the distance between the regions and the coasts, the infrastructure, the soil quality and the natural resources, among others, become decisive factors.

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<sup>2</sup> Moncayo Jiménez, Edgar. *Geografía Económica de la Comunidad Andina (Andean Community Economic Geography)* in *New actors of integration*, Lima, 2003.



With regard to natural resources, new focuses have resulted that are reevaluating the concept that such properly exploited factors might contribute to development, as it has already occurred in Northern countries, Canada, Australia and New Zealand. One of the keys is becoming more industrial and processes the natural resources through “clusters” that in the event of exploitation of mining resources, benefit activities and mineral transformation get integrated with support (raw material suppliers, engineering services and equipment, training centers, etc.).<sup>3</sup> In such sense, a recent study of the World Bank points out that if a country rich in natural resources efficiently adopts the adequate technologies, it might grow in a similar way to those that support their growth in the industrial sector.<sup>4</sup>

The industrial or mining district might be defined as the productive system where a significant number of producers is located and devoted to manufacture or exploiting in different phases, the homogeneous product or a mineral or group of minerals. Such companies activity belong to the same production cycle with different strategic responsibilities. The “cluster” concept that has recently become popular, has repercussions related to the industrial district ones. As per Michael Proter’s: “The clusters are geographical concentrations of interconnected companies and institutions in certain sector, linked among them, which comprise a range of industries and other activities relevant to competitiveness. They have vendors of specialized supplies such as components, machinery, services and specialized infrastructure. Often, they extend forward to include the customer distribution channels and horizontally toward the supplement product producers and companies in sectors connected by technology, skills or common supplies. Likewise, many of them include government institutions and of other nature such as universities, standardizing agencies, research centers, union associations and vocational education centers”.

As it might be observed, the concepts such as chaining, externalities, proximity, association, networking, innovation, cooperation, etc., are implicit in the above definition.<sup>5</sup>

### 1.1.2 Regional competitiveness

The concept of competitiveness applied at national scale, emerged in the middle of the eighties’ in the United States as a matter centered in the link between the countries economic advance and their participation in international markets. The most known competitiveness definition states that it is “the country capacity to sustain and expand its

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<sup>3</sup> Ramos, Joseph, *Una estrategia de desarrollo a partir de los complejos productivos (clusters) en torno a los recursos naturales (A development strategy on the basis of clusters around the natural resources)*, CEPAL magazine No. 66, Santiago de Chile, 1998.

<sup>4</sup> World Bank, *From natural resources to knowledge economy*, Washington D.C. 2002.

<sup>5</sup> Porter, Michael E., *Clusters and the New Economic of Competition*, Harvard Business Review, 1998. Cited by Moncayo Jiménez, Edgar, *Geografía Económica de la Comunidad Andina*, en Nuevos Actores de la integración, Lima, 2003.

participation in international markets and simultaneously raise the population life level".<sup>6</sup> Other authors adapted the competitiveness concept to the productive sectors and activities and from them to the geographic regions.

For measuring the competitiveness capacity of the country regions, several methodologies have been designed with a representative number of applied cases. The common base for such measurements is the "Benchmarking" methodology which consists of the comparative evaluation on the economic performance of several regions by using certain criteria: sector structure, internationalization level, government quality, private management, infrastructure commodity, financial sector efficiency, science and technology and human capital.

### 1.1.3 Mining agglomeration and local developments in America

Several authors confirm that mining could become the development engine if an adequate set of local policies were implemented. Modern mining is an activity of intensive knowledge use and technological development which long-term competitiveness depends on the strengthening of the local innovation capacity. The economic and social development in the mining specialized places is also linked to the local learning capacity. The Comisión Económica para América Latina, CEPAL (Economic Commission for Latin America) has expressed the possibility of devising a sustainable development pattern and an industrialization process on the basis of the natural resources exploitation, strategy that is regarded as viable, and of special relevance to countries and locations that depend strongly on activities related to the natural resources exploitation.<sup>7</sup> The institution obviously, warns that it should not be regarded as excluding but supplementary to other strategies. In such way the concept that Latin America would not reach a satisfactory growing rhythm if it does not develop the endogenous technological capacity in state-of-the-art sectors and if it is not able to export intensive technology manufacturing has been reevaluated.

Several cases of mining concentrations are known in America. During the XX century Canada developed a large mining sector and a wide range of economic activities around mining. The basis of the Canada mining agglomeration is exploration, extraction and mineral processing. During the period 1995-1998 the total value of extracted minerals, excluding oil and natural gas, ranged between 18,300 and 19,400 million of Canadian dollars per year (approx. equivalent to 0.65-0.70 US dollar), i.e., about 2.3% of GDP<sup>8</sup>. The main minerals produced in Canada are copper, gold, iron ore, nickel, zinc, potash and coal. In the intermediate level there are cobalt, lead, platinum, silver, uranium, asbestos, peat, limestone, sand, gravel and

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<sup>6</sup> Commission Industrial Competitiveness Report. Washington, 1985

<sup>7</sup> Ocampo, José Antonio. *Aglomeraciones Mineras y Desarrollo Local en América Latina (Mining Agglomerations and Local Development in Latin America)*, CEPAL, Editorial Alfa Omega, Chile, 2001.

<sup>8</sup> Ritter, Archibad R.M. *La Aglomeración en torno a la Minería en Canadá: Estructura, Evolución y Funcionamiento (The Agglomeration around Canadian Mining: Structure, Evolution and Operation)*, en *Agglomeraciones Mineras y Desarrollo Local en América Latina*, Editorial Alfa Omega, 2001.

clay material. Together with the mining exploitation there are also mineral treatment and transformation plants that produce the industrial aggregated value products.

The strength in concentration and mining development in Canada resides in factors such as volume and diversity of mineral resources, the proximity to main markets, the close relation with technological research centers and the development of machinery and specialized equipment manufacturers related to mining companies. The financial sector and the information dissemination through the mining specialized press have also been important factors. Likewise, the public politics have played an important role in the sector development. The Canada Geologic Service was of great service by contributing with the basic geographic mapping using state-of-the-art technologies and hence fostering the production of exploration equipment, thus allowing that the Canadian companies might function with effectiveness worldwide.

At last, the productive agglomeration around the Canada mining and their companies have always been exposed to the competence of foreign companies and to the introduction of new technologies. Besides, they have had to compete subject to the strictest rules of environmental control and social policies which has obliged to a faster adoption of the best practices not only in the technical area for improving productivity but also in the environmental management and the compliance of the social requirements of local communities.

Another well known case is the Chilean mining sector, which generates 8% of GDP, being the 16% of the Capital gross and 46% of exports. The mining production grew in an annual mean of 11% throughout the last decade.<sup>9</sup>

Matters such as economic, technological, human resources education, availability of engineering companies and representatives of equipment manufacturers, regulatory and institutional work frames that are interconnected and gather feedback among themselves, have determined together an important long-term mining process in the Austral country.

Likewise, mining has been consolidated as one of the Peruvian economy engines. In Peru an entire range of minerals, mainly metallic, is being exploited. In 1995 this country became the second silver producer, the third in tin, the fourth in zinc and lead, the sixth in copper and the twelfth in gold. There are other activities around mining such as sale of equipment and supplies and mining services, and mineral commercial activities that contribute as a whole to disseminate the mining impact and to the country economy diversification.<sup>10</sup>

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<sup>9</sup> Katz, Jorge; Cáceres, Jaime; Cárdenas, Katia, *Dimensiones macro y mezo económicas en la evolución de la minería en Chile (Macro and intermediate economic dimensions in the Chilean mining evolution)* in *Aglomeraciones Mineras y Desarrollo Local en América Latina*. Editorial Alfa Omega, 2001.

<sup>10</sup> Kuramoto, Juana R. *Las aglomeraciones mineras en Perú (Peruvian mining agglomerations)* in *Aglomeraciones Mineras y Desarrollo Local en América Latina*. Editorial Alfa Omega, 2001.

## 1.2 CONCEPT OF MINING DISTRICT

### 1.2.1 Definition scope

For the preparation of the study on “Transportation and Port Infrastructure for the Mining Development in Colombia” it was necessary to define some territorial units that were committed with relevant mining activities and that could be exporting centers. The term that was regarded as the most adequate was mining district, in spite of the scope of its definition.

To this regard, it is appropriate to highlight that the mining district definition contained in the Mining Glossary effective in the country<sup>11</sup> is not easily applicable. Such definition, textually taken from the US Bureau of Mines (1996) states as follows: “Portion or country land area, generally designed by its name, which borders have been described and where there are minerals extracted according to the rules and regulations set forth by local miners. For the mining district definition there is not a border of the territorial extension and its property line might change provided that other nonintrusive rights”. On the contrary, in Colombia due to the fact that all soil and subsoil minerals are property of the State, the rules and resolutions are not set forth by the miners but by the State itself.

In the old company Mineralco, district mining was defined as such “region whose main economic activity is the exploitation of one or more minerals, organized in entrepreneurial units using local work force, in compliance with the sound development of their exploitations with technical, economic, social and environmental feasibility parameters for achieving its entire development that harmonizes the economic activities, the use of soil and subsoil with the community aspirations, the culture and the regional and national progress”.<sup>12</sup> However, this definition was never formally adopted, probably because it discarded a large number of country areas where mining is another economic activity but that have a significant mining potential and give origin to a large mineral production.

Due to above circumstances, it was necessary to define some criteria as a basis for the characterization, identification and selection of the country areas that could be ranked as mining districts.

### 1.2.2 Characterization of mining districts

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<sup>11</sup> Ministry of Mines and Energy, *Glosario Minero (Mining Glossary)*, Bogota, 2002.

<sup>12</sup> Mineralco S.A., Management Report 1994-1998 (preliminary version)

The criteria adopted in this study for identification of areas that could be regarded as mining districts included: a) the type of mineral material and the production volume, b) the level of mining concentration versus areas relatively homogeneous and uniform, and c) the mining tradition of local and regional communities.

To that effect the most representative minerals of the national mining production were identified with regard to the production volume that might be considered important from the marketing perspective of each of them. Then, the productive areas were located and the geographical zones that met the mining concentration criteria were identified. Nevertheless, due to limitations in the available statistics, the minimum geographical areas taken were the municipality jurisdictions where such zones were located.<sup>13</sup>

At first, 32 zones with mining activity relatively concentrated and 6 associated to prospectus of possible future development were identified. After analyzing each zone, only those that showed the characteristics that could have them considered as mining districts were

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<sup>13</sup> The characterization of selected zones was made on the basis of the secondary information obtained from mining sector entities and/or related with the project, which have been grouped by sources as:

Source 1: Ingeominas. The Mining Inventory made in 18 departments was consulted there.

Information was obtained on reserves, exploitation systems and market. Also, access was gained to the systematized data base and to the information on prospectus and potential mining areas.

Source 2: Minercol, Regional Management and Department Government that have received delegated functions from the Mining Authority. In such areas, the data from the annual production reports of the mining holders was taken, and in some cases with information on reserves, production, type of exploitation, of market, mainly. Likewise, the information on the projects being performed by the Programa para el Desarrollo de las Naciones Unidas - PNUD (United Nations Development Program) and Minercol in south Bolivar, in La Llanada municipality in Nariño and on the social fabric in the Cundi-boyacense high lands was consulted.

Source 3: In a third level several information sources were grouped, represented by following entities:

-Carbocol: documentation on coal reserves, production and markets

-UPME: studies on some minerals, prices and foreign trade information

-DANE, PROEXPORT, DIAN and IGAC as sources related to foreign trade information, geography and economic partner of departments and municipalities

-Production Unions (ANDI, ICPC, ASOGRAVAS and coal unions) for sector information

-Studies from consulting companies such as Hill & Associates, Geominas Ltda., ERS y Asociados on mining regions, production, prices, markets, etc.

-Ministry of Environment, Housing and Territorial Development, Office of Natural National Parks, for maps of the forestry reserve, natural national parks and flora and fauna sanctuaries

-Ministry of Interior, Office of races, for data base on Indigenous Shelters legally constituted in the country and areas of partialities and indigenous communities off the shelters

-Departamento Nacional de Planeación - DNP (National Planning Office): to obtain sector information and economic projections

-Ministry of Transport: to obtain information on the georeferenced infrastructure offer of transport and characterized according to the road inventory carried out by INVIAS in year 2002. Likewise, the cargo surveys of year 2001 were obtained which were used to identify the most important flow of mineral origin commodities to determine the basic road network.

-INVIAS: for information related to the road inventory and proposed and ongoing projects

-IGAC: for national physical-political map and department maps.

selected. Such zones or districts turned into 26 and comprise territories of 188 municipalities, as follows:

**Table 1.1 Mining districts, municipal jurisdictions and produced minerals**

District	Municipalities	Departments	Mining products
Barrancas	Barrancas, Maicao, Hato Nuevo and Albania	La Guajira	Coal
La Jagua	Becerril, El Paso, Codazzi, La Jagua and La Loma	Cesar	Carbon
Sabana de Bogota	Bogota, D.C., Bojacá, Chía Gachancipá, Guasca, La Calera, Madrid, Mosquera, Nemocón, Sibaté, Soacha, Sopó, Subachoque, Tabio, Tenjo y Tocancipá	Cundinamarca	Construction materials, clay, others
Paz del Río	Belén, Corrales, Duitama, Firavitoba, Iza, Jericó, Monguí, Nobsa, Paipa, Paz del Rio, Pesca, Santa Rosa de Viterbo, Socotá, Socha, Tasco, Tibasosa, Tópaga	Boyacá	Limestone, construction materials and others
Ataco-Payandé	Ataco, Chaparral, Coello, Coyaima, El Carmen de Apicalá, Espinal, Flandes, Guamo, Ibagué, Melgar, Rovira, Saldaña, San Luis and Valle de San Juan.	Tolima	Limestone, construction materials, and others
El Tambo-Dovio	Bolívar, Buenaventura, Buenos Aires, Buga, Bugalagrande, Caicedonia, Cali, Candelaria, El Dovio, El Tambo, Guacarí, Ginebra, Jamundí, Puerto Tejada, Sevilla, Suárez, Vijes and Yumbo	Cauca and Valle del Cauca	Limestone, construction materials, coal, gold, silver, platinum and others
Zipaquira	Cogua, Cucunubá, Guachetá, Lenguzaque, Samacá, Sutatausa, Tausa and Zipquirá	Cundinamarca	Coal, silica sand, salt and others
Amagá - Medellín	Amagá, Angelópolis, Fredonia, Itagüí, Medellín, Bello, Copacabana, Girardota, Titiribí and Venecia	Antioquia	Construction materials, coal, clay
El Zulia	Cúcuta, Chinácota, Chitagá, El Zulia, Los Pátios, Pamplona, Salazar, San Cayetano, Sardinata,	Norte de Santander	Clay, limestone, coal, phosphoric rock

	Tibú and Villa del Rosario		
Puerto Nare	Puerto Berrío, Puerto Triunfo, San Luis and Sonsón	Antioquia	Limestone, clay, ferrogineous clay
Western Antioquia	Abejorral, La Unión, Carmen de Viboral, Rionegro	Antioquia	Construction materials, limestone, kaolin and clay
Montelíbano	Buenavista, La Apartada, Montelíbano, Planeta Rica, Pueblo Nuevo and Puerto Libertador	Córdoba	Coal, ferronickel, gold and silver
Los Santos	Curití, Los Santos, Villanueva and Zapatoca	Santander	Gypsum, limestone
Northern Antioquia	Amalfi, Anori, Cáceres, Caucasia, El Bagre, Henchí, Maceo, Remedios, San Roque, Segovia, Tarazá and Zaragoza	Antioquia	Limestone, clay, gold
Frontino	Abriaqui, Anzá, Buriticá, Dabeiba, El Carmen de Atrato, Frontino, Murindó, Mutatá and Urrao	Antioquia	Gypsum, manganese, copper concentrate, gold, silver and platinum
Marmato	Mamato, Quinchía and Supía	Caldas and Risaralda	Gold and silver
Santa Rosa	San Pablo, Santa Rosa del Sur and Simití	Bolívar	Gold and silver
Istmina	Bagadó, Condoto, Istmina, Sipí and Tadó	Chocó	Gold, silver and platinum
South Pacific Coast	Barbacoas, Guapi, López de Micay, Magüí, Santa Bárbara (Iscuandé) and Timbiquí	Cauca and Nariño	Gold, silver and platinum
San Martín de Loba	San Jacinto de Achí, San Martín de Loba, Barranco de Loba, Río Viejo, Montecristi, Morales, Pinillos and Tiquisio	Bolívar	Gold and silver
La Llanada	Cumbitara, la Llanada, Los Andes, Mallama, Samaniego and Santacruz	Nariño, Nariño	Gold and silver
Vetas	California, Vetas	Santander	Gold and silver
Mercaderes	Almaguer, Balboa, Bolívar, Mercaderes and El Tambo	Cauca and Nariño	Gold and silver
Muzo	Coper, Briceño, La Victoria, Maripí, Muzo, Otanche, Pauna, Quipama, San Pablo de Borbur,	Boyacá and Cundinamarca	Emeralds

<b>Chivor</b>	Yacopí Chivor, Gachalá, Somondoco, Ubalá	Guateque,	Boyacá and Emeralds Cundinamarca
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## 2. AREAS CHARACTERIZED AS MINING DISTRICT

Having identified the country areas with highest mining concentration and ranking them as mining districts, their infrastructure conditions were analyzed in relation to their potential exportable development. For such purpose they were grouped in function to the production and export production.

### 2.1. DISTRICT RANKING

The examination of the 26 areas with mining district characteristics, in terms of reserves, production and target market, allowed to group them in categories from higher to lesser production volume, as follows:

Group I - Districts with production volume over 5 million tons per year.

Group II - Districts with medium-scale production, below 5 million tons per year.

Group III - Producing districts of precious metals and emeralds.

The following table shows the districts ordered as per the production volumes recorded in 2002 and the mineral branches, including intended market:

*Tabla 2.1 Distritos mineros y volumen de producción – exportación 2002*

Group	District	Production Volume 2002			Mining Product	Market	
		Total	By Prods	Unit		National	Exports
I	Barrancas	18,076,940	18,076,940	t	Carbón		19,315,0000
	La Jagua	16.427.000	16.427.000	t	Coal		15.722.000
II	Sabana de Bogota	4.817.973	2.716.944	t	Construction materials	X	
			2.041.920	t	Clay	X	
			59.109	t	Others	X	
	Paz del Río	3.704.903	1.725.505	t	Limestone	X	
			1.093.740	t	Coal	X	365.000
	Luruaco	3.576.153	689.687	t	Iron ore	X	
			195.971	t	Others	X	
			2.633.154	t	Limestone	X	
			917.685	t	Construction materials	X	
			25.314	t	Others	X	

Group	District	Production Volume 2002			Mining Product	Market	
		Total	By Prods	Unit		National	Exports
I	Barrancas	18,076,940	18,076,940	t	Carbón		19,315,0000
	Ataco-Payandé	3,158,872	1,903,263	t	Clay	X	
			948,349	t	Construction materials	X	
			307,260	t	Others	X	
	El Tambo-Dovio	2,384,440	1,237,050	t	Limestone	X	
			766,457	t	Construction materials	X	
			334,000	t	Coal	X	
			46,933	t	Others	X	
			302,993	g	Gold, silver and platinum	X	
	Zipaquirá	2,071,178	1,540,560	t	Coal	X	455,000
			241,466	t	Silica sand	X	
			191,554	t	Salt	X	
			97,598	t	Others	X	
	Amagá - Medellín	2,024,000	1,178,880	t	Construction materials	X	
			629,220	t	Coal	X	
			215,900	t	Clay	X	
	El Zulia	1,735,289	405,200	t	Clay	X	
			384,000	t	Limestone	X	
			929,000	t	Coal	X	657,400
			17,089	t	Phosphoric rock	X	
	Puerto Nare	1,633,508	1,528,498	t	Limestone	X	
			105,010	t	Ferruginous clay	X	
	Oriente Antioqueño	791,510	348,800	t	Construction materials	X	
			234,640	t	Limestone	X	
			208,070	t	Kaolin and clay	X	
	Montelíbano	163,079	119,000	t	Coal	X	
			44,079	t	Ferronickel		52,577
			6,741,158	g	Gold and silver		X
	Los Santos	204,919	111,919	t	Gypsum	X	
			93,000	t	Limestone	X	
	Nordeste Antioq.	66,486	66,486	t	Limestone, clay	X	
	Frontino	9,855,908		Gold		X	
		30,041	21,515	t	Gypsum, manganese	X	
			8,526	t	Copper concentrate		8,296
			269,794	g	Gold, silver and platinum	X	
III	Marmato		1,797,308	g	Oro y plata	X	
	Santa Rosa		1,597,214	g	Oro y plata	X	
	Istmina		996,279	g	Gold, silver and platinum	X	
	Costa Pacífica		378,752	g	Gold, silver and platinum	X	
	San Martín de Loba		294,179	g	Gold and silver	X	
	La Llanada		151,321	g	Gold and silver	X	
	Vetas		26,779	g	Gold and silver	X	
	Mercaderes		8,175	g	Gold and silver	X	
	Muzo		5,326,184	carat	Emeralds	X	
	Chivor		63,956	carat	Emeralds	X	

Source: Minercol-UPME, 2002

From this table it might be concluded that from the 26 mining districts only 3 have a full export component and they are the coal districts of Barrancas and La Jagua de Ibirico, as the district of Montelibano, ferronickel producer. Likewise, there are 3 districts with a lesser export component: El Zulia, Zipaquira and Paz del Rio, whose production of coking coal satisfies both the internal and export market. Below there are the 10 districts which assign almost all their offer to internal market: the Sabana de Bogota stands out among them with an important volume of construction materials intended for the demand at the country capital city; also the Luruaco district, in the north coast, where limestone derived products such as clinker and cement are exported. At last, there are 8 districts producers of precious metals and 2 of emeralds, which assign almost all their production to external markets.

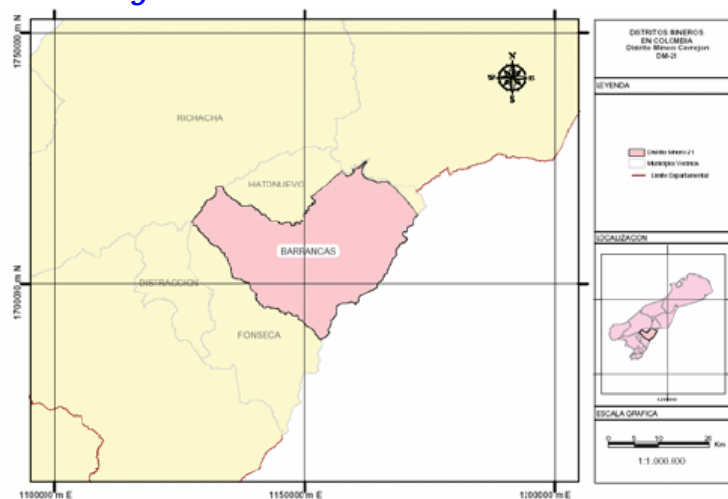
## 2.2 GROUP I - HIGH PRODUCTION VOLUME DISTRICTS

The areas or districts with a production above 5 million tons, exclusively destined to export are included in this group.

### 2.2.1 Barrancas District

This district is comprised of a 380 km<sup>2</sup> area, located between Cuestecitas del Norte and Ranchería river and the Cerrejoncito stream at south, and is comprised of the municipalities of Barrancas, Maicao, Hato Nuevo and Albania. The district mining activity is exclusively focused in production of thermal coal in the Tertiary Era formation of Cerrejón. The exploitation is open pit type with high yield and competitive costs due to the use of large capacity equipment that remove big volumes of material.

*Figure 2.1 Barrancas mining district*



Production and reserves. The Barrancas district has coals reserves of up to 3,933.3 mt and records a production that in year 2003 reached the amount of 22.6 mt which was entirely destined to the international market.

The mining operation in the aforementioned three blocks has been developed by the following companies:

In the Northern zone operates Carbones del Cerrejón LLC, company of the consortium by subsidiaries of BHP Billiton, Anglo American Plc and Glencore International AG, well known multinationals in the mineral and metal international market. The area has measured reserves of 3.000 mt of bituminous coal high in B type volatile, up to 300 m. depth<sup>14</sup>. The exploitation is open pit type with a production that in 2003 reached 16.5 Mt, equivalent to 72.8% of the total district production.

The Central Zone, located at the southeast of the Northern Zone has an extension of 100 km<sup>2</sup>. It has been divided in three sectors: Patilla sector, Sarahita sector and Oreganal - El Descanso sector. The measured reserves accounted for 670 Mt of bituminous coal high in B type volatile.<sup>15</sup> In 2001 the zone was granted by public bid to the consortium owner of Carbones del Cerrejón LLC. In addition to the integral mining exploitation carried out by this company, there is the operation at the Caypa mine in the area La Comunidad del Cerrejón, who holds the exploitation contract with Carbones Colombianos del Cerrejón S.A., in 350 ha. area. Said mine owns mineral reserves for 76 Mt at 250 mt depth. Its production in 2003 accounted for 6.1 Mt from which 5.3 Mt corresponded to Carbones del Cerrejón LLC and 800 kt to Carbones Colombianos del Cerrejón S.A., operator of La Comunidad area.

**Table 2.2 Barrancas district coal production, 1998-2004**

Project	1998	1999	2000	2001	2002	2003	2004
Northern zone	15.509	17.148	18.400	19.405	15.035	16.461	20.458
Carbones Colombianos del Cerrejón	1.180	800	800	800	833	800	601
Carbones del Cerrejón	3.160	1.200	2.900	3.000	1.625	1.857	2.307
Carbones del Cerrejón -Oreganal					584	1.113	1.181
Consorcio Cerrejón-Patilla						2.353	5.784
Total	19.849	19.548	22.100	23.205	18.077	22.584	24.547

Sources: Minercol and Ministry of Mines and Energy, Report to the Congress of the Republic 2004-2005

The Southern Zone, located at south of Palomino river, has an approximate extension of 325 km<sup>2</sup>. Such area is currently under exploration period and the results obtained show that coal levels are covered by 140 m width of alluvium. The exploration contract of this area was granted by bid to the international consortium of the subsidiaries of Glencore, Anglo American and BHP Billiton.

<sup>14</sup> Carbones del Cerrejón LLC

<sup>15</sup> idem

Projections. The coal offer projection in Barrancas mining district as shown below is the consolidation of the companies projections in the zone:

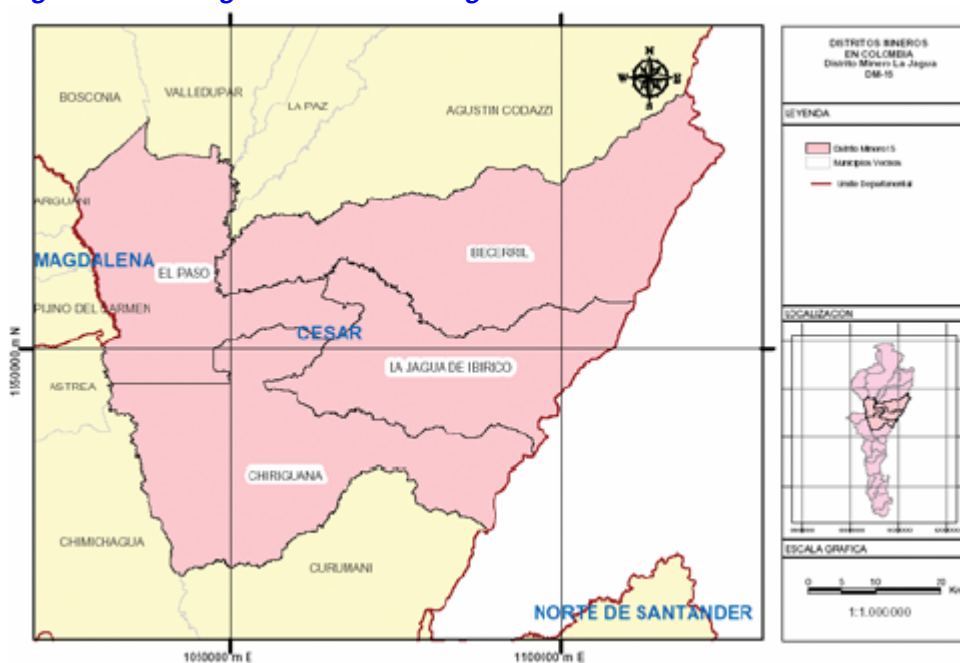
*Table 2.3 Coal offer projection of Barrancas mining district, 2004-2010 (Mt)*

Mining product	2003	2004	2005	2006	2007	2008	2009	2010
Coal	22.6	25.7	27.0	28.0	29.0	30.0	30.0	30.0

## 2.2.2 La Jagua de Ibirico District

This district is located in the center region of Cesar department in the municipalities jurisdiction of Becerril, El Paso, Codazzi, La Jagua and La Loma. Its mining activity has been focused toward the exploitation of the coal layers in Los Cuervos formation. From the structural geological perspective, this district has three different zones: La Jagua de Ibirico, formed by the synclinal with same name, and Alto de Becerril and La Loma, where there are three large structures known as synclinals of El Descanso, La Loma y El Boquerón.

*Figure 2.2 La Jagua de Ibirico mining district*



Production and reserves. The prevailing exploitation system in this district is the open pit type but the underground also applies. In year 2003 its total production accounted for 21.2 Mt split as follows: in La Loma the Drummond exploitation contributed with 77.4%, Carbones del Caribe 10.9%, Carboandes 6.6% and Consorcio Minero Unido 4%. The entire

district contributed with 42% of the total coal exploited in the country. The coal produced in this district are intended almost entirely to the external markets and only 400 thousand are intended for consumption of the cement producing plants in Barranquilla and Cartagena.

La Jagua area is located in La Jagua de Ibérico municipality and has an approximate extension of 24 km<sup>2</sup>. The measured reserves for this area amount to 258 Mt and it contains the medium scale exploitations with current productions between 1 million and 2.5 Mt which are being performed by the Colombian companies Carbones del Caribe S.A., Carboandes S.A. and Consorcio Minero Unido S.A.

La Loma area, located in the municipalities of Chiriguana, Becerril, El Paso (with La Loma village) and La Jagua de Ibérico, has an approximate extension of 570 km<sup>2</sup>. The measured reserves for this area are in: La Loma 460 Mt; El Descanso 800 Mt open pit and 700 Mt in underground mining; Similoa and Rincon Hondo 120 Mt and Sororia 12 Mt. In this area the Boquerón sector is under open pit exploitation of the Pribbenow mine of Drummond, which by its size is the second in the country, with a production that in 2003 exceeded the 16 Mt. In La Loma sector there are also El Hatillo and Calenturitas blocks. In El Descanso and Rincon Hondo sectors studies are being carried out for establishing the type of projects that might be developed there.

**Table 2.4 Thermal coal production in La Jagua mining district, 1988-2004 (kt)**

Company	1998	1999	2000	2001	2002	2003	2004
La Loma-Drummond	6.080	7.109	8.874	12.336	12.967	16.363	20.454
Carboandes	1.100	826	285	314	798	1.423	394
Carbones del Caribe	1.400	1.265	2.020	1.916	1.723	2.310	2.387
Consorcio Minero Unido	710	594	750	713	810	1.023	1.071
Otros	7	-	100	106	129	33	722
TOTAL	9.297	9.794	12.029	15.385	16.427	21.152	25.028

Sources: Reports to the Congress of the Republic 2004-2005, Ministry of Mines and Energy.

Projections. In conformity to the expansion plans stated by Drummond and by Carbones del Caribe, Carboandes and Consorcio Minero Unido, the production volume could increase to 193,4 Mt with an annual average of 27.6 Mt for the period 2004-2010. Such projections suggest that as of year 2008 the region would become in the leader of the Colombian coal production with an annual volume of 29.6 Mt which would increase to 34.8 Mt in 2010.

**Table 2.5 Coal offer projection of La Jagua district, 2004-2010 (Mt)**

Company	2003	2004	2005	2006	2007	2008	2009	2010
Drummond	16.4	18.0	19.0	20.0	22.0	24.0	26.0	28.0
Medium-scale	3.5	3.8	4.2	4.7	5.1	5.6	6.2	6.8

mining								
TOTAL	19.9	21.8	23.2	24.7	27.1	29.6	32.2	34.8

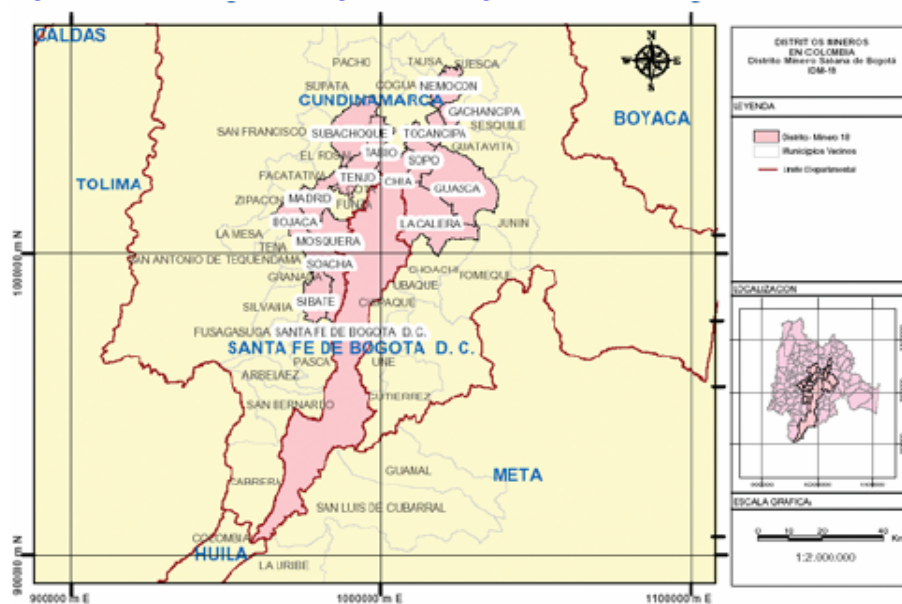
## 2.3 GROUP II. MEDIUM-SCALE PRODUCTION DISTRICTS

The 14 zones with a production volume below 5 million tons are included in this second group, but a good part of said volume is intended for export, such as the case of Montelíbano district, ferronickel producer, El Zulia, Zipaquira and Paz del Río who export metallurgical coal and Frontino who export precious metals.

### 2.3.1 Sabana de Bogota district

The geographic term “Sabana de Bogota” is comprised of the high Bogota river basin that extends from its source (Villapinzón Municipality) to the Tequendama fall (Bogota District). In turn, the mining district includes the mining activity areas located in Bogota Capital District and in the municipalities of Bojacá, Chía, Gachancipá, Guasca, La Calera, Madrid, Mosquera, Nemocón, Sibaté, Soacha, Sopó, Subachoque, Tabio, Tenjo and Tocancipá.

Figure 2.3 Sabana de Bogota mining district



The mining in this district is sustained mainly on the high demand of construction materials for the city of Bogota, D.C. and the surrounding municipalities. Nevertheless, limestone, silica sands, coal and salt, among others, are also exploited.

Construction materials. In this district there is wide production of construction materials which include concrete aggregates, mortar sands, materials for base and under pavements and rock blocks and plates for foundation and enchape. Said materials come from several sedimentary rocks in the formations of the Cretaceous and Tertiary Eras which are present in a large extension of the Sabana. The stone materials existing in modern fluvio-glacial deposits are also used.

According to existing records in Minercol,<sup>16</sup> the reserves of district construction materials have been estimated in 386.7 Mt and clays in 42.12 Mt which distribution per municipality is shown below:

*Table 2.6 Sabana de Bogota district reserves of construction material and clays in 2001*

Municipality	Construction materials (t)	%	Clay (t)	%
Bogota D.C	1.501.000	0,4	433.778	0,1
Bojacá	228.171.414	59,0	3.136.111	0,7
Chía	16.081.500	4,2	91.667	0,0
Gachancipá	2.240.793	0,6		
Guasca	4.796.800	1,2	371.612.780	88,2
La Calera	23.486.200	6,17		
Madrid	539.498	0,1		
Mosquera	17.151.900	4,4		
Nemocón			8.548.305	2,0
Sibaté	1.137.007	0,3		
Soacha	52.351.840	13,5	32.098.919	7,6
Sopó	552.090	0,1		
Subachoque	15.462.760	4,0		
Tabio	16.149.850	4,2	1.175.393	0,3
Tenjo			4.082.600	1,0
Tocancipá	7.042.027	1,8		
TOTAL	386.664.679	100,0	421.179.553	100,0

Source: Minercol, 2001.

For year 2002, the construction materials production for said district was estimated in 2.716.944 t and its distribution per municipality is shown in the following table:

<sup>16</sup> The reference to "records existing in Minercol" and alike that shall be found further, are referred to the exploitation reports submitted to such entity by the miners that were operating covered by the legal mining title.



*Table 2.7 Construction materials production in Sabana de Bogota mining district, 2002*

Municipality	Construction materials (t)	%
Bogota - Soacha	1.440.000	53,0
Chía	539.520	19,9
Madrid	189,617	7,0
Subachoque	266,282	9,8
Tabio	281,525	10,4
TOTAL	2.716.944	100,0

Source: UPME, 2002

As it might be observed above, 53% of the construction materials total volume is extracted from Bogota - Soacha area. In turn, Chía municipality contributes with 19.9%, Tabio with 10.4%, Subachoque with 9.8% and Madrid with 7%.

Clays. Clays exploited in Sabana de Bogota come mainly from Guaduas, Bogota, Usme and Regadera formations of Tertiary Era. Pursuant to Minercol records, in year 2001 the measured clay reserves accounted for 421.179.553 t and its production during 2002 increased to 2.041.920 t, as detailed in the following table:

*Table 2.8 Clay production in Sabana de Bogota mining district, 2002*

Municipality	Construction materials (t)	%
Bogota D.C.	582.820	28,5
Bojacá	47.000	2,3
Mosquera	44.900	2,2
Nemocón	573.700	26,3
Soacha	829.500	40,6
TOTAL	2.041.920	100

Source: Minercol, 2002

District projections. Taking into account only the construction materials and clay production, which are the most significant economic branches of the district mining activity, the projections have been made on the basis of the same growth rate foreseen for the construction sector, which is 7,6% annual average:

*Table 2.9 Offer projection of Sabana de Bogota mining district, 2004-2010 (Mt)*

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Construction Mat. (kt)	2.700	2.900	3.100	3.400	3.600	3.900	4.200	4.500	4.900
Clay (kt)	2.000	2.200	2.400	2.500	2.700	2.900	3.200	3.400	3.700
<b>TOTAL</b>	<b>4.700</b>	<b>5.100</b>	<b>5.500</b>	<b>5.900</b>	<b>6.300</b>	<b>6.800</b>	<b>7.400</b>	<b>7.900</b>	

### 2.3.2 Paz del Río District

This district includes the mining activity areas located in the municipalities of Belen, Corrales, Duitama, Firavitoba, Iza, Jerico, Mongui, Nobsa, Paipa, Paz del Rio, Pesca, Santa Rosa de Viterbo, Socota, Socha, Tasco, Tibasosa, Topaga, all of them in Boyacá department. The Paz del Río district is one of the regions that best fits in the mining district due to the variety of sedimentary minerals exploited, the reserve volume, the number of people linked to the mining activity and the amount of mining titles granted. Coal, limestone, phosphoric rock, iron ore, clays, pozzolanas and construction materials.

*Figure 2.4 Paz del Río district*



Coal. This district produces bituminous coal high in type B and C volatiles (Ingeominas)<sup>17</sup> and its measured reserves accounted for 126.87 Mt in 2002. The thermal and coking coal production constitutes the 29.5% of the region production. In 2002 the coal extraction amounted approximately to 1.1 Mt from which 68% were thermal coal and 32% coking coal. It has been estimated that the production is distributed among following markets: coking coal exports 0.35 Mt, coal for local consumption in cement, steel and power energy 0.65 Mt, and 0.10 Mt for the industry partial demand of Valle del Cauca, Antioquia and Tolima departments. The export records show that a bit more than 80% of coking coal was transported by road to Buenaventura port, for Perú, México and the USA, mainly. The remaining percentage was exported from Barranquilla and Santa Marta ports. The following table shows the coal production per municipality (year 2002) and its percentage share:

*Table 2.10 Construction materials production in Sabana de Bogota mining district, 2002*

	Municipality	Construction Materials (t)	%
	Corrales	117,120	10.7
	Iza	26,520	2.4
	Jericó	2,400	0.2
	Monguí	84,480	7.7
	Paipa	256,080	23.4
	Paz del Río	3,000	0.3
	Socha	156,060	14.3
	Socotá	110,448	10.1
	Tasco	162,600	14.9
	Tópaga	175,032	16.0
	<b>TOTAL</b>	<b>1,093,740</b>	<b>100.0</b>

The small-scale traditional coal mining techniques and low production volume are predominant in this district. The report on the program "Recovery of the social fabric of Cundiboyacense high lands coal mining zones" shows that for 2002, 49% of mines in Boyacá hold a production below 200 t/month; 35% between 201 and 500 t/month and 8% between 501-1000 t/month.

Limestone. The limestone extraction represented 46.6% of total district production in 2002. Said rock is used as raw material for cement and steel region industries. According to Minercol reports, the measured reserves of limestone were of 128.240.9 kt in 2002. In such year the limestone production accounted for 1.725.5 kt among the municipalities of Nobsa, Tibasosa and Duitama:

<sup>17</sup> Ingeominas. *Inventario Minero Departamento de Boyacá (Boyacá Department Mining Inventory)*, 1999.

*Table 2.11 Limestone production in Paz del Río mining district, 2002*

	Municipality	Clay (t)	%
Nobsa		972,383	56.4
Duitama		104,687	6.1
Tibasosa		648,435	37.6
<b>TOTAL</b>		<b>1,725,505</b>	<b>100.0</b>

Pozzolana. The ore deposits are located in the municipalities of Paipa and Iza. According to Minercol information, for year 2001 the existing reserves in Iza totaled 10,397.9 kt and in 2002 its production accounted for 169.34 kt. From Paipa deposits no reserves have been known since they are in the exploration stage. Pozzolane is absorbed by the zone cement plants for the production of pozzolanic cements.

Phosphoric rock. The deposits in this district are associated to sand facies sedimentary rocks of the Superior Cretaceous. For year 2001 the district reserves had been estimated in 20,000 kt with a P<sub>2</sub>O<sub>5</sub> content above 20%, from which 4,000 kt corresponded to Iza zone and 16,000 kt to Pesca. During 2002 the region total production was 23 kt and it was entirely destined to the fertilizer producing local industries.

Iron ore. It is located in a sedimentary deposit of oolitic iron at the Chicamocha river basin, which extends along 20 km between Paz del Río and Sativanorte municipalities. The mineral reserves were estimated in 31,710 kt for 2001. The exploitation is being carried out by Acerías Paz del Río S.A. and with 690 kt/year represents the 18.6% of total district production.

Projections. In Table 2.12 the results of the district mining offer projection are shown, made under following assumptions:

Coal: the average growth rate of 13.8% for Cundinamarca department production during 1998-2003 was used.

Limestone: it was projected assuming the 7.6% growth, used for national construction sector.

Pozzolana: the same assumption for limestone projection was used.

Phosphoric rock: the parameter used was the national GDP projected growth as: year 2003: 3.6% (actual), year 2004: 4%, year 2005: 5%, year 2006: 5.5%, years 2007-2010: 6%).

Iron: production was projected using the 7.2% rate registered in 1998-2002.

**Table 2.12 Offer projection of Paz del Rio mining district, 2003-2010**

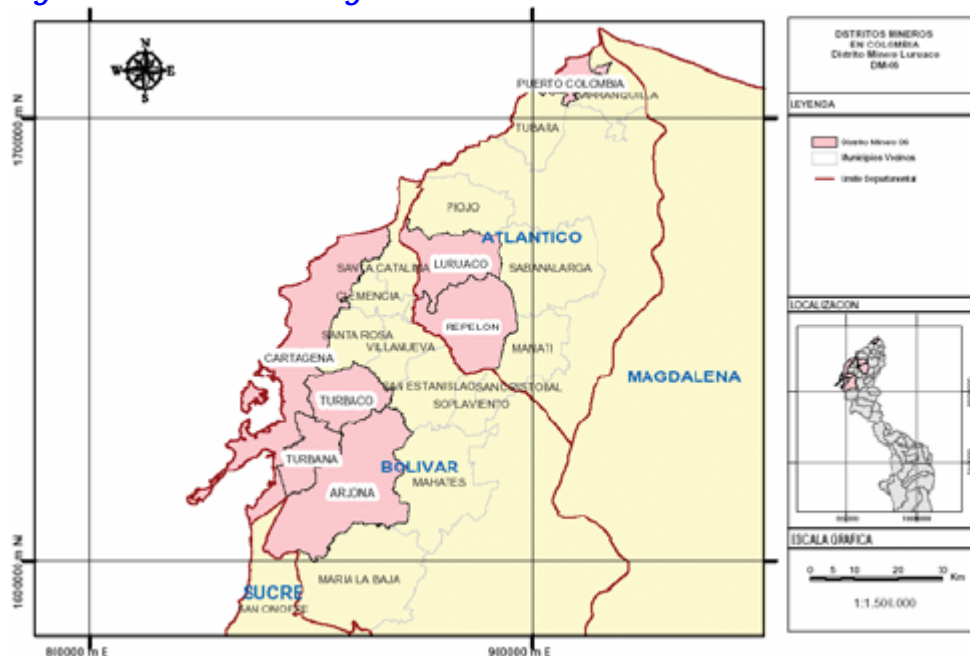
Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Coal (kt) Limestone (kt)	1,094	1,244	1,416	1,612	1,834	2,087	2,376	2,704	3,077
Puzolana (kt)	1,726	1,857	1,998	2,149	2,313	2,489	2,678	2,881	3,100
	169	182	196	211	227	244	263	283	304
Iron (kt) Phosphoric Rock (kt)	689 23	739 24	793 25	850 26	911 27	976 29	1,047 31	1,122 33	1,203 35

### 2.2.3 Luruaco District

This district covers the mining activity of limestones, construction materials and clays that takes place in Luruaco, Repelon and Puerto Colombia municipalities in Atlantico Department and in the municipalities of Turbana, Turbaco, Arjona and Cartagena in Bolivar Department.

For year 2001 the measured limestone reserves accounted to 705 Mt, approximately. In 2002 the extracted volume was 2.6 Mt equivalent to 74% of the district production. Said limestone is almost fully transformed in clinker and cement, products that are destined to the Atlantic region and abroad markets. In 2002 2.4 Mt of clinker and cement were exported by Colclinker S.A. in Cartagena and Cementos del Caribe S.A. in Barranquilla, companies with own export docks and adjacent to their producer plants. Main purchasing countries were Panamá, Dominican Republic, United States of America, Haiti and Surinam.

**Figure 2.5 Luruaco mining district**



Construction materials recorded in 2002 a 917 Kt production and the coralline rock and clays 59 Kt, volume that represent the 26% of the district mining production. The clays are fully destined to local production of oven brick. Extracted construction materials mainly commodity the Cartagena and Barranquilla markets. The coralline rock is sold in local sawmills for finished products.

The following table shows the reserves measured by mining product and municipality existing at year 2001, according to Minercol records:

**Table 2.13 Limestone, construction materials, coralline rock reserves of Luruaco mining district, 2001**

Municipality	Limestone (kt)	%	Clay (kt)	%	Construction Materials (kt)	%	Coral Rock (kt)	%
Luruaco	5.674	0,8						
Pto. Colombia	23.908	3,4	350.000	1,6	17.257	17,7 20,7		
Repelón					20.200			
Cartagena	132.335	18,8	20.910	96,2	20.770	40,3		
Turbaco Turbaná	306.269 236.489	43,5 33,6	481.480	2,2	39.225	21,3	20	100,0
<b>TOTAL</b>	<b>704.677</b>	<b>100,0</b>	<b>21.741</b>	<b>100,0</b>	<b>97.452</b>	<b>100,0</b>	<b>20</b>	<b>100,0</b>

District projection. The limestone, clay, construction materials and coralline rock production related to the construction sector behavior, was projected on the basis of the forecast made for such industry which estimates an average annual rate of 7.6%. Table 2.14 shows the results of the mining offer projection of Luruaco district for the period 2003-2010.

**Table 2.14 Offer projection of Luruaco mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Limestone (kt)	2.633	2.833	3.049	3.280	3.530	3.798	4.086	4.397	4.731
Clays (kt)	25	27	29	31	33	36	39	42	45
Construction Materials (kt)	918	987	1.062	1.143	1.230	1.323	1.424	1.532	1.649
Coral Rock(t)	367	395	425	457	492	529	570	613	659

### 2.3.4 Ataco-Payandé district

This district is comprised of the mining activity zone located in the Tolima municipalities of Ataco, Chaparral, Coello, Coyaima, El Carmen de Apicala, Espinal, Flandes, Guamo, Ibaguè,

Melgar, Rovira, Saldaña, San Luis and Valle de San Juan. The mining portfolio is relatively varied: limestone, construction materials, gypsum, marble, feldspar, gold and silver.

Precious materials. Gold and silver mining in this district is associated to the reaving of alluvium deposits and mud flows. There is no information on these metals reserves. The production reported in 2002 of the municipalities that form part of the district was of 128.62 kg of gold and 0.11 kg of silver, equivalent to 0.5% of the national precious metal production.

**Figure 2.5 Ataco-Payande mining district**



Gypsum. Gypsum deposits of this district consist on irregular lenses and bands of variable thickness inside the Mesozoic sedimentary rocks. For the deposit exploited in Valle de San Juan municipality reserves were estimated in 1.284 kt. In year 2002 the gypsum mines reported a production of 5.68 Kt destined to commodity the internal demand of construction sector.

Limestone. Black mycrite and ferruginous limestones are exploited in this district. The first ones have been reported in San Luis municipality with 153.783 kt reserves. In 2002 the district reported the limestone production of 1.903 kt. Most of this production is used in cement manufacturing and a low percentage is consumed by constructors and lime producers.

*Table 2.15 Construction materials and precious metals production in Ataco - Payandé mining district, period 2002*

Municipality	Materiales Construcción (kt)	%	Clay (kl)	%	Gold(kg)	%	Silver (kg)	%
Ataco					127.3	99,0	29	26,0
Chaparral					1.0	0,8	84	74,0
Coello	6.609	-	82.312	,0				
Coyaima					0.2	0,2	-	-
Carmen de Apicalá	129.600							
Espinal	320.000	98,8		-				
Guamo	487.452							
Ibagué	3.664	1,2	1.800	,0				
Valle de San Juan		-	24.000	-				
TOTAL	948.349	100,0	208.112	100,0	128.5	100,0	113	100,0

Construction materials and clays. The exploitation of construction materials (sand, gravel and clay) is being performed in volcanic and sedimentary origin deposits, including recent alluviums. According to data reported to Minercol, this district has construction material reserves of 121.159.7 kt and 15.130.4 kt of clays, among which there are various types of clays and ferruginous. During 2002 the construction material production was of 948.34 kt and 208.11 of clay.

Feldspar. Feldspar mines of this district are related to pegmatitic dams in Batolito de Ibagué. The mineral reserves account for 4.680.89 kt only for Ibagué. From this place also a production of 71.67 kt was reported also in 2002.

Projections. For the mining offer projection of the district it was taken into account that the gold and silver shall grow at a rate equivalent to the average registered during the period 1998-2003, which is equivalent to 10.1% and 5.5%, respectively. For clays, gypsum, limestone and construction materials related to the construction sector, the production was projected with the forecasted growth rate for said sector, which is 7.6% annual average. For feldspar the GDP18 projections were used. The following table shows the results of projections:

<sup>18</sup> %GDP-year: 3.6-2003, 4.0-2004, 5.0-2005, 5.5-2006, 6.0-2007 to 2010



**Table 2.16 Offer projection of Ataco - Payande mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	128	141	156	171	189	208	229	251	277
Silver (kg)	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Plaster (kt)	6	7	7	8	8	9	9	10	10
Construction Materials. (kt)	948	1.020	1.796	1.932	2.079	2.237	2.407	2.590	2.787
Clays (kt)	208	223	241	259	279	300	323	348	374
Feldespato (kt)	72	75	78	81	86	91	97	102	108
Limestone (kt)	1.903	2.048	2.203	2.371	2.551	2.745	2.953	3.178	3.419

### 2.3.5 El Tambo - Dovio district

This district is comprised of the mining activity zones of the municipalities of Bolivar, Buenaventura, Buga, Bugalagrande, Caicedonia, Cali, Candelaria, El Dovio, Guacari, Ginebra, Jamundí, Sevilla, Yumbo and Vijes in Valle department and Buenos Aires, El Tambo, Puerto Tejada and Suarez in Cauca department. From these areas important volumes of limestone and constructions materials are extracted and in less scale coal, bentonite, magnesite and feldspar.

**Figure 2.6 El Tambo - Dovio mining district**



Construction materials. The main sources used in this district for stone and compacted fills aggregated production are the igneous rocks present in the Central and Western mountain chain; in turn, the alluvial depositions and washout material are for the production of sand and

stone aggregated. Residual soils developed on the basis of basalts and other volcanic rocks, as well as of clay layers of some sedimentary formations, are the source of the clays used in the brick production.

In the Mining Inventory of Valle del Cauca carried out by Ingeominas in 1999, the 89% of the inventoried mines were of construction materials. According to the reports submitted to Minercol by the mining title holders of the district, in year 2001 the reserves of construction materials amounted 416.479.2 kt. In turn, the production of such materials during the 2002 period was of 766.45 kt.

Limestone. The limestone extracted in the district come from Vijes Formation, sedimentary sequence that outcrops in the east border of the Western mountain chain to the north of Cali city. According to Minercol records, for year 2001 the reserves accounted for 17.034 kt in the deposit located in Vijes municipality. It has been estimated that the production was 1.237 kt for year 2002. Such limestone is destined mainly to commodity the region cement industry requirements.

Coal. The coal zone located along the east border of the Western mountain chain, between Yumbo in Valle del Cauca department and El Tambo in Cauca department. Coals are found in the formations Guachinte and Ferreira of the Superior Tertiary Era and are classified as bituminous high in volatile and dashes type c. For year 2003 the coal reserves of Valle del Cauca and Cauca departments were estimated in 41.450 kt, distributed in the surroundings of the municipalities of Cali, Yumbo, Jamundí, Buenos Aires and El Tambo.<sup>19</sup>

The departments of Valle del Cauca and Cauca constitute the seventh coal producing region of the country, however, in the last six years they show a continuous declination in production volume. After registering volumes of up to 400 kt, the 2003 production only reached 269 kt. Paradoxically, the thermal coal demand for Valle del Cauca industry is higher than the region offers; therefore, the consumption need should be supplied with coal produced in Cundinamarca, Boyacá and Antioquia departments.

Precious metals. The auriferous deposits of Valle del Cauca department are related to the igneous activity of the Central mountain chain and the sedimentary accumulations in the Pacific Basin of the Western mountain chain.<sup>20</sup> The gold vein corresponds to an enriched stripe which corresponds to the contact zone of the Ginebra mountain range with Batolito of Buga, which is exploited in Ginebra, Buga and Guacarí (Central mountain chain). There are also deposits of precious materials associated to alluvial deposits of the west side of the Western mountain chain, in particular in the basins of Anchicayá, Raposo, Calima and Aguaclara rivers.

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<sup>19</sup> Ingeominas, *El carbon colombiano, reservas, recursos y calidad (Colombian coal, reserves, resources and quality)*, 2004

<sup>20</sup> Ingeominas, *El inventario minero del Departamento del Valle del Cauca (Valle del Cauca department mining inventory)*, 1999

The volume of the precious metals reserves existing in the district is unknown. The registered production for 2002 was of 303 kg and represents 1.13% of the national production of precious metals. Such production, segregated by metal and municipality is shown below:

*Table 2.17 Precious metals production in El Tambo - Dovio mining district, 2002*

Municipality	Gold (kg)	%	Silver (kg)	%	Platinum (kg)	%	Total (kg)	%
Bolívar	1,66	0,6	-	-	-	-	1,66	0,6
Buenaventura	13,95	4,8	0,004	0,1	2,57	100,0	16,53	5,5
Buga	35,74	12,2	-	-	-	-	35,74	11,8
Cali	28,31	9,7	-	-	-	-	28,31	9,3
Candelaria	104,78	35,7	-	-	-	-	104,78	34,6
El Dovio	5,04	1,7	-	-	-	-	5,04	1,7
El Tambo	4,69	1,6	1,60	21,9	-	-	6,29	2,1
Ginebra	0,33	0,1	-	-	-	-	0,33	0,1
Jamundí	1,66	0,6	-	-	-	-	1,66	0,5
Suárez (Cauca)	96,92	33,1	5,68	78,0	0,003	-	102,61	33,9
<b>TOTAL</b>	<b>293,12</b>	<b>100,0</b>	<b>7,29</b>	<b>100,0</b>	<b>2,58</b>	<b>100,0</b>	<b>302,99</b>	<b>100,0</b>

**Magnesite.** The magnesite deposit in exploitation is associated to the Complejo Ultramáfico de Bolívar, located in the east side of the Western mountain chain. According to Minercol records, the magnesite reserves estimated for such deposit amounted 214.65 kt in 2001 and the production for the same year was of 33.23 kt. The production is fully destined to the national market.

**Manganese.** The manganese deposits of this district are located at the west basin of the Western mountain chain and are constituted by groups of manganese minerals (pyrolusite, rhodochrosite, and rodonite) which are interestraticados with coal shales from Formation Cisneros of the cretaceous era. Minercol records show that in 2001 the estimated manganese reserves were of 320.858 t. in Buenaventura. The production recorded in 2002 was 535 t. and it was destined as commodity for the automobile battery producing plants.

**Bentonite.** This variety of clay was originated in this region due to the alteration of the volcanic dash levels in Formation La Paila of the Superior Tertiary. According to Minercol records the reserves were of 619.92 kt in 2001 in Bugalagrande. Its production, in the same period, totaled 13.16 kt.

**Projections.** The district shows a diversified mining portfolio and for the offer projection different criteria were applied, as follows:

For gold and silver the average growth rates registered for national production during the period 1998-2003, were used, i.e. 10.1% and 5.5%, respectively.

For limestone and construction materials the projected growth rate for the construction industry was used, i.e. 7.6% annual average.

For magnesite, manganese and bentonite the same rate of the GDP21 growth forecasts was used.

For coal the same negative trend registered during the period 1998-2003 was applied, which it has been expressed at a -4.9% annual average rate.

**Table 2.18 Mining offer projection of El Tambo - Dovio mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	293	323	355	391	430	474	522	575	633
Silver (kg)	7	7	8	8	9	9	10	10	11
Limestone (kt)	1.237	1.331	1.432	1.541	1.658	1.784	1.920	2.066	2.223
Construction Materials (kt)	766	824	887	954	1.027	1.105	1.189	1.279	1.376
Magnese (kt)	33	34	36	38	40	42	45	47	50
Coal (kt)	0,5	0,5	0,6	0,6	0,6	0,7	0,7	0,8	0,8
Manganese (kt)	13								
<b>Bentonite (kt)</b>	334	308	293	279	265	252	240	228	217

### **2.3.6 Zipaquira district**

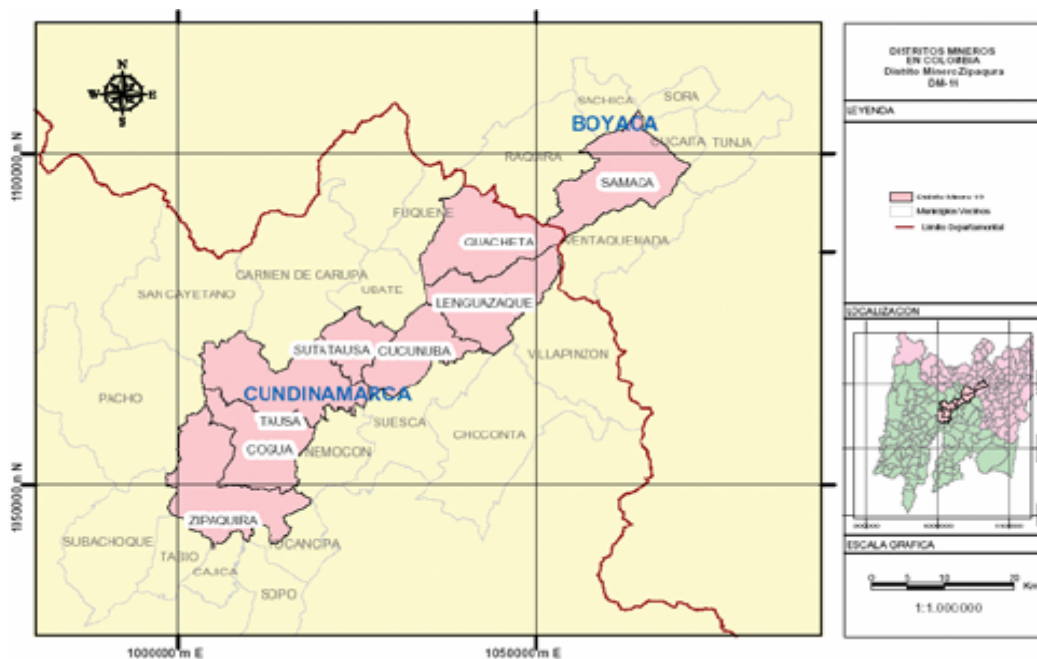
The Zipaquira mining district is comprised of the municipalities of Cogua, Cucunuba, Guacheta, Lenguazaque, Sutatausa, Tausa and Zipaquira in Cundinamarca department and Samaca in Boyacá department, where coals, sands, salt and other mineral products are produced.

Coal. Coals of this district are at the Guaduas Formation of the cretaceous-tertiarius era. The most interesting deposits are located in a large structure named Checua - Lenguazaque synclinal, which extends from Cogua to Samacá. The measured coal reserves that the district had in 2002 were distributed as follows:<sup>22</sup>

**Figure 2.7 Zipaquira mining district**

<sup>21</sup> %GDP-year: 3.6-2003, 4.0-2004, 5.0-2005, 5.5-2006, 6.0-2007 to 2010

<sup>22</sup> Ingeominas. *El carbon colombiano, reservas, recurso y calidad (Colombian coal, reserves, resources and quality)*, Bogota, 2004



**Table 2.19 Resources and basic measured coal reserves in Zipaquirá mining district, 2002**

Sectors	Coal (t)	%
Zipaquirá - Neusa	1.640.000	0,7
Guatavita-Sesquilé-Chocontá	21.900.000	9,4
Checua - Lenguazaque	176.110.000	75,7
Suesca-Albarracín	32.920.000	14,2
<b>TOTAL</b>	<b>232.570.000</b>	<b>100,0</b>

In 2002 the coal production accounted for 1.540.56 kt from which the thermal coal represented the 68% and the coking coal the remaining 32%. Cucunuba generated the 37.2% and Samacá, Tausa and Gacheta contributed with 40%. It has been estimated that the installed production capacity of the district could be around 2.8 Mt, with two shifts working, since in year 1992 it reached a production of 1.8 Mt with one shift.

**Table 2.20 Coal production of Zipaquirá mining district, 2002, per municipality**

Sectores	Coal (t)	%
Cogua	13.080	0,8
Cucunubá	573.480	37,2
Guachetá	200.040	13,0
Lenguazaque	147.000	9,5
Samacá	227.040	14,7
Sutatausa	111.900	7,3
Tausa	210.840	13,7
Zipaquirá	57.180	3,7
<b>TOTAL</b>	<b>1.540.560</b>	<b>100,0</b>

The largest amount of thermal coal is destined to the region market. The other part (375 kt approximately in 2002) is destined to satisfy the industry demand in Valle del Cauca, Tolima and Antioquia. Coking coal is mostly used to produce coke which is destined to the national market and to some international markets. In year 2002, 455 kt were exported mainly to Peru, Mexico and United States.

Salt. The most important salt mines in Colombia are located at the central latitudes of the Eastern mountain chain. The Zipaquira salt mine is in this district. It is a rock salt deposit between sedimentary levels of the Chicaque formation of the cretaceous era. According to Ingeominas<sup>23</sup> at the beginning of the 1990s the proved salt reserves totaled 22.000 kt. and its production for 2002 was of 191.5 kt.

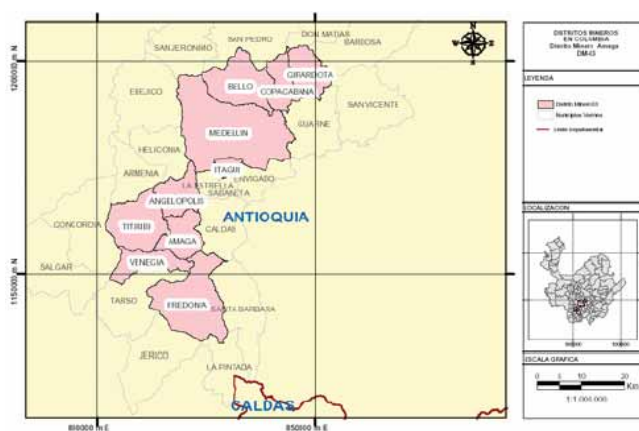
**Table 2.21 Mineral offer projection of Zipaquira mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Coal (kt)	1.541	1.754	1.996	2.271	2.584	2.941	3.346	3.808	4.333
Salt (kt)	192	200	210	221	233	247	262	278	294

## 2.2.7 Amaga - Medellin district

The mining zones of the municipalities of Amaga, Angelopolis, Bello, Copacabana, Fredonia, Girardota, Itagui, Medellin, Venecia and Titiribi are included in this district. The coal exploitations of Amaga and construction materials of Medellin are characteristics of the district.

**Figure 2.8 Amaga - Medellin district**



<sup>23</sup> Ingeominas. *Minerales estratégicos para el desarrollo de Colombia 1994-1995 (Strategic minerals for Colombia development)*, 1994

Coal. Coal deposits of the district are located in the Sinifana basin (formerly known as the Amaga - Venecia - Albania subzone), inside the Amaga formation of the tertiary era. They are thermal coals and are classified as sub-bituminous type a. They are locally affected by andesitic silos, changing its range to anthracitic coals. With regard to Minercol and Ingeominas records, for year 2002 the measured coal reserves amounted 90.060 kt, distributed by municipalities as shown below:

**Table 2.22 Coal reserves in the Amaga - Medellin mining district**

Sectors	Coal (t)	%
Amagá – Angelópolis	11.840	13,1
Fredonia	8.940	9,9
Titiribí	11.330	12,9
Venecia	57.950	64,3
<b>TOTAL</b>	<b>90.060</b>	<b>100.0</b>

The coal production was 629.22 kt in 2002. Nevertheless, in conformity to the historic department production, it has been estimated that the installed production is of 1.139 kt/year for the period 1994-2002. The following table shows the production segregated by municipalities:<sup>24</sup>

**Table 2.23 Coal production in Amaga - Medellin mining district, 2002**

Sectors	Coal (t)
Amagá – Angelópolis	11.840
Amagá	380.760
Angelópolis	28.800
Fredonia	72.600
Titiribí	120.540
Venecia	26.520
<b>TOTAL</b>	<b>629.220</b>

According to Minercol records, the coal mine production scale of the district is disclosed with following indicators:

The company Industrial Hullera S.A. exceeds the production level of 150 kt/year.

Four companies: Carbones San Fernando S.A., Carbones Nechí S.A., Carbones y Minerales S.A. and Mina La Margarita Ltda., produce more than 60 kt/year.

Seven companies produce more than 10 kt/year.

Fourteen companies produce more than 1 kt/year.

<sup>24</sup> %GDP-year: 3.6-2003, 4.0-2004, 5.0-2005, 5.5-2006, 6.0-2007 to 2010

The 75% of thermal coal produced in the district is consumed by the cement plants and other region industries. The remaining 25% is destined to Valle del Cauca industry and occasionally small volumes are exported from Buenaventura, for instance, 10 kt were exported in year 2003.

Construction materials and clays. The sources of stone aggregated and other materials used in construction are the recent alluviums from Medellín river, the sandstones of Amaga formation and amphibolites that outcrop at north of Medellín. The clays used in brick production come from residual soils derived from igneous rocks also and from clayey levels of the Amaga formation.<sup>25</sup> Most of the construction materials produced in the district are used for Medellín city demand.

According to Minercol records, there were proved reserves of 673.779 kt of construction materials and 18.680 kt of clay in 2001. In turn, during year 2002 the production of construction materials increased to 1.179 kt and of clays to 216 kt.

**Table 2.24 Construction materials production and clays in Amaga - Medellín mining district, 2002**

Sectors	Coal (t)	%	Clays (t)	%
Amagá	43.200	3,70	29.900	13,90
Angelópolis	-	-	168.000	77,80
Bello	538.880	45,70	-	-
Medellin	268.000	22,70	-	-
Copacabana	50.400	4,30	-	-
Itagüí	-	-	18.000	8,30
Girardota	278.400	23,60	-	-
<b>TOTAL</b>	<b>1.178.880</b>	<b>100,00</b>	<b>215.900</b>	<b>100,00</b>

Projections. In order to project the coal production the factor that reflects production during 1998-2003 period, such as the annual growth rate of 2.8% was used. Taking into account that the production of clay and construction materials is pulled by the construction sector behavior, the average annual growth rate of 7.6% foreseen for the sector was used.

**Table 2.25 Offer projection of Amaga - Medellín mining district, 2003-2010**

Mining product	2002 Real	2003 Real	2004	2005	2006	2007	2008	2009	2010
Coal (kt)	630	780	802	824	847	871	895	921	946
Clays (kt)	216	324	250	269	289	311	335	361	388

<sup>25</sup> Ingeominas, *Inventario Minero Departamento de Antioquia (Antioquia department mining inventory)*, 1996



## 2.2.8 El Zulia district

This district includes the mining production zones of coal, clay, limestone, phosphoric rock, among others located in the municipalities of Cucuta, Chinacota, Chitaga, El Zulia, Los Patios, Pamplona, Salazar, San Cayetano, Sardinata, Tibu and Villa del Rosario, located in Norte de Santander department.

Coal. El Zulia district is the fifth country coal producer. Coals outcrop in sedimentary formations of Tertiary (Cuervos and Carbonera formations) and are both thermal and metallurgic (bituminous varieties high in volatile type A and bituminous high in volatile type C).<sup>26</sup> The most important productive zone is located between Astilleros at the north and La Don Juana at the south, in an approximate length of 55 km. It is followed in importance by Tasajero hill.

*Figure 2.9 El Zulia mining district*



According to Ingeominas and Minercol information, in 2002 the resources and basic measured coal reserves were estimated in 68 Mt, which at current pace allows maintaining the production for the next 45 years. Its production reached the record volume of 1.3 Mt in 2003, which represents an increase of 40% versus 2002. The region coal community has estimated that with the current entrepreneurial structure a production near 1.900.000 t might be reached.

<sup>26</sup> Ingeominas, 1981 and 1987

**Table 2.26 Coal production, internal consumption and exports of El Zulia mining district, 1998-2004**

Year	1998	1999	2000	2001	2002	2003	2004
Production (kt)	960	787	760	929	906	1.600	1.283
Apparent Consumption (kt)	440	262	336	57	249	531	210
Exports (kt)	520	525	424	872	657	1.069	1.073

In general, coal of this district has two destinations: international market and local consumption. As it might be observed in Table 2.26, in year 2003 exports got close to 1.1 Mt, amount that represents 67% of the total production. From exported volume, 67% corresponds to thermal coal and 33% to metallurgic coal. The local consumption is given by Termotasajero and by brick and ceramic producing industries.

Export coal is sent by road to Maracaibo lake, Venezuela. For such purpose, the roads Cucuta - Puerto Santander - Orope - La Ceiba are used; also Cucuta - Ureña - La Fria - La Ceiba. Coal export through Venezuela cross the border in Cucuta and Puerto Santander. In both cases these are complex operations that could be facilitated by the construction of a new international bridge. As an alternate route it has been suggested the combined transportation Cucuta - Atlantic Coast, using the Cucuta-Ocaña-Gamarra road and the Magdalena river.

Phosphoric rock. It corresponds to phosphate facies in the sedimentary formations of the Inferior Cretaceous of Eastern mountain chain. The phosphatic mineral is carbonate-fluorapatite, which gives the rock the P<sub>2</sub>O<sub>5</sub> contents, ranging between 15% and 36%. According to Ingeominas, the phosphoric rock reserves in Sardinata deposit are about 9.000 kt, from which 2.000 kt are of non-meteorized rock with an average content of 17% of the P<sub>2</sub>O<sub>5</sub>. The production reported to Miinercol for year 2002 was 17.09 kt. Said phosphoric rock is traded as fertilizer in the national market.

Limestone. There are several outcrops of good quality limestones in Paleozoic or Cretacic sedimentary formations. According to Miinercol records, the limestone reserves estimated in 2001 were about 95.000 kt. In turn, for year 2002 the limestone production was of 384 kt in all the district.

Clay. Clay deposits are related to sedimentary formations of the Superior Tertiary that outcrop in large extensions of Cucuta, El Zulia and San Cayetano, among others. There are no calculations on clay reserves of the region. In year 2002 the production volume was 405.2 kt, destined to manufacturing ceramic products such as bricks, tablets and moldings.

Projections. Offer projections for the most important four mining products of the district were made by using the growth rates: for coal the average growth rate registered in the department for the period 1998-2003 was used, i.e., 8.2% annual. For phosphoric rock the

projected growth rate for GDP was used.<sup>27</sup> For clays and limestone the average annual growth rate projected for the construction sector, which is 7.6% annual.

**Table 2.27 Offer projection of El Zulia mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Coal (kt)	929	1301	1.408	1.523	1.648	1.783	1.930	2.088	2.259
Phosphorus Rock	17	17	18	19	20	22	23	24	26
Limestone (kt)	384	413	445	479	515	554	596	641	690
Clays (kt)	405	436	469	505	543	584	629	676	727
TOTAL	1.735	2.167	2.340	2.526	2.726	2.943	3.178	3.429	3.702

## 2.2.9 Puerto Nare district

**Figure 2.10 Puerto Nare mining district**



This district is formed by territories of the municipalities of Puerto Berrio, Puerto Nare, Puerto Triunfo, San Luis and Sonson. It stands out for the abundant reserves of marble and limestone, raw material for the production of cement and lime. It also produces ferruginous clays also used as commodity in the cement industry.

The most important limestone deposits of the district are located at the Antioquia zone of the middle valley of Magdalena river and are constituted by the white-grey marble type limestones, included in metamorphites of the Paleozoic era.

<sup>27</sup> %GDP-year: 3.6-2003, 4.0-2004, 5.0-2005, 5.5-2006, 6.0-2007 to 2010

According to Minercol records, for 2001 measured limestone reserves were 977.87 Mt distributed as shown in Table 2.28. In Puerto Triunfo location there are also ferruginous clays exploitation but their reserves are unknown.

**Table 2.28 Limestone reserves of Puerto Nare mining district at 2001**

Sectors	Coal (t)	%
Puerto Nare	822.139	84,1
Puerto Berrío	15.000	1,5
Puerto Triunfo	850	0,1
San Luis	303	0,0
Sonsón	139.584	14,3
<b>TOTAL</b>	<b>977.877</b>	<b>100,0</b>

The limestone production registered in 2002 increased to 1.528.5 kt and ferruginous clays to 105 kt. Its distribution per municipality is shown below:

**Table 2.29 Limestone and clay production in Puerto Nare mining district, 2002**

Sectors	Limestones (t)	%	Ferruginous Clays	%
Puerto Nare	143.190	9,4	-	
Puerto Berrío	405.000	26,5	-	
Puerto Triunfo	-	-	105.010	100,0
San Luis	-	-	-	
Sonsón	980.308	64,1	-	
<b>TOTAL</b>	<b>1.528.498</b>	<b>100.0</b>	<b>105.010</b>	<b>100,0</b>

In 2002, 97% of production was destined to local market for supplying the region cement producing plants, of lime or grinding and powdered. The remaining 3% was gross sold for other uses, mainly for ornamental rock.

Projections. As of the 2002 production, and under the assumption that it was a construction sector related mineral, it was projected that limestone production should grow at an average rate equal to that sector, which is estimated in 7.6% annual. Resulting projections are shown in following table:

**Table 2.30 Production projection of Puerto Nare mining district 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Limestones (kt)	1.528	1.645	1.770	1.904	2.049	2.205	2.372	2.552	2.746

## 2.2.10 Oriente Antioqueño district

This district includes the mining activity zones located in the municipalities of La Unión, Carmen de Viboral, Rionegro and Abejorral. Kaolin and clays production stands out in the district, it supplies the region ceramic industry.

Kaolin and clays. Kaolin production is developed in La Union and Rionegro, while clay is in Abejorral and La Union. According to Minercol records, measured kaolin reserves in 2001 were 1.962.9 kt and clay of 1.208.51 kt. The largest part of kaolin and clays is destined to ceramic plants located in Medellin and in less proportion it is powdered and exported to countries such as Venezuela, Ecuador, Mexico and Dominican Republic.

*Figure 2.11 Oriente Antioqueño mining district*



Limestone. Minercol records indicated 28.000 kt limestone reserves in Abejorral for 2001. Production registered in 2002 was 234.64 kt and it was fully destined to the cement production.

Construction materials. Materials construction of the district come from alluvium deposits, mainly. According to Antioquia government, the proved construction materials reserves were 5.869.8 kt for 2001, most of them located at La Union and Rionegro. Said materials were traded at La Ceja, Rionegro, Guarne and Medellin.

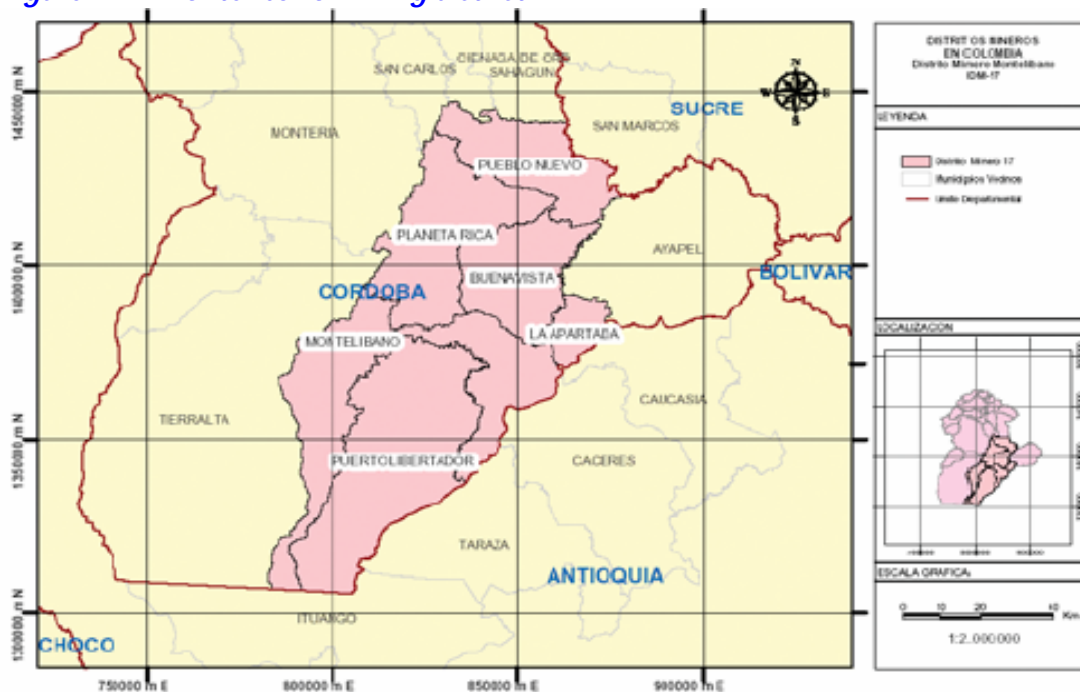
Projections. For projecting kaolin, limestone and clays offer the annual average growth rate of 7.6% was used, which is the same one for the national construction sector. The result of the mining offer for the district is the following:

**Table 2.31 Offer projection of Oriente Antioqueño mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Kaoline (kt)	78,8	84,8	91,2	98,2	105,6	113,7	122,3	131,6	141,6
Clays (kt)	129,2	139,1	149,6	160,9	173,2	186,3	200,5	215,7	232,2
Limestones (kt)	234,6	252,4	271,6	292,3	314,5	338,4	364,1	391,8	421,6
<b>TOTAL (kt)</b>	<b>442,6</b>	<b>476,3</b>	<b>512,4</b>	<b>551,4</b>	<b>593,3</b>	<b>638,4</b>	<b>664,1</b>	<b>739,1</b>	<b>795,4</b>

## 2.2.11 Montelibano district

**Figure 2.12 Montelibano mining district**



This district cover the mining activity zones located at the municipalities of Buenavista, La Apartada, Montelibano, Planeta Rica, Pueblo Nuevo and Puerto Libertador of Cordoba department. The Cerromatoso nickel mine and others of gold, silver and coal are in these areas.

Ferronickel. The largest mining wealth of the district are the nickeliferous laterites of Cerromatoso, material that in a lesser amount is also found in Ure and Planeta Rica areas. The Cerromatoso deposit is constituted by peridotites in process of laterizacion, when nickel

substitutes magnesium or iron in the olivine structure and is concentrated in the meteorite rock, together with iron and less quantities of aluminium and chromium. According to Ingeominas information, the nickel reserves for year 2002 totaled 49.768 kt. with an average content of 2%.<sup>28</sup>

Currently, the Cerromatoso S.A. plant nominal capacity is of 55 kt, which makes it the largest worldwide ferronickel producer. Its production reached 48.8 kt in 2004 and it was fully exported to the countries of the European Union and Asia, such as Taiwan, South Korea, Japan and China.

Coal. There are three coal areas in Cordoba department, located in the municipalities of Puerto Libertador, Montelibano and San Carlos. Coals are found in Ciénaga de Oro and Cerrito formations, of the Oligocene and Miocene eras, respectively, and they are classified as sub-bituminous type B and C.<sup>29</sup> According to the Ingeominas preliminary information, in 2002 the coal resources and measured reserves totaled 381.000 kt. In last years, the coal production has ranked from 63 kt to 204 kt, production volume considered marginal if compared with other country regions. This coal is entirely destined for supplying the Cerromatoso ferronickel plant and the Caribbean cement industry.

Precious metals. The geological - mining information available on the auriferous production of the district is scarce, but it is known that the mining activity has concentrated on the high and medium basin of San Jorge river, in Juan Jose, Pica Pica and Bocas de Ure villages and in the basin of San Pedro stream, at the southeast part of the department.

Minercol production records show for year 2002 the production of 5.476 kg of gold and 1.264 kg of silver, which represent in total 25.5% of national production. The production per municipality is shown below:

**Table 2.32 Precious metals production in Montelibano mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Total (kg)	%
Buenavista	2.239,45	40,9	772,47	61,1	3.011,92	44,7
La Apartada	452,41	8,3	0	0,0	452,41	6,7
Montelibano	0,10	0,0	0	0,0	0,10	0,0
Planeta Rica	1.860,30	34,0	433,47	34,3	2.293,77	34,0
Pueblo Nuevo	651,18	11,9	19,27	1,5	670,46	9,9
Puerto Libertador	273,20	5,0	39,27	3,1	312,47	4,6
<b>TOTAL</b>	<b>5.476,66</b>	<b>100,0</b>	<b>1.264,49</b>	<b>100,0</b>	<b>6.741,15</b>	<b>100,0</b>

<sup>28</sup> Ingeominas. *Inventario Minero del Departamento de Córdoba (Cordoba department mining inventory)*, 2000

<sup>29</sup> Ingeominas. *Inventario Minero del Departamento de Córdoba (Cordoba department mining inventory)*, 2000

Projections. The mineral production of the district was made taking into consideration that gold and silver shall grow at a rate equal to the average annual growth registered during the period 1993-2003, which was 10.1% for gold and 5.5% for silver. For projecting the coal production the annual average growth rate registered during the period 1998-2003 of 3.8% was used. For ferronickel the projections provided by Cerromatoso S.A. were used. The following table shows the projections obtained for the whole district mineral offer:

**Table 2.33 Offer projection of Montelibano mining district, 2004-2010**

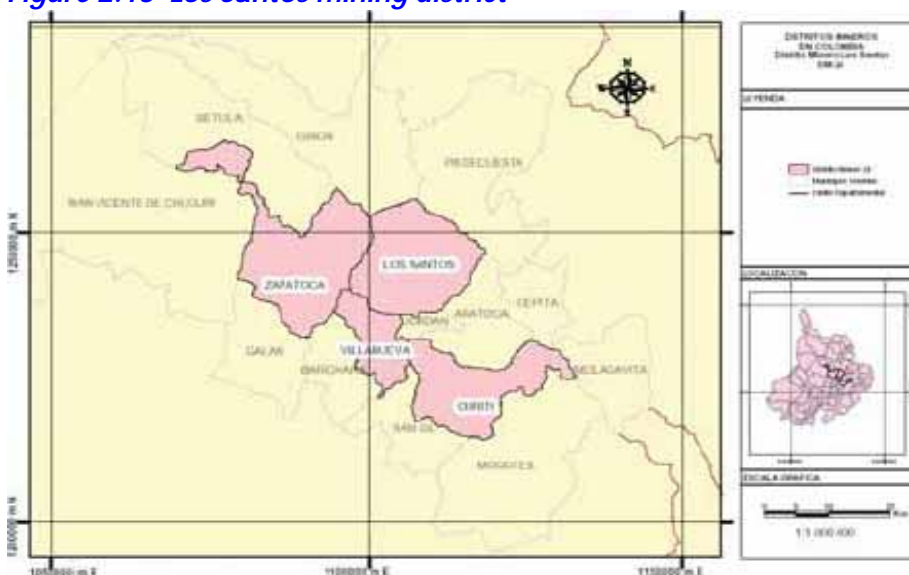
Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold(kg)	5.476	6.030	6.639	7.309	8.048	8.860	9.755	10.741	11.825
Silver (kg)	1.265	1.334	1.407	1.485	1.566	1.653	1.744	1.839	1.941
Ferroniquel (kt)	44	48	49	52	54	54	53	53	53
Coal (kt)	119	204	212	220	228	237	246	255	265

### 2.2.12 Los Santos district

This district includes the mining activity zones of the municipalities of Curiti, Los Santos, Villanueva and Zapatota in Santander department and is specialized in gypsum and limestone production for cement industry.

Gypsum. It comes from the sedimentary deposits located in the formation rocks of Los Santos, Rosa Blanca and Paja. According to Minercol records, in 2001 the reserves of the deposits located in Los Santos were 7.796.29 kt. In 2002 its production was close to 112 kt and it was destined to the cement companies such as Cemex, Cementos Boyacá, Cementos Paz del Rio and others of Antioquia.

**Figure 2.13 Los Santos mining district**





Limestone. Banks or layers of limestone outcrop in Rosa Blanca, La Paja, Simiti and Tablazo formations, which form one stripe in the western borders of the Eastern mountain chain. Data reported to Minercol register for 2002 an annual limestone production of 93 kt destined almost entirely to cement factoring.

Projections. Gypsum and limestone production was projected by applying the annual growth alike the forecasted for the construction industry, which is 7.6%.

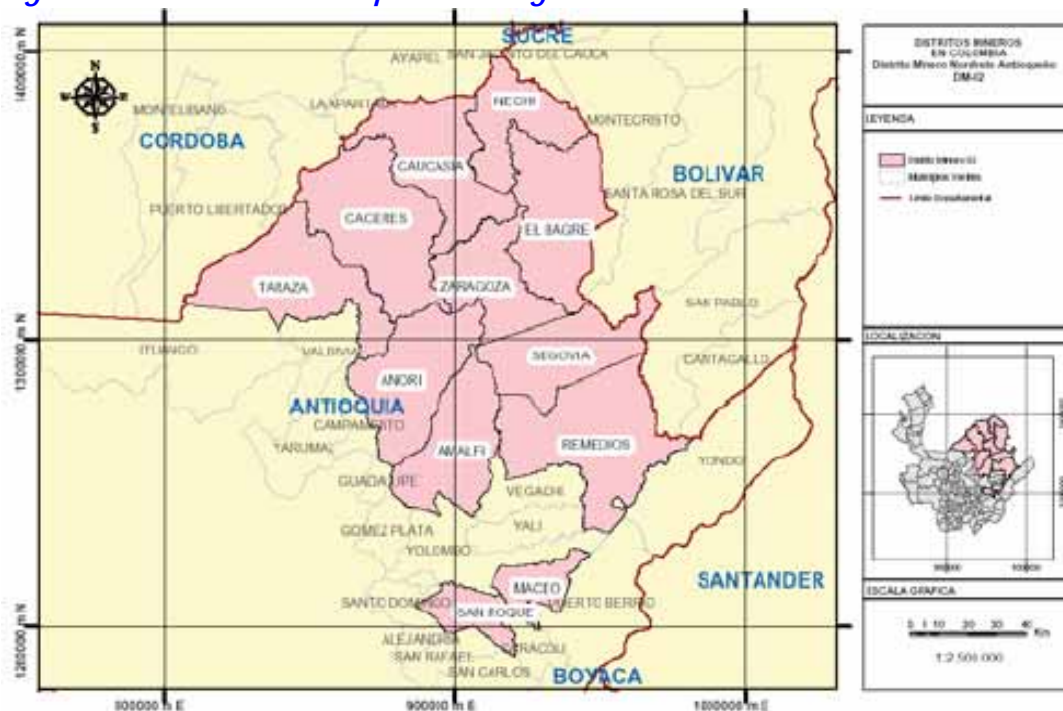
**Table 2.34 Offer projection of Los Santos mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gypsum (kt)	112	120	130	139	150	161	174	187	201
Limestone (kt)	93	100	108	116	125	134	144	155	167

### 2.2.13 Nordeste Antioqueño district

It is comprised of the mining activity zones located in the municipalities of Amalfi, Segovia, Remedios, Anori, San Roque, Maceo, Caucasia, El Bagre, Zaragoza, Nechi, Taraza and Caceres. The main mining products of the district are the precious materials (gold, silver and platinum) of which it is the largest national producer, followed by clays and limestones.

**Figure 8.14 Nordeste Antioqueño mining district**



Precious metals. At the northeast zone of the Central mountain chain, between Segovia and Remedios, the main vein deposits of Antioquia department and also there are important alluvium deposits over the borders of Nechi and Cauca rivers.

The auriferous veins are embedded in the Paleozoic metamorphic rocks of Grupo Valdivia and in igneous rocks of Batolito Antioqueño of the cretaceous era.<sup>30</sup>

At the lower region of Cauca, which includes the municipalities of Taraza, Cáceres, Caucasia, Nechí and El Bagre, there are large deposits associated to alluviums whose age goes from neogene to recent times. In such alluvium deposits there are also small amounts of platinum which possibly have a genetic relation with the ultramafic bodies that are present in the Central mountain chain.

Minercol records indicated that in 2001 the measured reserves of auriferous mineral were 146.12 Mt. They have been located in 6 from the 11 municipalities of the district, as it is shown below:

**Table 2.35 Auriferous mineral reserves in Nordeste Antioqueño mining district, 2001**

Municipality	Coal (t)	%
Amalfi	81.670,30	55,9
Remedios	139,21	0,1
Segovia	1.099,03	0,8
El Bagre	62.172,00	42,5
San Roque	4,55	0,0
Zaragoza	1.037,18	0,7
<b>TOTAL</b>	<b>146.122,27</b>	<b>100,0</b>

In 2002 the district registered a production of 6.290.9 kg of gold, 2.102.2 kg of silver and 2.6 kg of platinum for a total of 8. 395.7 kg of precious metals. In the national context the production is equivalent to 31.3% of the registered for precious metals in the whole country.

**Table 2.36 Precious metals production of Nordeste Antioqueño mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Platinum (kg)	%	Total (kg)	%
Amalfi	7,71	0,1	2,92	0,1	0	0,0	10,63	0,1
Anorí	3,20	0,1	0,54	0,0	0	0,0	3,74	0,0
Cáceres	1.817,43	28,9	102,29	4,9	0	0,0	1.919,73	22,9
Caucasia	17,33	0,3	0,33	0,0	0,145	5,6	17,81	0,2
El Bagre	1.018,81	16,2	259,72	12,4	2,464	94,4	1.281,00	15,3
Maceo	415,74	6,6	192,63	9,2	0	0,0	608,37	7,2
Nechí	4,92	0,1	0,32	0,0	0	0,0	5,25	0,1
Remedios	196,06	3,1	185,63	8,8	0	0,0	381,69	4,5
San Roque	3,98	0,1	2,33	0,1	0	0,0	6,31	0,1
Segovia	828,23	13,2	562,51	26,8	0	0,0	1.390,74	16,6
Tarazá	1.435,70	22,8	684,94	32,6	0	0,0	2.120,64	25,3

<sup>30</sup> Ingeominas. *Inventario Minero del Departamento de Antioquia (Antioquia department mining inventory)*, 1999

Zaragoza	541,75	8,6	108,02	5,1	0	0,0	649,78	7,7
<b>TOTAL</b>	<b>6.290,91</b>	<b>100,0</b>	<b>2.102,23</b>	<b>100,0</b>	<b>2,60</b>	<b>100,0</b>	<b>8.395,75</b>	<b>100,0</b>

Mining activity in the municipalities of Segovia, Remedios and Amalfi is being performed by Frontino Gold Mines and Minas La Bramadora. In Nechi and El Bagre, Mineros de Antioquia S.A. works with alluvial deposits. In turn, the small companies and individuals with less organization, exploit the alluviums in Caucasia, Caceres and Taraza.

Limestones and clays. A lenticular shape limestone deposit in metamorphic rocks of Precambic Age is exploited in Amalfi. Such limestone contains 99% of CaCo<sub>3</sub>, although in some sites it becomes dolomitic.<sup>31</sup> Due to its low iron content it is destined to glass, ceramic and lime industries. The deposits of transported clays are used in Amalfi and Segovia because their low iron content is very appreciated for the ceramic industry.

Minercol records indicate that in 2001 the measured limestone reserves were of 616.54 kt and of 624.9 kt of clay. Likewise, for 2002 the registered production was 38.35 kt of limestones and 28.13 kt of clays.

Projections. As of 2002 projection, the district mining offer volume was projected on the basis of following criteria: for gold an annual average growth of 10.1% during the projection period was assumed. For silver the annual average growth of 5.5% was assumed. For platinum, although the production volume is very linked to the alluvial gold, it was considered that the registers for 2002 remain constant during the projection horizon. For clays and limestones related to the construction industry, the average annual rate of 7.6% foreseen for the growth of said sector was used. The resulting projections are shown in following table:

**Table 2.37 Offer projection for Northeast Antioqueño District, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold(kg)	6.290,9	6.926,3	7.625,8	8.396,0	9.244,1	10.077,7	11.205,7	12.337,4	13.583,5
Silver (kg)	2.102,1	2.217,8	2.339,7	2.468,4	2.604,2	2.747,4	2.898,5	3.057,9	3.236,1
Platinum (kt)	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6	2,6
Clays (kt)	28,1	30,2	32,5	35,1	37,7	40,5	43,6	46,9	50,5
Limestones	38,5	41,4	44,6	48,1	51,6	55,6	59,8	64,3	69,2

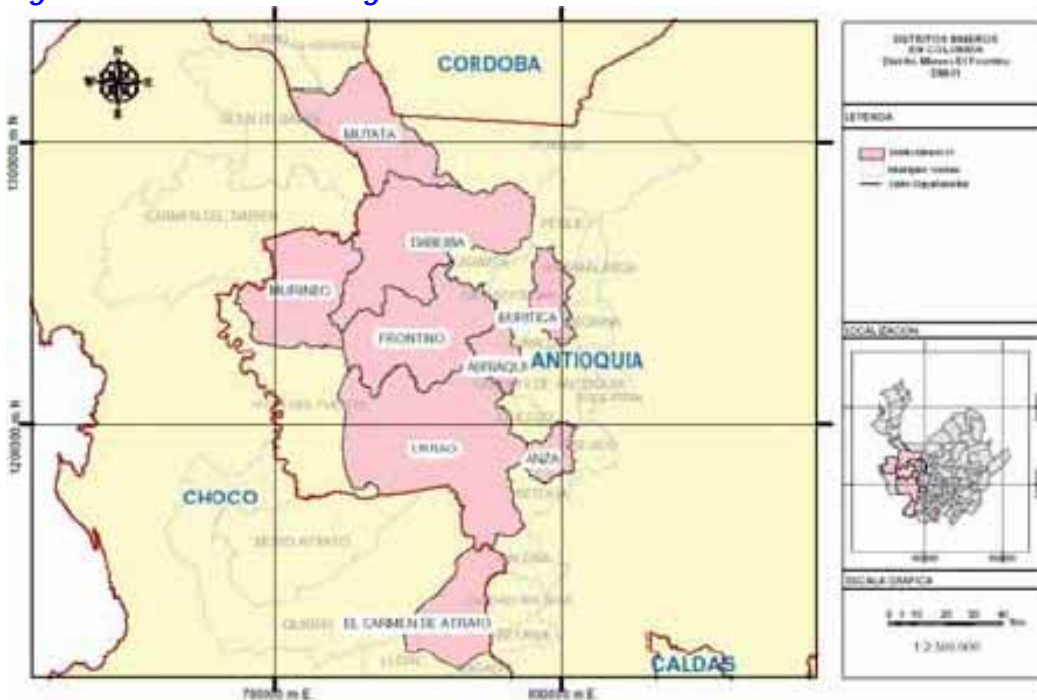
## 2.2.14 Frontino district

It is located in the Western mountain chain, covering the mining activity zones of the municipalities of Abriaqui, Anza, Buritica, Dabeiba, Frontino, Murindo, Mutata and Urrao of Antioquia department and of El Carmen de Atrato in Choco department. The district

<sup>31</sup> Ingeominas, 1970, 1978

registers the production of precious metals (gold, silver and platinum) concentrated in copper, gypsum and manganese.

**Figure 2.15 Frontino mining district**



Precious metals. The precious metals deposits of the municipalities of Frontino, Mutata, Dabeiba, Abriaquí and Urrao correspond to vein mineralizations of sulfide with gold and silver, located volcanic rocks - sedimentary of Cretaceous and intrusives of dioritic to andesitic composition of the tertiary age. The alluvial deposits of Sucio, Uraudo, Tasido, Urama and Mutata rivers is exploited in Dabeiba and Mutata.<sup>32</sup>

Minercol records report the auriferous mineral without mentioning the amount or the gold equivalences, for 3 of the 9 municipalities of the district.

**Table 2.38 Auriferous mineral and gold reserves of Frontino mining district**

Municipality	Ore Mineral (kt)	%
Abriaquí	-	-
Anzá	-	-
Buritica	3.948.1	135
Dabeiba	-	-
Frontino	20.0	-
Murindó	-	-
Mutatá	-	-
Urrao	1.1	-

<sup>32</sup> Ingeominas. *Inventario Minero del Departamento de Antioquia (Antioquia department mining inventory)*, 1999

El Carmen de Atrato	-	-
<b>TOTAL</b>	<b>3.969,2</b>	<b>135</b>

In year 2002 the precious materials production in the district increased to 219.35 kg of gold, 48.08 of silver and 2.35 kg of platinum, totaling 269.79 kg of precious metals. This production constituted the 1.01% of national production of precious metals (gold, silver and platinum).

**Table 2.39 Precious metals production in Frontino mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Platinum (kg)	%	Total (kg)	%
Abriaquí	18.085	8,2	2.814	5,9	0	0,0	20.899	7,7
Anza	256	0,1	30	0,1	29	0,0	286	32,9
Buriticá	51.411	23,4	37.321	77,6	0	1,2	88.761	0,1
Dabeiba	446	0,2	72	0,1	26	1,1	544	0,2
Frontino	46.949	21,4	7.750	16,1	88	3,7	54.787	20,3
Mutatá	8	0,0	1	0,0	232	9,9	241	0,1
Urrao	1.464	0,7	45	0,1	3	0,1	1.512	0,6
El Carmen de Atrato	100.738	45,9	49	0,1	1.977	83,9	102.764	38,1
<b>TOTAL</b>	<b>219.357</b>	<b>100,0</b>	<b>48.082</b>	<b>100,0</b>	<b>2.355</b>	<b>100,0</b>	<b>269.794</b>	<b>100,0</b>

The company Minera El Roble S.A. whose main activity is obtaining copper concentrate, contributes with 45.9% of gold and 83.9% of platinum produced in the district. The remaining volume is contributed by the miners that work with very low resources.

**Copper.** In Carmen de Atrato (Choco) there is the mine El Roble where a mineralization composed by pyrite and chalcopyrite, as well as pyrrhotite, sperrylite marcasite and free gold. It is a massive sulfide deposit in a volcano sequence - sedimentary from Superior Cretaceous. Other copper prospectus related to copper porphyry associated to Batolito de Mande, which are located in Murindo, in the limits with Dabeiba and Frontino. According to Minercol records, El Roble copper deposit has reserves that represent 1.980 kt with average tenorites of 4.71% of copper and 3.11 g/t of gold. In the last five years, the sulfide concentrate production (chalcopyrite, pyrite) with copper content of 20%<sup>33</sup> has ranged between 10.57 kt in 1998 to 8.5 kt in 2002. The full copper concentrate is exported to Japan from Buenaventura port.

**Gypsum.** This is a 2m to 6m thickness lenticular gypsum layers deposit, included in a volcano sequence - sedimentary of Cretaceous.<sup>34</sup> According to Minercol records, the measured reserves were 479.1 kt in 2001. The production during 2002 increased to 21.11 kt. Gypsum extracted is destined almost totally to the region cement companies.

<sup>33</sup> Miner S.A., reports.

<sup>34</sup> Ingeominas. *Inventario Minero del Departamento de Antioquia (Antioquia department mining inventory)*, 1999

Manganese. The manganese deposit of Dabeiba is inside one of the volcano sequences - sedimentary of uncertain age,<sup>35</sup> associated to grey cherts, limestones, tuffs and jaspers. According to available Minercol records, in 2001 the proven manganese reserves were 601.54 kt and the reported manganese production in 2002 was 0.39 kt. The mineral is traded as manganese sulfide in the national market, used as fertilizer.

Projections. The future offer projection of the district mineral products was made on the basis of the mineral production obtained in 2002. Besides, following criteria were used:

As of 2003 the gold and silver amounts were projected having in mind the average growth rates of the national production registered during the 1993-2003 period, which were 10.1% and 5.5%, respectively. With regard to platinum, and taking into consideration that its production is quite linked to alluvium gold and in spite of the decreasing trend (-6,4%) registered in the national production for the same period, it was decided to maintain the 2002 production constant for the projection horizon.

In last six years (1996-2002) the copper concentrate production was placed in a range between 8.4 kt and 10.5 kt. For the projection the average production registered in the former period of 9.5 kt was used. To project the manganese volume the estimated growth rate for the national GDP<sup>36</sup> was used.

In conformity to the study prepared by CICO Ltda.<sup>37</sup>, the construction cycle starts its increasing period as of 2002 until 2005, when its growth desaccelerates, although remains positive. As of 2008 it has been estimated that the cycle starts its descending phase until 2010. This projection assumes a mean growth rate of 7.6%, which is used for the projection of the production volume of gypsum, clays, limestones and construction materials.

The following table shows the results of the production projections for the period 2003-2010.

**Table 2.40 Offer projection of Frontino mining district, 2003-2010**

Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold(kg)	219,4	241,5	265,9	265,9	292,8	354,9	390,7	430,2	473,6
Silver (kg)	48,1	50,7	53,5	53,5	56,6	62,8	66,3	69,9	73,8
Platinum (kt)	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3	2,3
Cobre (kt)	8,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5	9,5
Gypsum	21,1	22,7	22,7	24,4	26,3	30,4	32,7	35,2	37,9
Manganese	397,0	397,0	397,0	413,0	434,0	485,0	514,0	545,0	577,0

<sup>35</sup> Idem

<sup>36</sup> %GDP-year: 3.6-2003, 4.0-2004, 5.0-2005, 5.5-2006, 6.0-2007 to 2010

<sup>37</sup> CICO Ltda. Análisis y proyecciones del sector de la construcción y productos industriales de Pizano S.A. (Analysis and projections on the construction sector and Pizano S.A. industrial products). July, 2002

When thinking about the future mining offer of the district is important not to lose sight of the probable future development of the porphyritic copper prospectus of Pantanos - Pegadorcito, in the Murindo, Dabeiba and Frontino areas. Also, the gold mineralizations with sulfide associated to Batolito de Mande, in areas of Murindo, Urrao, Dabeiba and the western part of Frontino in Antioquia and Quibdo in Choco; also in Frontino snow peak, Plateado hill and Citara cliffs.

## **2.3 GROUP III. DISTRICTS PRODUCERS OF PRECIOUS METALS AND EMERALDS**

In this third group there are eight mining zones included, which together with the two districts Nordeste Antioqueño and Frontino, concentrate the country's highest production of precious metals. They are San Martin de Loba, Santa Rosa, Costa Pacifica Sur, Mercaderes, La Llanada, Marmato, Istmina and Vetas. In this group the two emerald producing zones are included: Muzo and Chivor.

### **2.4.1 Marmato mining district**

This district groups the auriferous production of Marmato and Supia municipalities in Caldas department and of Quinchia municipality in Risaralda department.

The Marmato zones is located in the Cauca river canyon, a structural depression, product of two failure systems: Romeral at the east and Cauca - Patia at the west. Gold is found in veins that fill the diaclasis of the dacitic porphyry known as Marmato Stock.<sup>38</sup> Supia and Quinchia zones are located in the borders of the Western mountain chain, the auriferous veins embedded in silica sediments, basic vulcanites and Cenozoic intrusive rocks.<sup>39</sup>

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<sup>38</sup> Ingeominas. *Inventario Minero del Departamento de Caldas (Caldas department mining inventory)*, 2000

<sup>39</sup> Ingeominas. *Inventario Minero del Departamento de Risaralda (Risaralda department mining inventory)*, 2000

**Figure 2.16 Marmato mining district**



According to Minercol records, the auriferous mineral reserves totaled 7.157.4 kt in 2001, from which 4.157.4 kt were in Marmato and 3.000 kt in Quinchía. The mineralization tenorites ranged between 7 g and 10 g of gold per ton. The district precious metal production was of 1.797.3 kg in 2002, distributed as shown below:

**Table 2.41 Precious metals production in Marmato mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Platinum (kg)	%
Marmato	644,50	91,2	1.067,10	97,8	1.711,60	95,2
Supía	0,64	0,1	0,24	0,0	0,89	0,0
Quinchía	61,21	8,7	23,59	2,2	84,81	4,7
<b>Total</b>	<b>706,36</b>	<b>100,0</b>	<b>1.090,94</b>	<b>100,0</b>	<b>1.797,30</b>	<b>100,0</b>

The district total production corresponds to 6.71% of the national precious metal production. In turn, the 75% of such production is obtained by one single company, while the remaining percentage comes from informal small miners.

Projections. As in the other auriferous districts, the production projections were made using the growth rate of 10.1% in gold and 55% in silver, registered by the national production during the period 1993-2003.

**Table 2.42 Offer projection of Marmato mining district, 2003-2010**

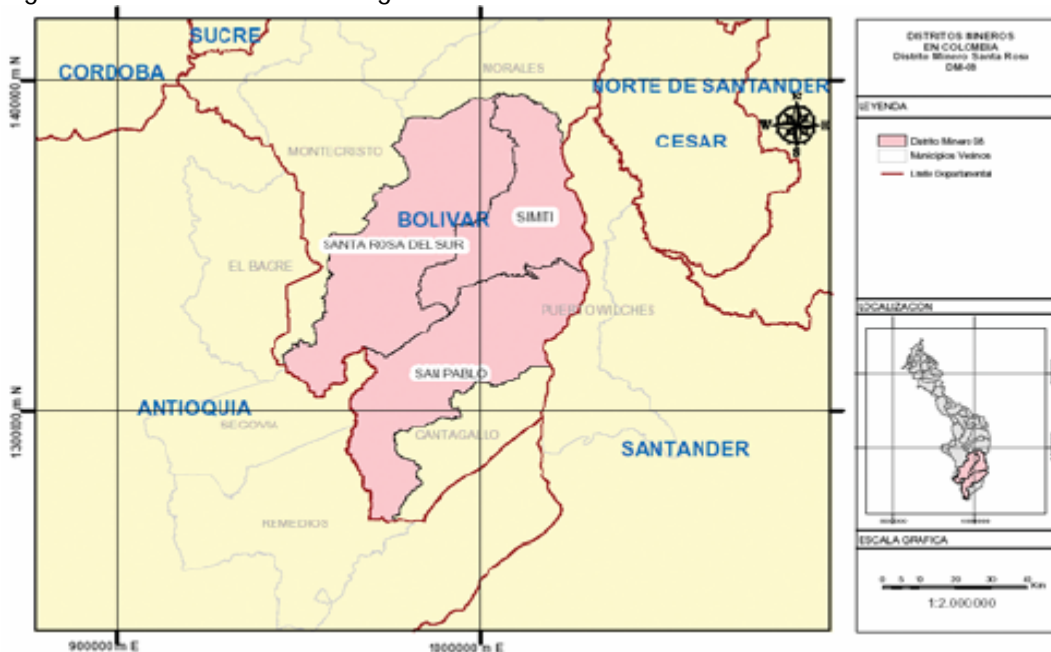
Mining product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	706.4	777.7	856.3	942.7	1.038.0	1.142.8	1.258.2	1.385.3	1.525.2
Silver (kg)	1.090.9	1.150.9	1.214.3	1.281.0	1.351.5	1.425.8	1.504.2	1.587.0	1.674.3
<b>TOTAL</b>	<b>1.797.3</b>	<b>1.928.6</b>	<b>2.070.6</b>	<b>2.223.7</b>	<b>2.389.5</b>	<b>2.568.6</b>	<b>2.762.4</b>	<b>2.972.3</b>	<b>3.199.5</b>



## 2.4.2 Santa Rosa district

This district covers the auriferous activity registered in the municipalities of San Pablo, Simiti and Santa Rosa del Sur in Bolivar department.

Figure 2.17 Santa Rosa mining district



Precious metals. The 69% of vein deposits known in the South of Bolivar department is in this district. Free gold and associated to the structure of sulfides (pyrite, sperrylite, galena and silver sulfur salts).<sup>40</sup> There is no information available on reserves. The metal production in 2002 was of 1.597 kg, which represented 5.96% of national production.

**Table 2.43 Precious metals production in Santa Rosa mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Total (kg)	%
Santa Rosa del Sur	695,49	44	0,151	100	695,64	44
Simiti	901,57	56	0	0	901,57	56
<b>TOTAL</b>	<b>1.597,06</b>	<b>100</b>	<b>0,151</b>	<b>100</b>	<b>1.597,21</b>	<b>100</b>

Projections. As in the other precious metal producing districts, the production was projected keeping in mind the national average growth rate in the period 1993-2003 of 10.1% for gold and 5.5% for silver. The following table shows the results of the projection of the precious metals offer for the district:

<sup>40</sup> Ingeominas. *Inventario Minero del Departamento de Bolivar (Bolivar department mining inventory)*, 1999

*Table 2.44 Offer projection of Santa Rosa mining district, 2003-2010*

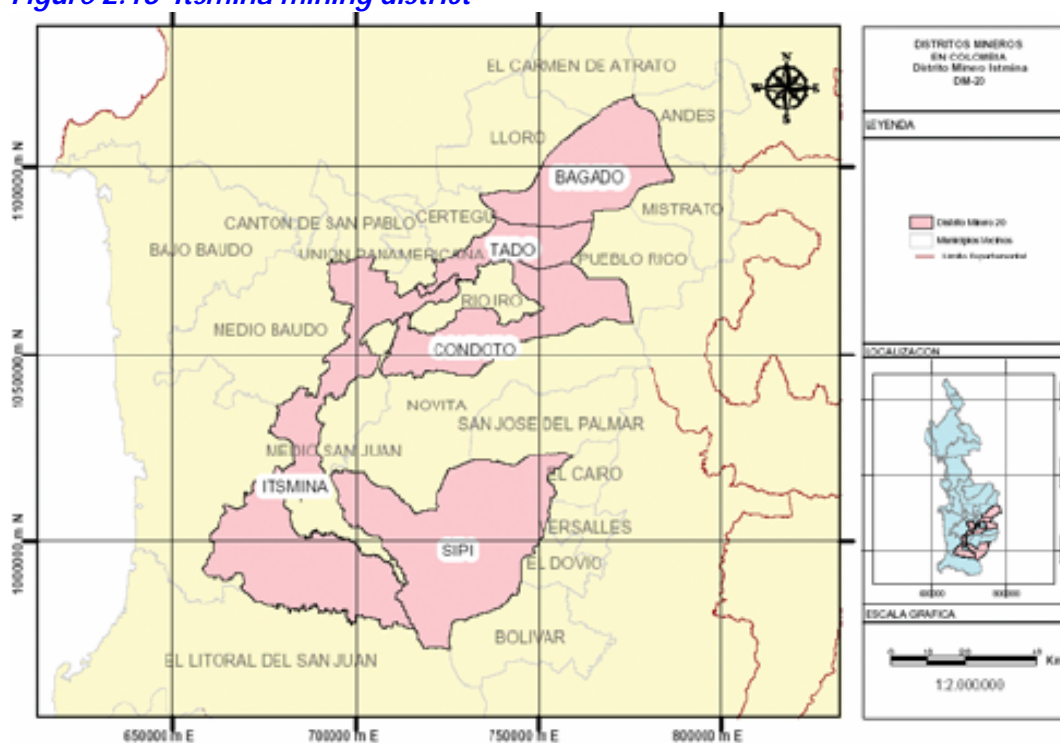
Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	1.597,1	1.758,4	1.936,0	2.131,5	2.346,8	2.583,8	2.844,8	3.132,1	3.448,4
Silver (kg)	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2	0,2

### 2.4.3 Itsmina mining district

This district is comprised of the mining activity registered in the municipalities of Bagado, Condoto, Istmina, Sipi and Tado in Choco department, which has been focused to the exploitation of platinum, gold and silver. The platinum exploitation started in 1778 in the district and is still the largest and only producer in Latin America.

Precious metals. They are extracted from several auriplatiniferous alluviums located along San Juan and Atrato rivers, mainly in its tributaries, Condoto, Opogodo, Sipi, Novita, Cajon, Tamana and Suruco rivers. The presence of platinum in such deposits has been generally attributed to the existence of ultrabasic rocks in the western basin of the Western mountain chain; however, Ingeominas only reports intermediate composite intrusives.<sup>41</sup>

*Figure 2.18 Itsmina mining district*



<sup>41</sup> Ingeominas. *Inventario Minero del Departamento de Chocó (Choco department mining inventory)*, 2000

There is no information available on the precious metals reserves existing in the district. The production reported for year 2002 was 538.4 kg of platinum, 408.7 of gold and 49.1 kg of silver. Such production is equivalent to 82% of the national platinum production and 5% of the total precious metals production. The distribution of the mining production per municipalities is as follows:

**Table 2.45 Precious metals production in Istmina mining district, 2002**

Municipality	Gold (kg)	Silver (kg)	Platinum (kg)	Total (kg)
Bagadó	7.25	1,8	0,44	0,9
Condoto	94.55	23,1	11.11	22,6
Istmina	175.23	42,9	23.42	47,7
Si pi	40.38	9,9	5,86	11,9
Ta do	91.30	22,3	8,28	16,9
<b>TOTAL</b>	<b>408,73</b>	<b>100,0</b>	<b>49,14</b>	<b>100,0</b>

Projections. For projecting the gold and silver production of the district, the growth rate registered in the national production of these metals during the period 1993-2003 was used, which is 10.1% for gold and 5.5% for silver. For projecting the platinum production the previous procedure was not adequate since it had a decreasing trend between 1993 and 2000. Consequently, and keeping in mind that in the district there is always a direct proportional relation between the platinum and gold produced volume, it was decided to consider that the platinum production grows proportional to the gold production.

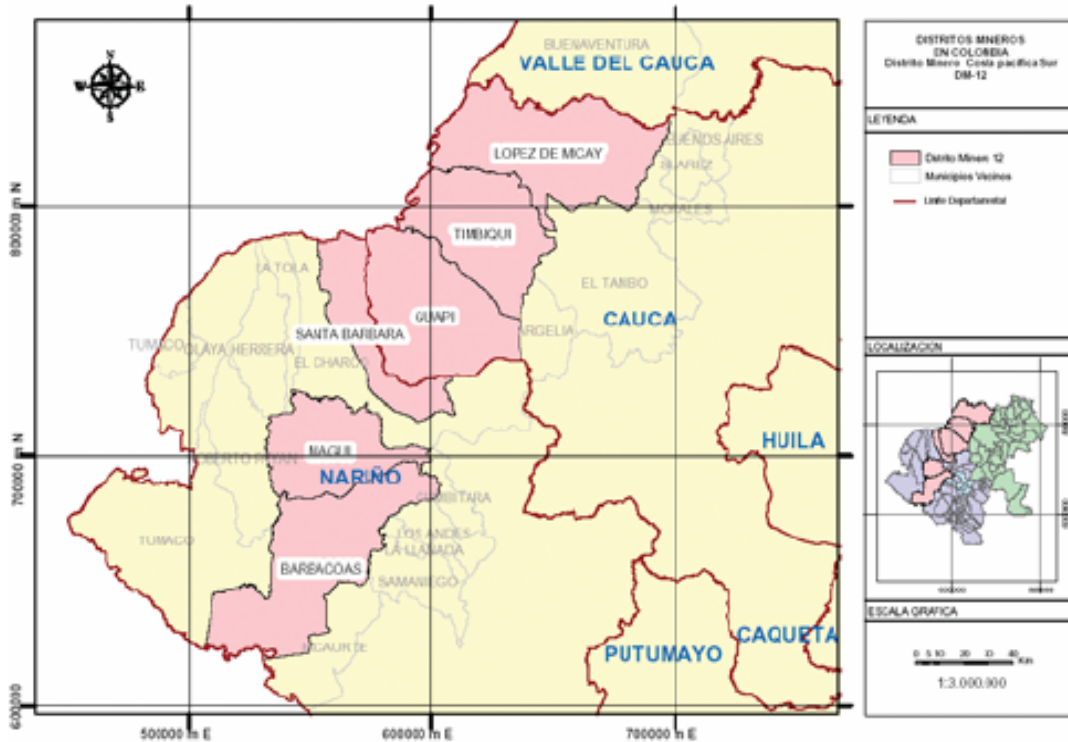
**Table 2.46 Offer projection of precious metals for Istmina mining district, 2003-2010**

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	409	494	544	599	659	726	799	887	977
Silver (kg)	49	52	55	58	61	64	68	71	75
Platinum (kg)	538	592	652	718	790	870	958	1.055	1.162
<b>TOTAL</b>	<b>996</b>	<b>1.138</b>	<b>1.251</b>	<b>1.375</b>	<b>1.510</b>	<b>1.660</b>	<b>1.825</b>	<b>2.013</b>	<b>2.314</b>

#### 2.4.4 Costa Pacifica Sur mining district

The Costa Pacifica Sur mining district includes the precious metals producing zones located in the following municipalities of the Pacific plains: Barbacoas, Magui and Santa Barbara (Iscuande) in Nariño department and Guapi, Lopez de Micay and Timbiqui in Cauca department.

Figure 2.19 Costa Pacifica Sur mining district



According to Minercol records, the production increased to 285.9 kg of gold and 2.8 kg of platinum in 2002. Therefore, the total production of precious metals totaled 378.3 kg, which for said year represented 1.41% of national production. In the district the Lopez de Micay stands out because it contributes with 68% of precious minerals production, followed by Guapi (21%).

Table 2.47 Precious metals production of Costa Pacifica Sur mining district, 2002

Municipality	Gold (kg)	%	Silver (kg)		Platinum (kg)		Total (kg)	%
Gua pi	76,29	26,7	0,17	0,2	2,13	75,6	78,60	20,8
López de Micay	167,79	58,7	88,38	98,3	0	0,0	256,18	67,6
Timbiquí	16,01	5,6	0	0,0	0,04	1,5	16,06	4,2
Barbaças	24,57	8,6	1,37	1,5	0,64	22,9	26,60	7,0
Santa Bárbara	1,30	0,5	0	0,0	0	0,0	1,30	0,3
Magüí Payán	0	0,0	0	0,0	0	0,0	0	0,0
Total	285,99	100,0	89,93	100,0	2,82	100,0	378,75	100,0

Projections. Table 2.48 shows the results of the precious metals offer projection for 2003-2010. Such projection is based on two assumptions: The first one assumes that there are enough reserves because there is not available information thereof. The second assumes a 10.1% growth in gold production and 5.5% in silver. Platinum production remained constant.

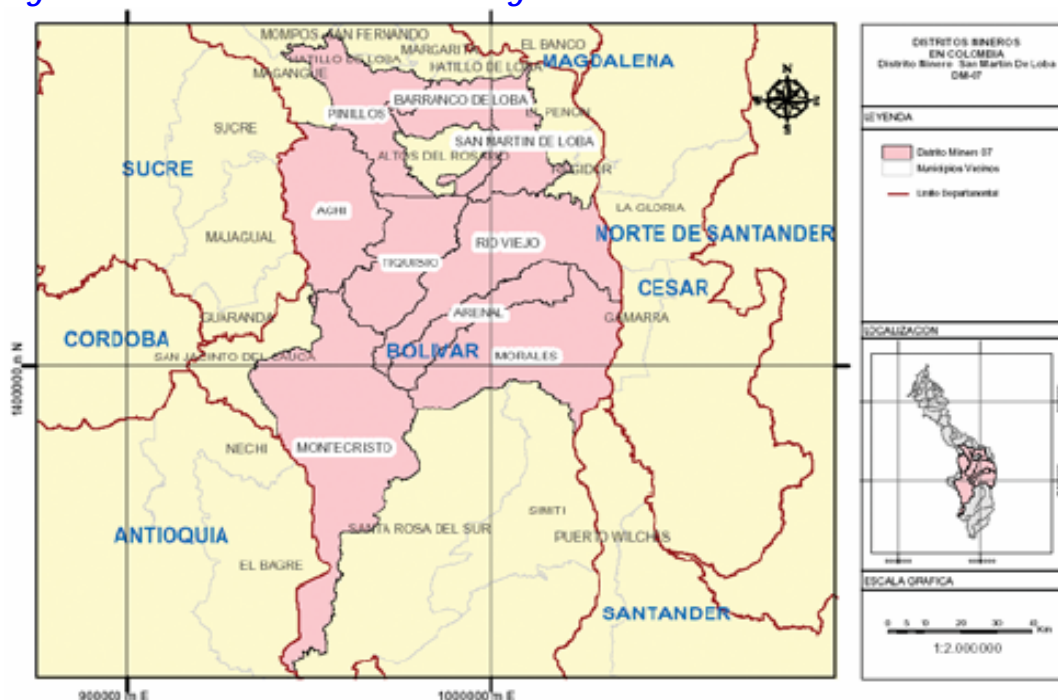
*Table 2.48 Offer projection of Costa Pacifica Sur mining district, 2003-2010*

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	286.0	314.1	346.7	381.7	420.2	462.7	509.4	560.9	617.5
Silver (kg)	89.9	94.8	100.0	105.5	111.1	117.4	123.9	130.7	137.9
Platinum (kg)	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Total	378.7	411.7	449.5	490.0	534.1	582.9	636.1	694.4	758.2

### 2.4.5 San Martin de Loba district

It is comprised of the auriferous mining activity registered in the municipalities of San Jacinto de Achi, San Martin de Loba, Barranco de Loba, Rio Viejo, Montecristo, Morales, Pinillos and Tiquisio in Bolivar department. The exploitation of gold deposits started in the 1980s by small miners without any formal organization.

*Figure 2.20 San Martin de Loba mining district*



Precious metals. The district has disseminated auriferous deposits, vein and alluvial type. The first ones are associated to bottlenecks and volcanic cones that seem to be related to recent magmatic events. The deposits identified in Buena Señá and Santa Cruz hills are regarded as the most representative of the region.

The vein type deposits are inside the intrusive rocks which outcrop in San Lucas hills. The veins are constituted by quartz with pyrite, sperrylite, galena and sulfur salts of silver and the

gold is free and associated to the sulfide structure.<sup>42</sup> An important part of the district mining is performed in this deposit type, mainly in Barranco de Loba and San Martin de Loba.

Alluvium deposits with good gold contents are exploited in several places of San Lucas hills but the higher number of exploits is made in Montecristo.

There is no information available on the district precious metals reserves. During 2002 the precious metals production was of 294.1 kg, volume equivalent to 1.1% of national production.

*Table 2.49 Precious metals production of San Martin de Loba mining district, 2002*

Municipality	Gold (kg)		Silver (kg)		Total (kg)	
Morales	71.21	26,1	0	0	71.21	24,2
San Jacinto de Achi	111.03	40,8	4.75	21,8	115.78	39,4
San Martin de Loba	5.07	1,9	1.17	5,7	6.24	2,1
Tiquisio	85.03	31,2	15.90	72,9	100.94	34,3
<b>TOTAL</b>	<b>272,34</b>	<b>100,0</b>	<b>21,83</b>	<b>100,0</b>	<b>294,17</b>	<b>100,0</b>

Projections. Taking into consideration the average growth rate in the precious metals production registered for 1993-2003, which was 10.1% for gold and 5.5% for silver, the following offer projection was made:

*Table 2.50 Offer projection of San Martin de Loba mining district, 2003-2010*

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	272,3	299,8	330,1	363,8	400,2	440,6	485,1	534,1	588,2
Silver (kg)	21,8	23,0	24,3	25,6	27,0	28,5	30,1	31,8	33,5

## 2.4.6 La Llanada district

The district is comprised of the auriferous zones and mining activity of the municipalities of Cumbitara, La Llanada, Los Andes (Sotomayor), Mallama, Samaniego and Santacruz (Guachaves) in Nariño department.

<sup>42</sup> Ingeominas. *Inventario Minero del Departamento de Bolívar (Bolívar department mining inventory)*, 1999

Figure 2.21 La Llanada mining district



Precious metals. Gold mineralizations known in this district outcrop in quartz, pyrite and chalcopryrite veins which are host to volcanic and sedimentary rocks of the cretaceous era. According to Minercol records, the district auriferous mineral reserves were estimated in 13,266.7 kt, with tenores between 5 g/t and 10 g/t in 2001. Such reserves correspond to Los Andes (52%) and Santa Cruz (45.3%):

Table 2.51 Gold reserves in La Llanada mining district, 2001

Municipality	(KG)	%
Cumbitara	170.640	1,3
La Llanada	137.970	1,0
Los Andes	6.900.553	52,0
Mallama	8.355	0,1
Samaniego	42.258	0,3
Santa Cruz	6.006.981	45,3
<b>TOTAL</b>	<b>13.266.757</b>	<b>100,0</b>

The district precious metals production was of 151.32 kg in 2002, which is equivalent to 0.56% of national production.

Table 2.52 Precious metals production in La Llanada mining district, 2002

Municipality	Gold (kg)	%	Silver (kg)	%	Total (kg)	%
Cumbitara	14,92	11,2	1,89	10,2	16,82	11,1
La Llanada	45,56	34,3	8,62	46,3	54,19	35,8
Los Andes (Sotomayor)	27,52	20,7	5,85	31,4	33,38	22,1
Mallama (Piedrancha)	0,09	0,1	0	0,0	0,09	0,1
Samaniego	3,65	2,8	0,44	2,4	4,09	2,7
Santacruz	40,93	30,8	1,81	9,7	42,74	28,2
<b>TOTAL</b>	<b>132,69</b>	<b>100,0</b>	<b>18,62</b>	<b>100,0</b>	<b>151,32</b>	<b>100,0</b>

Projections. For La Llanada district projection, it was assumed a 10.1% production growth in gold and 5.5% in silver, according to the growth registered in the national production during 1993-2003. Table 2.53 shows the results obtained in the precious metals offer projection of La Llanada mining district for 2003-2010.

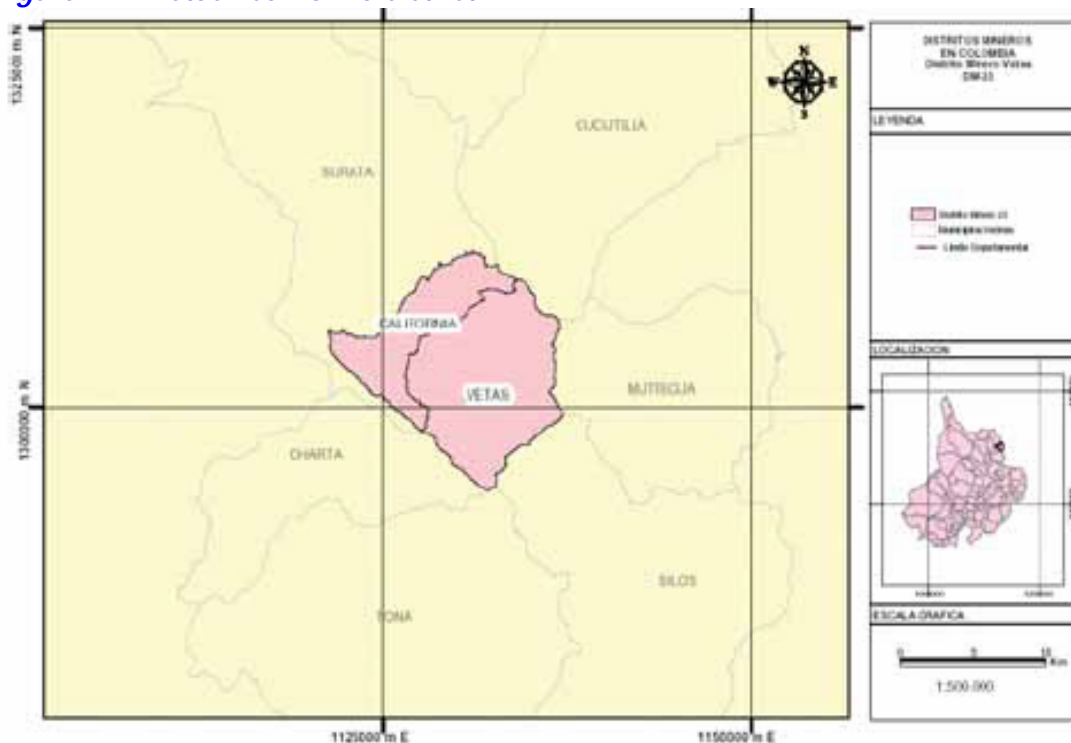
*Table 2.53 Offer projection of La Llanada mining district, 2003-2010*

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	132.7	146.1	162.2	178.5	196.6	216.4	238.3	262.4	288.9
Silver (kg)	18.6	19.6	20.7	21.9	23.1	24.3	25.7	27.1	28.6
<b>Total</b>	<b>151.3</b>	<b>165.7</b>	182.9	<b>200.4</b>	219.7	240.7	<b>264.0</b>	<b>289.5</b>	317.5

### 2.4.7 Vetas - California district

The district is comprised of the mining activity located in the municipalities of Vetas and California of Santander department, from where gold is extracted since the colonial period.

*Figure 2.22 Vetas - California district*



This is the only zone of the Eastern mountain chain where vein gold deposits are exploited. It is about mineralized quartz veins with gold, silver and sulfides, mainly, which develop zones of hydrothermal alteration in the host rocks which correspond to granodiorites, quartzomanzonites and quartzodiorites of the Jurassic era.



According to Minercol records, the auriferous reserves of the district totaled 114.995 kt. A production of 21.1 kg of gold and 5.6 kg of silver was reported for the district, contributing with 0.1% of the gold national production. Gold and silver production is sent to Bucaramanga and is mostly used for jewelry production.

District projection. Projections for the district were made using as a parameter the annual growth rates registered for the national production for 1993-2003, which are 10.1% annual for gold and 5.5% annual for silver.

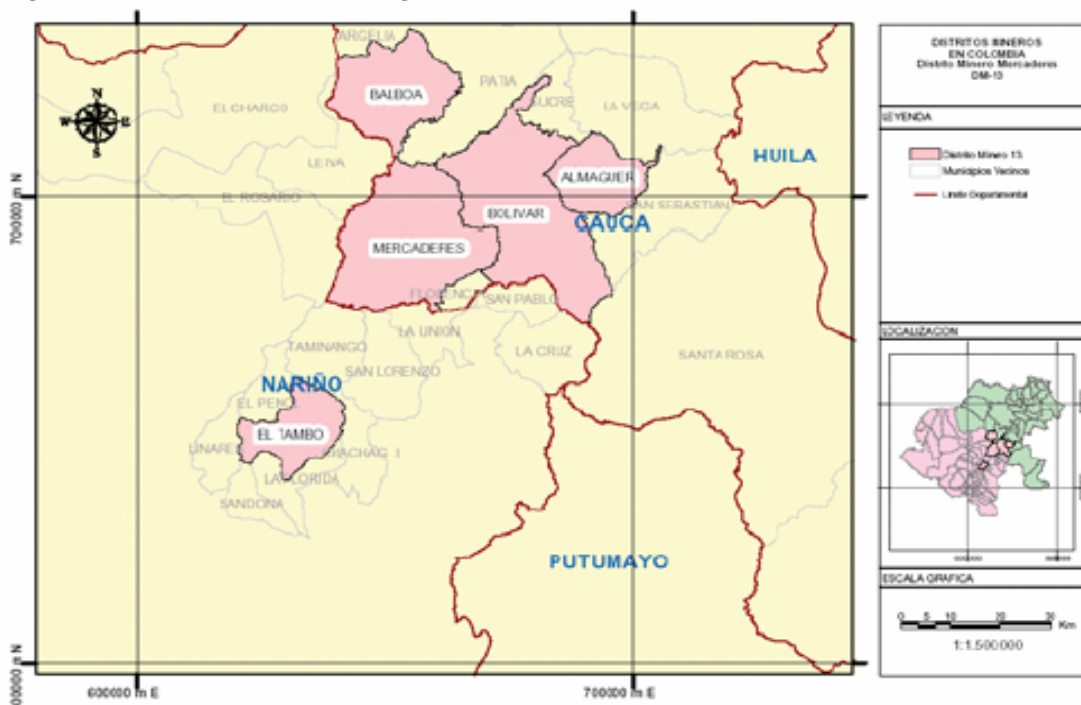
*Table 2.54 Mineral offer projection of Vetas - California mining district, 2003-2010*

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	21,0	23,2	25,6	28,2	31,0	34,1	37,6	41,4	45,5
Silver (kg)	5,6	5,9	6,2	6,6	6,9	7,3	7,7	8,2	8,6
TOTAL (kg)	26,6	29,1	31,8	34,8	37,9	41,4	45,3	49,6	54,1

### 2.3.8 Mercaderes district

It is comprised of the mining activity zone located in the municipalities of Almaguer, Balboa, Bolivar and Mercaderes in Cauca department and Tambo in Nariño, which was of great importance in the 18th and 19th centuries.

*Figure 2.23 Mercaderes mining district*



The predominant mining in this district is gold, which exploits hydrothermal veins associated to dacitics and andesitics porphyry. Exploitation is underground and the production volumes are low, therefore the manual extraction operations are more common.

According to the information registered in Minercol files, the district production was of 6.24 kg of gold and 1.9 kg of silver in 2002; the distribution by municipalities is below:

**Table 2.55 Precious metals production in Mercaderes mining district, 2002**

Municipality	Gold (kg)	%	Silver (kg)	%	Total (kg)	%
	Bolívar	1.54	25	0.33	17	1.88
Tambo	4.69	75	1.60	83	6.29	77
<b>TOTAL</b>	<b>6,23</b>	<b>100</b>	<b>1,93</b>	<b>100</b>	<b>8,17</b>	<b>100</b>

Projections. The table 2.56 show the offer projection results of the precious metals of Mercaderes mining district for 2003-2010, made using the growth rate of 10.1% in gold and 5.5% in silver, rates registered in the national production for 1993-2003, and under the assumption that they shall not be totally extracted in the projection horizon.

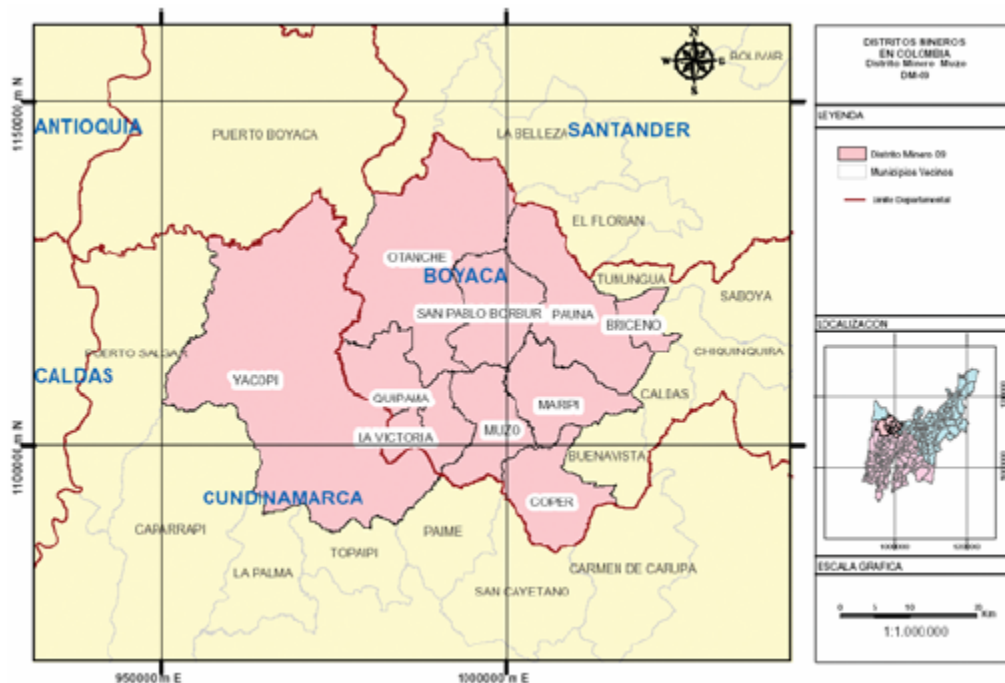
**Table 2.56 Offer projection of Mercaderes mining district, 2003-2010**

Mining Product	2002 (Real)	2003	2004	2005	2006	2007	2008	2009	2010
Gold (kg)	6.2	6.9	7.6	8.3	9.2	10.1	11.1	12.2	13.5
Silver (kg)	1.9	2.0	2.2	2.3	2.4	2.5	2.7	2.8	3.0
Total	8.1	8.9	9.8	10.6	11.6	12.6	13.8	15.0	16.5

## 2.4.9 Muzo district

The district groups the mining activity areas of the municipalities of Muzo, Quipama, San Pablo de Borbur, Maripi, Pauna, Coper, Otanche, La Victoria, Briceño in Boyaca department, and of Yacopi in Cundinamarca department. Emerald exploitation stands out in the activity.

**Figure 2.24 Muzo mining district**



Emerald gems outcrop in the thinner carbonate veins hosted in black shales of the Inferior Cretaceous (Paja and Rosablanca formations) and the associated minerals are: albite, quartz, dolomite, pyrite, apatite, barite, talc, fluorite, moscovite, feldspar and pyrophanite.<sup>43</sup> Due to the unpredictable distribution of the mines mineralization, it is impossible to establish the reserves estimation.

There are difficulties to accurately know the amount of produced emeralds, and therefore, the export figures have been used as indicators of the actual production. During 2002, the 98.8% of the exported emeralds volume and the 97.0% of the total value exported corresponded to Muzo district. Exports for years 2001-2002 by origin municipality are detailed below:

**Table 2.57 Emeralds exports of Muzo mining district, 2001-2002**

Municipality	2001		2002	
	Carats	Amount US\$	Carats	Amount US\$
Briceño	25.050	1.478.333		203.258
Coper	5.951	44.500		
La Victoria	670	255.460	150	135.615
Maripí	542.345	13.027.712	538.687	24.595.240

<sup>43</sup> Ingeominas. *Inventario Minero del Departamento de Boyacá (Boyaca department mining inventory)*, 1999

Muzo	846.422	23.206.442	987.698	19.593.390
Otanche	1.561.234	22.293.331	711.039	14.132346
Pauna	91.337	7.752.278	78.068	6.455.322
Quipama	2.688	353.734	2.657	1.657.459
San Pablo de Borbor	2.271.302	15.538.925	3.006.322	22.522.043
Yacopí	10.766	3.094.935		
<b>TOTAL</b>	<b>5.357.765</b>	<b>87.045.650</b>	<b>5.326.184</b>	<b>89.294.671</b>

In 2003 the country exports totaled to 8.963.298 carats of emeralds for an amount of US\$79.305.792, from which 710.668 carats corresponded to cut and polished or *chased* emeralds for a value of US\$77.539.030 and 8.242.635 carats to emeralds and *morrallas en bruto* (uncut and polished) for a value of US\$1.766.762. In other words, the 92.07% of exported carats corresponded to emeralds and *morrallas en bruto* which contributed with 2.2% of the total value, while the 7.93% of exported carats as cut and polished or *chased* emeralds corresponded to 97.8% of the total exploited.

Projection. The emerald exports projection for Muzo district in 2003-2010, applying the mean growth rate registered during 1993-2003, which was of 10.5%, shows the following results:

**Table 2.58 Exports projection of Muzo mining district, 2003-2010**

Mining Product	2002	2003	2004	2005	2006	2007	2008	2009	2010
Emeralds	5.326	5.885	6.503	7.186	7.941	8.775	9.696	10.714	11.839

#### 2.4.10 Chivor district

The district is comprised of the emerald production zones of the municipalities of Chivor, Somondoco, Guateque in Boyaca department and Gachala and Ubala in Cundinamarca.

Figure 2.25 Chivor mining district



In this zone the emeralds are located inside the carbonate veins host in black lutites of the Inferior Cretaceous (Guavio, Lutitas de Macanal and Arenisca Las Juntas formations) and the associated ore are albite, pyrite, quartz, calcite and moscovite. The erratic distribution of mineralizations does not allow any emerald calculation on the district reserves.

As aforementioned, the emerald production volume is alike the exports and, consequently, during 2002 Chivor district only exported the 2.2% of the total emeralds volume, equivalent to 3.0% of the total value. The municipality, volume and reported value of exports for years 2001 and 2002 are shown below:

Table 2.59 Emeralds export of Chivor mining district, 2001-2002

Municipality	2001		2002	
	Carats	Value US\$	Carats	Value US\$
Chivor	118.911	2.292.549	62.930	2.152.1351
Gachalá	26.235	47.000		
Guateque	1.968	860.830		
Somondoco	102	9.843		
Ubalá	18	1.132	1.026	600.000
<b>TOTAL</b>	<b>147.234</b>	<b>3.211.354</b>	<b>63.956</b>	<b>2.752.135</b>



## 3 MINING DISTRICTS AND TRANSPORTATION

### 3.1 TRANSPORTATION INFRASTRUCTURE AND COMPETITIVENESS

Furnishing the country infrastructure constitutes an important competitiveness factor. In particular, the mining industry infrastructure is directly related to the different activities and costs of the mining process, from the initial prospection - exploration up to the development, production and commercialization stages. Therefore, the availability, technical specifications, fees of the diverse transportation means, are the fundamental element in the cost structure of a mining project. Said variable is particularly sensitive in the production stage when the mining product and/or its derivatives destined to international markets are to be placed in port.

For last years the Colombian mining products have gained importance in the international market, exceeding in value the oil exports. Since several Latin America countries have supported their economical development on the mining activity, Colombia also desires to consolidate and enlarge such contribution.

In said frame it is indispensable the infrastructure modernization of roads, railroads, fluvial lines and ports, mainly the one related to the mining developments that foster for a space in the international market. Being large scale projects, with very favorable conditions in reserve volume and quality, it might be feasible that they themselves assume their own infrastructure construction. However, a high percentage of the mining projects present an increased risk and they are almost marginals as to their profitability, issues that make the start up more difficult, in particular, when the infrastructure costs must be assumed.

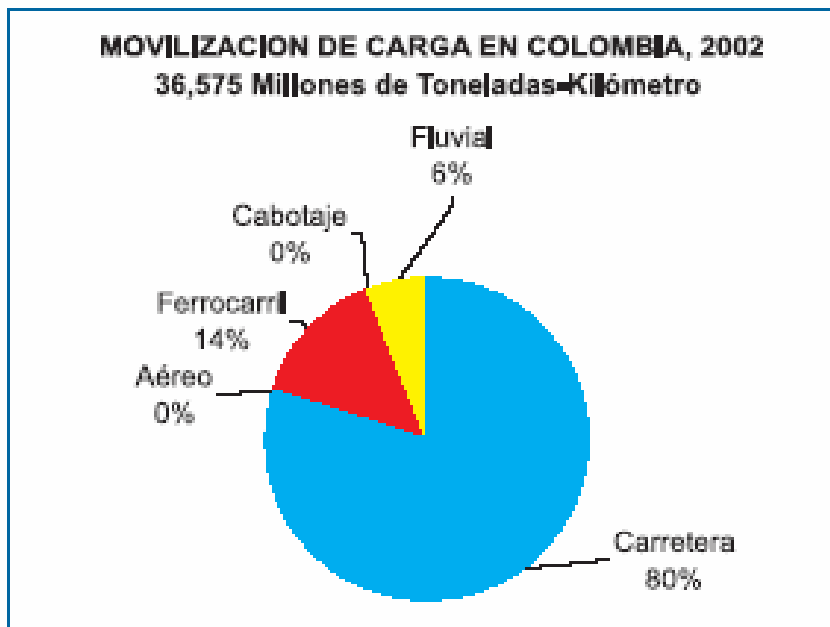
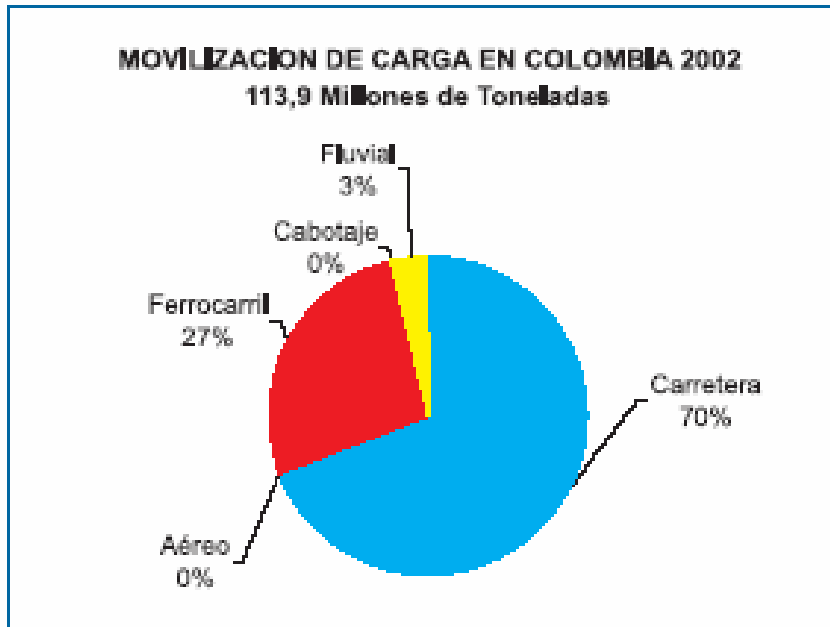
### 3.2 ORE TRANSPORTATION

During 2002 about 113,9 Mt load equivalent to 36.575 Mt-km were moved in Colombia, as detailed in Chart 3.1. In tons, the 70% was transported by road,<sup>44</sup> the 27% by railroad and 3% by fluvial lines. When this analysis is being performed in t-km, the road transportation has more participation and represents the 80% of total, the railroad participation decreases to 14% and the fluvial increases to 6%. Air and cabotage means have a low significance in volume.

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<sup>44</sup> The Annual Cargo Survey of MT takes the long-distance information in selected stations. Therefore, it does not include the short-distance flows originated in the same municipality or where there are no survey stations of origin-destination. The last survey published by the MT corresponds to the year 2000. The non-published preliminary processing for 2001 is available.

*Chart 3.1 Cargo mobilization in Colombia*



For ore transportation roads, railroads and Magdalena river fluvial system are used. It has been estimated that in 2000 the ore movements increased to 44.9 Mt from which 31.7 Mt were transported by railroad, 12.9 Mt by road and 0.8 Mt by fluvial way, as detailed in chart 3.1. On the other hand, the mineral and related products transportation represented the 41.2% of the national total load in 2000.

*Table 3.1 Minerals and related products estimated mobilization, 2000*



Transportation Mode	t	Observations
Carretera	12.948.513	
Cement & Limestone	4.515.704	National transp.
Coal	3.643.962	Exports & domestic
Stone, sand & clay	2.114.402	Domestic
Clay products	1.712.402	Domestic
Iron & steel	962.043	Domestic
Waterways	755.769	Coal
Railroad	31.170.000	Exports
TOTAL	44.874.282	

Notes: The road information corresponds to the Annual Load Survey from the Ministry of Transportation of 2000. The fluvial information corresponds to the load leaving the different fluvial basins included in the Fluvial Yearbook of said Ministry. The railroad information comes from the Ministry of Transportation statistics.

Above figures have only included the long-distance inter-departmental flows. Therefore, they do not include the municipality flows or those that are not captured in the origin-destinations stations of the Ministry of Transportation.

### 3.3. TRANSPORTATION INFRASTRUCTURE IN THE MINING DISTRICTS

With regard to mining transportation infrastructure there are offer items that are not exclusively related to the operation of a particular district, but they serve to the country economy in the sector where mining participates. For such reason, at the beginning the national primary infrastructure was characterized by identifying the service levels for the basic sections of the road network in order to establish where there are critical sectors and their overall relation with ore transportation.<sup>45</sup>

<sup>45</sup> Sources consulted on transport and port infrastructure issues, besides of direct interviews with sector officials were the following:  
 Statistics yearbook, Superintendencia de Puertos y Transporte - 1999-2001  
 Origin - destination surveys to Cargo vehicles, 2001. Ministry of Transport. Cargo Transport Motor Vehicles in Colombia, Ministry of Transport - 2002  
 Foreign Trade Bulletins and Yearbooks, DIAN - 2002  
 Traffic volume 1968-2002 INVIAS - several years  
 Information on traffic and toll tariffs, INVIAS - Technical Support Subdirección - 2003  
 Information on traffic and toll tariffs, INCO - 2003. Colombia mineral resources, Ingeominas - 1978  
 Feasibility study on Fluvial transport Puerto Salgar Costa Atlántica and Puerto Multimodal Puerto Salgar - La Dorada, Siva Carreño y Asociados - 1999.  
 Conpes Document 3045. Programa de Concesiones Viales 1998-2000: Tercera Generación de Concesiones, Ministry of Transport, INVIAS, DNP - Dirección de Infraestructura y Energía - 1999

The characterization of each of the areas regarded as mining districts was performed previously in order to determine the geographic environment of each of them, the type of minerals produced and their volume, as well as their relation with the current transportation infrastructure. In this last one the primary, secondary and tertiary roads, the operating railways and the fluvial and port systems were included. In the case of roads the detailed information for the primary network responsibility of Invias was available, but this was not the case with the secondary and tertiary roads information, responsibility of departments and municipalities. Thus, the Invias network is thoroughly georeferenced, digitalized and characterized with data of year 2002.<sup>46</sup> The digitalization of the secondary and tertiary reaches the 47.9% and 35.7%, respectively.<sup>47</sup>

The evaluation of the infrastructure availability in each district on the basis of the produced material, the distance to the main consumption centers (destination cities or export or transfer ports), as well as the analysis of the operation conditions of the primary road network, due to the fact that a high percentage of mining products and derivatives flow is transported through it, allowed the identification of such sectors where the operation conditions are already critical, from the capacity perspective and the service level offered to users. It is worth mentioning that the precious metals producing districts characterized by their high unit value (gold, platinum and emeralds, among others) have different infrastructure requirements than those low unit value mineral producers, such as construction materials or coal.

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Conpes Document. Road Caracas - Bogotá - Quito, Ministry of Transport, DNP - Dirección de Infraestructura y Energía - 2001

Study on Port modernization - Puertos graneleros, Hidrotec - Harris - 1994

Study for establishing tariff models and criteria for port fees, Consorcio Louis Berger-International Inc. - Compañía Colombiana de Asesores, 1998

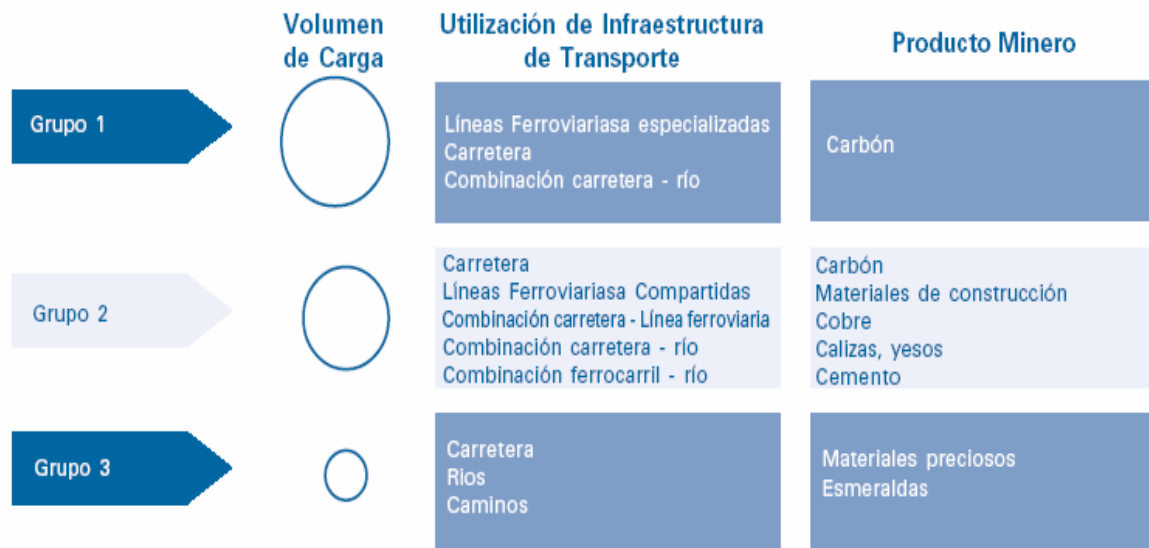
Transport bulletins, DANE - 2002

Study of Dry Port in Western Colombia, Ministry of Transport, 2000

<sup>46</sup> According to the Ministry of Transport data, the existing country road network has been estimated in 166.000 km. The main or primary network in charge of Invias is of 16.575 km and represents 10% of the total.

<sup>47</sup> From the length of the secondary network, estimated in 66.081 km., there are 31.683 km partially digitalized with some information associated to geometrical characteristics. From the tertiary network, 83.577 km, formed by minor, municipal and private roads, there are just 29.796 km georeferenced, without characterization associated information. In summary, the digitalized base made by the consultants covers about 48.7% of the total road network length.

**Chart 3.2 Relation districts group, cargo volume, infrastructure requirement and typical mining products**



As mentioned in the preceding chapter, the mining districts were grouped in three categories and such group, as shown in Chart 3.2, keeps relation with the transportation characteristics used in each level, be them mining products for internal consumption or for export. In fact, the Group 1 districts focused to coal export move a high cargo volume which demands a specialized infrastructure. Group 2 districts move moderated cargo volume and they share the infrastructure with other commodities transportation. Finally, the group 3 districts move very low volume, with little impact on the transportation demand; however, since they are located in isolated and marginal areas, ensuring the access to the mining communities is as important as the mineral transportation itself.

### 3.4 CAPACITY OF THE CURRENT SYSTEMS FOR ORE TRANSPORTATION

In order to analyzed the access conditions corresponding to each district, the exercise of locating the mining activity of each one in face of the road network and the available georeferenced available transportation was carried out. Said analysis allowed the identification of the main country road corridors, 48-49 which coincide, most of them, with the road network in charge of Invias. In the case of mining, the transportation demand is given upon the product type, apart of population. Thus, when the exploitations generate high cargo volumes, the infrastructure requirement is higher and in some cases, specialized as in the coal in La Guajira and Cesar. On the other hand, when it is about precious metals

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49 It should be mentioned that the available information on the transport infrastructure between mining exploitations and main roads is precarious, in particular, on such mining centers where the exploited volumes are significantly low, besides, their characterization was not the subject of this study.

extraction with low cargo volume, the infrastructure requirement is minor. In general, it matches with difficult-access locations as the precious metals districts as Frontino, Noreste Antioqueño, Istmina, Jamundi and Costa Pacifica Sur.

### 3.4.1 Group 1 districts

Districts at this level are focused to coal export. For such purpose, they basically use the railways existing between Barrancas and Puerto Bolivar (La Guajira) and between La Loma and Cienaga (Cesar - Magdalena). The first one is an independent line of standard gauge with 150 km length; the second one is a narrow gauge line with 220 km length, which makes part of the State owned railways.

According to available information, in La Guajira line about 23 Mt were moved in 2003 and it has been estimated that in the short term the movement shall reach 32 Mt, reason why it shall be necessary to enhance its operation. In the same years, in La Loma line, operated by Drummond, 16.3 Mt were moved, such figure shall increase to 34.8 Mt in 2010. As the line capacity has been estimated in 30 Mt per year, its enlargement shall be necessary.<sup>50</sup> To this sense, the construction of a second line parallel to the current one and two rail branches that communicate La Jagua with Chiriguana and Palestina with Tamalameque, port where the coal is shipped to Cartagena, has been proposed.

Both La Guajira and Cesar also move some cargo volumes by road. Such flows use the main Invias road network between Barrancas and Santa Marta (0.7 mt approx in 2003) and between La Loma and Barranquilla/Santa Marta (4.0 mt approx in 2003). This last cargo volume might affect the capacity of the Main Road Bogota - Santa Marta and to the future; it would be more convenient to transfer such movement to the second railway line previously mentioned.

Finally, in Cesar there is also a combined movement road - river between La Loma and Cartagena (0.5 Mt in 2003). Its future is uncertain due to the construction of the new coal port, near to Drummond's in Cienaga.

### 3.4.2 Group 2 districts

The main mining products moved in Group 2 districts are coal, construction materials, clays, limestones, iron, silica sands, salt, ferronickel, phosphoric rock, gypsum and manganese. The available infrastructure includes roads, interior railways and the fluvial system of Magdalena river. However, the main transportation mean is the road since by railway only the Paz del

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<sup>50</sup> For 2010 Drummond production has been estimated in 28 Mt and the medium scale production in 6.8 Mt. If the line capacity is not increased, the medium scale mining would have to move its coal by road.

Rio products are moved and by river the movement is low. Nevertheless, with the railway transportation recovery programs and of fluvial navigation, there are good perspectives for the use of such means. In turn, the ore product transportation by road shares the infrastructure with the remaining national cargo.

According to preliminary data, the cargo survey of the Ministry of Transportation (MT) corresponding to 2001, the road movement in such districts includes the following flows:

Sand, stone and gravel: 2.129.90 kt

Cement, gypsum and limestones: 5.828.04 kt

Coal: 1.908.96 kt<sup>51</sup>

Conversely to what occurs with group 1 districts production, focused to export, the group 2 districts production is destined both to export and internal consumption. In the first case, coal, ferronickel and copper concentrate are the most representative products; in the second, the sands, clays and construction materials.

With regard to coal, exports through Buenaventura, Barranquilla and Cucuta use the road transportation. In this case the exports are made through Venezuelan ports at Maracaibo lake. The ferronickel is exported through Cartagena and copper through Buenaventura. In these cases there is little impact on the road network, except at the port accesses, the border cross in Cucuta and San Roque - Ciénaga sector where the Cesar coal transportation and the transportation from the country interior get together.

For measuring the impact on roads of the ore transportation the capacity analysis was performed on the network in charge of Invias which might be used in such ore transportation. Said analysis was made using the geometric data of the Invias road inventory, the traffic manual volumes corresponding to year 2002 and the methodology used in the " Capacity Manual for two-lane roads" prepared by Universidad del Cauca for Invias.<sup>52</sup> The exercise result shows that almost 20% of the analyzed sectors are in critical levels of E and F service, considered as undesirable for an efficient road operation,<sup>53</sup> due to the impact on the vehicle operation costs.<sup>54</sup> However, in the majority of cases, such critical sectors are located out of the mining corridors. Construction materials mobilization constitutes a concerning issue that might affect the access service to the large country urban centers such

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<sup>51</sup> Total coal movement by road has been estimated, upon the 2001 survey, in 3.664.6 kt. From such total, 1.755.7 kt correspond to coal exported through Cartagena, Barranquilla and Santa Marta (port areas) destined to the export ports of Atlantico and 169.4 kt through Buenaventura.

<sup>52</sup> Since 1970 manual countings are carried out on 1000 stations located along the national roads in charge of Invias.

<sup>53</sup> The road capacity is a measure that shows the maximum number of vehicles that might use it for certain period of time, generally one hour. It is expressed in equivalent vehicles. For instance, a road with two lanes has a theoretical capacity of 3.200 vehicles equivalent in both ways, under ideal conditions (plain land, similar flow distribution and automobile type vehicles).

<sup>54</sup> Service levels of a road go from A to F, being A the level with best operating conditions for users and F the more deficient, characterized by a high level of traffic. Capacity is associated with E level.

as Bogota, Cali, Medellín, Barranquilla, Bucaramanga and Cartagena.<sup>55</sup> For Bogota case, routes and specific schedules have been established for the cargo mobilization in order to diminish its impact. Likewise, the construction of some highways such as Avenida ALO has been foreseen in order to prevent the congestion in ways that already have a high traffic volume such as Autopista del Sur (15.929 vpd - vehicles per day, between Soacha and Chusaca in 2002).

On the other hand, Invias data show that at present (2004) only 71% of its paved network is in good status. For this reason and for guaranteeing the optimum status of its road network the Institute has designed the Programa Integral de Rehabilitación y Mantenimiento (PIRM) (Integral Program of Recovery and Maintenance) which covers the mining interest ways, as it might observed in following table:

*Table 3.2 Integral Program of Recovery and Maintenance*

Road corridor	No.	Sectors to be contracted	Location	Length (km)
Occidente	1	Rumichaca - Pasto - Mojarras	Nariño	203.00
	2	Mojarras - Popayán	Cauca	120.60
	3	Cerritos - Medellín	Antioquia	236.58
	4	Hatillo - Caucasia	Antioquia	253.62
	5	Caucasia - Sincelejo	Cordoba and Sucre	181.18
Caribe	6	Sincelejo - Toluviejo - Cartagena	Sucre and Bolivar	156.42
Centro	7	Ibague - Mariquita and Manizales	Tolima and Caldas	233.10
Nororient	8	San Alberto - La Mata and Barrancabermeja - Lebrija	Santander and Norte de Santander	190.00
Magdalena	9	La Mata - Bosconia	Cesar	175.20
Pacífico	10	Buenaventura - Buga	Valle	118.40
	11	La Paila - Armenia - Ibagué - Puente Blanco and Ibagué bypass	Quindío and Tolima	140.25

In addition, new concession projects and additions to the national network have been proposed, as well as the improvement of departmental and municipal road networks. The majority of national projects were identified, previously in the Plan Estratégico de Transporte - PET (Strategic Transportation Plan). The most significant projects are:

La Linea tunnel, concession Bogota - Girardot, concession Girardot - Ibague, Concession Armenia - La Paila and improvement of access to Buenaventura port. These works would support the coal exports through Buenaventura.

<sup>55</sup> The surface status is associated to the degree of the road maintenance. In 2003 it was estimated that only 71% of the paved roads in charge of Invias was in good status.

Vial concessions Bogota - Tunja - Sogamoso and Zipaquirá - Bucaramanga, both ongoing. The first one supports the coal export through Buenaventura and the second the transportation from Boyacá locations to Bogotá.

Recovery of the fluvial navigation on Magdalena river under a intermodal transportation scheme. The project offers interesting perspectives for coal and other products movement, as it is detailed in the demand study carried out by Cormagdalena in 2002.<sup>56</sup> This projects support interior coal exports.

Railway concessions of Atlantic and Pacific. The recovery of such lines shall facilitate the coal transportation between the interior and the Atlantic coast, and between western country and Buenaventura. It is worth mentioning that the railway transportation operation is fundamental for the intermodal operations, combined with roads and Magdalena river. Likewise, its operation shall facilitate the analysis and subsequent execution of other projects such as Amaga - La Felisa - Cartago line and from there to Buenaventura.

Eastern and Western tunnels in Antioquia which shall facilitate the access to Medellín between Frontino and Oriente Antioqueño districts.

Specific projects such as paving the roads Barbosa - Velez - Landazuri.

Improving the conditions of the border cross in Cucuta. To that effect, several projects have been analyzed within the binational frame, for facilitating the coal export in Norte de Santander. As another alternative, the use of Cucuta - Ocaña - Gamarra road is being considered for an intermodal operation that would offer alternate ports for Zulia coal exports.

Paving plan 2500. Includes paving 2.500 km approx, of national, departmental, and municipal roads.

Also, it has been considered the importance of the Puerto Araujo connection with Cundinamarca's coal main road. It would be an alternate route for coal transportation between Cundiboyacense highlands and Magdalena valley, which in turn, would make the intermodal operation possible (road - railway or road - river).

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<sup>56</sup> The National Government is fostering the navigation recovery on Magdalena river through the YUMA project which looks for supplementing the transport means under the multimodal operation scheme. Under said program some cargo transfer centers have been considered, road-river, railway-river and road-railway, which are of interest for coal transport. That is the case, for instance, of the coal transport between the interior and the Atlantic coast which could use one sector by road up to Puerto Araujo or any other close port taking advantage of the road Barbosa - Velez - Landazuri - Puerto Araujo, and then a fluvial segment between Puerto Araujo and Barranquilla or Cartagena. Also, it has been proposed a multimodal operation using a transfer center in Puerto Salgar area. Said project is being promoted by Bogotá - Cundinamarca region.

### 3.4.3 Group 3 districts

The production of group 3 districts is constituted by precious metals that do not demand a sophisticated structure. However, the basic problem is that in most of cases the available vial infrastructure is precarious and in the rest zero. It makes that districts are highly dependant upon the fluvia, cabotage and air transportation. Consequently, improving the fluvial navigation conditions of Magdalena, Cauca, Nechi, San Jorge, Atrato, San Juan, Telembi, San Juan de Micay rivers and other branches and associated streams, is a priority.

Some of the vial projects that have been proposed for such districts are the following:

Roads improvement of San Martin de Loba - Norosi - Santa Rosa - San Pablo - Yondo and Guaranda - Norosi - Regidor, which would supplement the fluvial system of Cauca and Magdalena rivers at South Bolivar.

Bridge between Barrancabermeja and Yondo, currently in construction, which facilitates the southern access to Bolivar department.

Maintenance and improvement of Popayan - Lopez de Micay and Junin - Barbacoas roads. Both roads facilitate the combined transportation between interior and Pacific coast.

## 3.5 MAIN LIMITATIONS

Taking into consideration both current mining export volumes and those projected for 2010, only the group 1 mining districts, Barrancas and La Jagua, require of a specialized transportation infrastructure. The volumes moved in the other districts allow sharing the public transportation infrastructure with other users. Nevertheless, both in Barrancas and La Jagua districts, and other country places, the following problems associated to ore transportation were identified:

- Road capacity limitations in the access to Bogota, Medellin and Cali. Such factor affects construction materials transportation.
- Capacity limitations and level of service in the Troncal del Magdalena, La Loma - Cienaga sector to meet the production increase foreseen of La Jagua mining district.
- Operative limitations for coal export through Venezuela. The solution to this problems must be generated from binational agreements. As a transportation alternative it has been proposed the termination of the recovery works in the Cucuta - Ocaña - Aguachica road, which would facilitate the combined transportation road - rivere or road - railway between Norte de Santander and Atlantic ports.



- Low use of combined transportation railway - river, road - river and road - railway. With the foreseen recovery plans for fluvial navigation and the railway system, new transportation options are open which could be used for coal mobilization or other products such as clinker in Puerto Nare district.
- For coal transportation the railway is the most appropriate option since it is about moving large cargo bulk volumes with low unit value and intermediate distances. For the other products the road or combined transportation are most adequate options.
- Precious materials, gold, silver, platinum and gems, for their high price and very low volume are transported by air; however, secondary and tertiary roads that facilitate the access are required for supporting the production and the mining communities.
- The limit capacity of La Loma - Cienaga railway, building an additional lay-by between Bosconia and Algarrobo station was estimated in 30 Mt/year<sup>57</sup> which means that for moving the projected production in 2010 the construction of a parallel railway line that allows the simultaneous train circulation in both ways and other supplementary works should be studied.<sup>58</sup> But as important as supplementing the transportation infrastructure is regulating the third parties access to the way and the operative priorities system.
- To guarantee the export planned by Drummond for 2010, the direct ship load option should also be analyzed since the operation with barges and high sea load becomes a limit.
- When Carbones del Caribe port in Cienaga starts operations the Atlantic ports capacity for La Jagua coal export, other than Drummond, is enough to meet the export projections. However, if Prodeco's concession in Puerto Zuñiga is not renewed in 2009, the export capacity through Atlantic would be affected and other port expansions of the zones should be carefully analyzed.
- Due to the fact that for 2010 it is aimed to export 30 Mt through Puerto Bolivar, it will be necessary to enhance the transportation capacity of the mine railway - port and enable a second ship loader in the port.

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<sup>57</sup> Moffat & Nichol, Hidroestudios, Soros, Estudios Técnicos, *Estudio de factibilidad para la construcción de un puerto carbonífero integrado en la Costa Atlántica (Feasibility study for the integrated coal port construction in the Atlantic COSAT)*, 1997.

<sup>58</sup> Likewise, a railroad branch should be constructed connecting the storage site common to deposits of La Jagua de Ibirico area with the current railway line and construct the bypass between El Doctor stream and Santa Marta port for eliminating the passing of long convoys by the tourist area and downtown.

## 4 COAL EXPORTING DISTRICTS

Three mining districts have the full export component and they are: Barranca and La Jagua de Ibirico and Montelibano, ferronickel and coal producer. Likewise, there are four districts with a significant coal exporting component as El Zulia, Zipaquira, Paz del Rio and Amaga. For such reason, below there are the more relevant aspects of the coal international market and the Colombian mining industry potential for having a performance in such market.<sup>59</sup>

### 4.1. COAL INTERNATIONAL OUTLOOK

Coal is the most abundant fossil fuel worldwide since there are more than 100 countries that own important proven reserves and at the current production rate such reserves will last about 200 years in contrast with oil and gas reserves which are foreseen for 40 and 60 years, respectively. From the total world reserves amounting to 984.453 Mt, United States concentrates the 25.4%. In turn, Europe and Euro Asia own 36.1% where Poland and Russia reserves stand out. Asia-Pacific region holds the 29.6% where Australia (8.3%), China (11.6%) and India (8.6%) reserves stand out; Africa constitutes the 5.0%. Finally, South America and Central America only have the 2.2%, representing Colombia the 0.7% of the total.

The coal world consumption has been increasing, reaching in 2003 the amount of 4.028 Mt. Most part of it, around 55%, is concentrated in Asian countries. For instance, China consumed 1.410 Mt which are equivalent to 35% of the world consumption, while India and Japan has 9.01% and 4.02%, respectively. United States occupied the second place with 876 Mt equivalent to 21.75% of the world total.

The carbon volume traded in international markets is small in comparison to the worldwide consumption. In 2003 the worldwide imports accounted for 709 Mt, which represent 17.6% of total consumption. From such total volume 531 Mt corresponded to steam coal and 1987 Mt to coking coal.

During the period 2002-2003 both freights and export prices registered outstanding increases. The most maritime freights were attributed to the increase in the international demand on iron and coal ores. China became an important coal purchaser given the growth of their domestic prices, which induced the power energy producers located in south coast of the country to import the ore in more favorable conditions than the internal market.

At the end of 2003 the rates between Puerto Bolivar and Rotterdam were close to US\$21/t, quite far from US\$8.50 registered at the end of 2002. International prices of thermal coal,

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<sup>59</sup> Thorough information on the Colombian coal perspectives might be found at *La demanda potencial de carbon colombiano en el mercado nacional e internacional (Colombian coal potential demand in national and international markets)*, UPME, 2005.

spot market FOB in Richards Bay terminal was US\$35.82/t, as reported in December, 2003, considerably higher than the price in December 2002 which was US\$25.46/t. In the first quarter of 2004, the South Africa and Colombia coals reached FOB prices that ranged between US\$40 and US\$45/t.

The market projections prepared by the International Energy Agency<sup>60</sup> in a growing economy scenario, show that for 2010 the foreign trade of thermal coals might reach 584.3 Mt and 689 Mt in 2025. The Asian countries would increase their import participation from 54.5% in 2002 to 58.5% in 2010 and to 63.7% in 2025. On the other hand, it has been foreseen that Australia will keep as the exporter leader, although its current share would decrease from 24.1% to 23.3% in 2025.

*Table 4.1 Coal foreign trade projection, 2010-2025 (Mt)*

	Thermal coal		Coking coal		Total	
	2010	2025	2010	2025	2010	2025
Exporters						
Australia	130,8	160,6	133,5	143,4	264,2	304,0
United States	20,7	12,2	21,5	14,2	42,2	26,4
South Africa	83,0	92,3	1,7	1,1	84,7	93,4
former URSS	40,5	50,7	5,1	5,7	45,5	56,4
Poland	9,1	4,4	1,1	0,6	10,3	5,0
Canada	1,5	1,5	28,6	27,7	30,2	29,2
China	108,0	115,8	16,0	24,3	124,1	140,0
Sout America	87,7	128,4	0	0	87,7	128,4
Indonesia	102,8	123,1	12,9	12,9	115,7	136,0
TOTAL	584,3	689,0	220,3	229,8	804,6	918,8

Source: International Energy Agency

The coking coal market projection for 2010 foresees a volume of 220.3 Mt and 229.8 Mt for 2025. Australia, as the main supplier, would increase its market share with 62.4% of total; Asia countries (Taiwan, India, Japan, South Korea) will keep on being the largest purchasers (62.5%). Also, Brazil and Mexico in Latin America.

## 4.2 MARKET PERSPECTIVES FOR COLOMBIAN COAL

### 4.2.1 Offer situation

Coal resources have been found in the three cordilleras (Eastern, Central and Western) mainly in the North coast and in the country interior. The potential is 6.658 Mt coal and

<sup>60</sup> International Energy Agency, Energy Information Administration, National Energy Modelling System run IEO 2004, DO22304A (February 2004)

2.597 Mt for measured and noted resources and reserves, respectively.<sup>61</sup> With such figures Colombia becomes in the richest Latin America country in resources and bituminous coal reserves of excellent quality, thermal and coking.<sup>62</sup>

Approximately 75% of total resources and coal reserves are located in the Caribbean region and 25% in the interior departments. Thermal coals have been found mainly in La Guajira, Cesar, Cordoba, Antioquia, Cundiboyacense high lands, Valle del Cauca and Cauca. Coals for metallurgic use have been found in the center and eastern regions of the country, in the departments of Cundinamarca, Boyaca, Santander and Norte de Santander. There are also antracites in such departments. Colombian coal is generally recognized by its low ashes content, high volatile content, low sulfide content and high heating capability.

In 2003, 90.9% of national coal production, equivalent to 45.6 Mt, was destined to international markets. The main export destination of thermal coal was United States, representing 26.5% of their total value. In turn, the exports to European countries, as whole represented the 51.5% of such value. That same years, Colombia became the sixth worldwide coal exporter, as a result of the growing trend since the 1990s participating in the international market. At present, the Colombian coal share in the external markets is estimated in 8.5%.<sup>63</sup>

In the same period, the large-scale exploitations located in La Guajira and Cesar generated 86% of the exported volume; their comparative advantages are the open pit exploitation system and the closeness to export ports. In turn, medium scale mining (exploitations with volumes between 800 kt and 2.5 Mt) contributed with 4.2 Mt, i.e., 9.1% of total. Briefing, these two regions reached the 95.1% of total exports. Exploitations in El Zulia, Norte de Santander, contributed with 2.4% of foreign sales; while those located in Boyaca, Cundinamarca and Antioquia contributed with the remaining 2.5%.

In the next table it might be observed a future export vision through the projections made by department - district for 2004-2010. Such projections considered that 100% of Barrancas in La Guajira and La Jagua in Cesar production is destined to export, while for the country interior districts the export coefficient defined as the porcentual ratio of their volume with production volume was applied<sup>64</sup>. Thus, for 2004 the projections foresee that the coal

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<sup>61</sup> Empresa Colombiana de Carbón Ltda. - Ecocarbón, *Plan de Desarrollo del subsector Carbón 1999-2010 (Coal subsector development plan 1999-2010)*, Bogota, 1998.

<sup>62</sup> The reserve study prepared for Ingeominas by LGT. Perforaciones y Minería Ltda., of March, 2004, indicates a 17.184 Mt potential, from which 7.074 Mt are resources plus basic reserves; such figures are under review. That is the reason why this report has used the figures published by Ecocarbon in December, 1998.

<sup>63</sup> In 2002, pursuant to International Energy Agency, the coal international market was 457.4 Mt. In turn, Colombian exports registered 36.5 Mt, representing 8% share. In 2003, the Republic of China substantially reduce its exports, while Colombia increased them to 45.6 Mt.

<sup>64</sup> Export penetration coefficient: La Guajira-Barrancas 1.00; Cesar-La Jagua 1.00; Cundinamarca-Zipaquira 0.326; Boyaca-Paz del Rio 0.342; Norte Santander-Zulia 0.668.

export volume would totaled 49.9 Mt, increasing to 59.3 Mt in 2007 and reaching 69 Mt in 2010.

**Table 4.2 Coal export projection per district, 2004-2010 (kt)**

Mining product	2002 (True)	2003 (Pr)	2004	2005	2006	2007	2008	2009	2010
La Guajira- Barrancas	19.315	23.330	25.700	27.000	28.000	29.000	30.000	30.000	30.000
Cesar - La Jagua	15.722	19.946	21.800	23.200	24.700	27.100	29.600	32.200	34.800
Cundinamarca -Zipaquirá	455	489	521	554	590	626	665	717	756
Boyacá - Paz del Río	365	650	732	828	934	1.057	1.194	1.344	1.505
N. Santander - El Zulia	657	1.069	1.162	1.269	1.376	1.496	1.623	1.770	1.920
Antioquia - Amagá	0	0	0	0	0	0	0	0	0
Valle Cauca - Jamundí	0	0	0	0	0	0	0	0	0
Córdoba - Montelibano	0	0	0	0	0	0	0	0	0
<b>TOTAL</b>	36.534	45.494	49.915	52.851	55.600	59.279	63.082	66.031	68.981

Source: Calculation based on the information contained in the national coal offer projection table. (Pr: preliminary)

## 4.2.2 Commercial perspective

For the next two decades, at least, the perspective is favorable for thermal coal export, mainly due to the good behavior of international prices. Analysts of international coal market estimate that the increase in the energy consumption in United States, China and Asia is being reflected in the international market increase for thermal and coking coals by steel producers.

The coal production in Europe is still going down due to the subsidies elimination and industry reorganization for the imposed environmental limitations. However, it is expected that coal demand in Europe remains constant during the next decades and the thermal coal is increased with less carbon contents produced in other regions.

The Atlantic market is one of the most important ones in the coal international trade. Said market is formed by the east coast of the United States, Europe, Mediterranean countries, and Latin America. The estimations show that Atlantic coal market is around 172 - 182 Mt.<sup>65</sup>

<sup>65</sup> McCloskey's Steam Coal Forecaster, McCloskey's Coal Conference of The Americas, Cartagena, 2004.

As mentioned already, the thermal coal forecast shows South America, represented by Colombia and Venezuela, increasing their international market share, from 10.3% in 2002 to 15.0% in 2010 and to 18.6% in 2025. If so, the region might become in the second largest exporter, overcoming countries such as South Africa, Indonesia and China. Those markets that would absorb the Latin America offer would still be the European and the American continent.

The geographical situation of La Guajira and Cesar coal zones, with regard to main thermal coal consumer countries in the world, the resources and reserves potential, the associated infrastructure, its cost efficiency, allow that Colombia consolidates its international market position. The two large producers of the Caribbean coast, Carbones El Cerrejon LLC in Barrancas district and Drummond in La Jagua district, have already started expansion plans which will allow them to exceed together the 60 Mt in 2010. Said increase will be supplemented by the foreseen by several medium companies that operate in Cesar department. To achieve said plans, additional infrastructure projects will be required, which are mentioned below.

In turn, El Zulia district producers, with the improvements required in internal and external infrastructure could as per projections, duplicate their current production at the end of the decade. The Cundiboyacense high lands have interesting possibilities for coking coal exports and to meet the internal demand of thermal coal. It has been projected that for 2010 Zipaquirá and Paz del Rio districts together could reach a 6.7 Mt/year production. Nevertheless, the fulfillment of the projected export projection (2.3 Mt in 2010) is subject to the correction of a good part of their structure problems, such as the use of more productive technologies, strengthening of miners' capacity and entrepreneurial thinking with regard to their management ability in planning, production, commercialization and environment preservation phases.

Finally, it should be mentioned that the estimated production of thermal coal in Antioquia, Córdoba, Valle and Cauca will grow at a moderate pace to meet the internal demand, mainly.

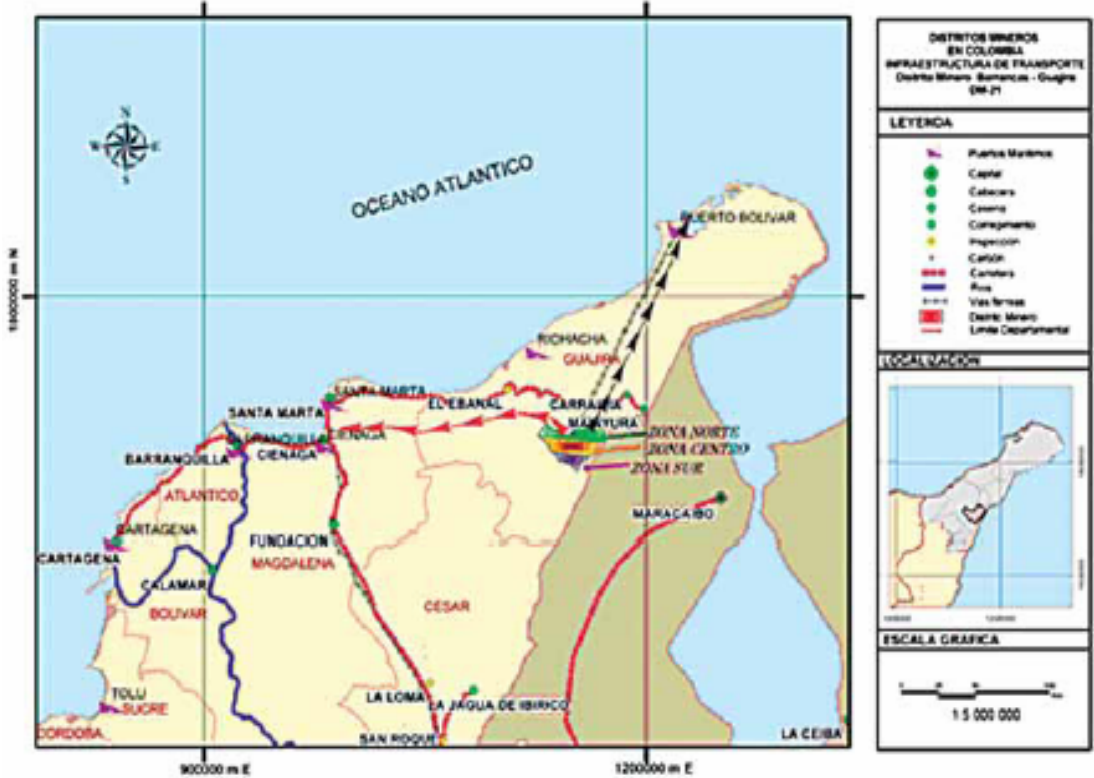
### **4.3 DISTRICT INFRASTRUCTURE FOR COAL EXPORTS**

Below the transportation and shipping infrastructure conditions existing for each of the six country coal districts with presence in international markets are reviewed and analyzed. Also, some considerations are presented on the coal districts with very low export development and on country zones with possibilities for integrating to the coal mining industry in the next future.

#### **4.3.1 Barrancabermeja District**

Access to Cerrejon is done by roads that head to Barrancas from Riohacha and Maicao or from Valledupar to Riohacha and Maicao. Also, by the road that goes from the mine to Puerto Bolivar and is connected in the four-way site with Riohacha - Maicao road.

Figure 4.1 Barrancas district - transportation infrastructure



Almost all Cerrejon operation in north and central zones which is comprised of exploration, production, transportation and shipping of thermal coals is being developed by Carbones del Cerrejon LLC, company property of the consortium formed by the affiliates of Anglo American Plc, BHP Billity Glencore, each with 33.33% of capital. In Cerrejon central zone operates Carbones Colombianos del Cerrejon S.A. who exploits the Caypa mine, property of La Comunidad del Cerrejon. The company is property of Pragma Energy S.A. with headquarters in Switzerland. Pragma is a trade company with business offices in United Kingdom, Hong Kong and Singapore.

Pursuant to the sale structure of Cerrejon companies, all the produced coal is destined to export, mainly to Atlantic market, which is comprised of United States, Europe and Mediterranean markets, and to Latin America countries.

**Table 4.3 Barrancas district coal exports, 1998-2004 (kt)**

Company	1998	1999	2000	2001	2002	2003	2004 pr
Cerrejón Zona Norte	16.831	17.444	19.200	18.058	15.389	17.840	14.674
Car. Col. del Cerrejón –							
La Comunidad	-	800	800	800	883	750	600
Consorcio Cerrejón-Patilla	-	-	-	-	-	1.987	5.784
Carbones del Cerrejón-							
La Comunidad	3.160	1.200	2.900	3.000	2.280	1.842	2.307
Carbones del Cerrejón-							
Oreganal	-	-	-	-	812	1.060	1.181
<b>TOTAL</b>	<b>19.991</b>	<b>19.444</b>	<b>22.900</b>	<b>21.550</b>	<b>19.315</b>	<b>23.479</b>	<b>24.546</b>

Source: Report to the Congress of Republic 2004-2005, Ministry of Mines and Energy (pr): Preliminary

- **Coal transportation and port infrastructure**

Most of district coal is exported through Puerto Bolivar, specialized terminal in coal management located in Portete Bay, in the north coast of La Guajira department. A less production volume (up to 600 kt) is transported by road and exported through Santa Marta port.

Transportation to Puerto Bolivar is made by railway, using the 150 km length line by which trains with up to 120 train cars circulate, each with unit transportation capacity of 100 tons. Puerto Bolivar receives ships of up to 175.000 t dead-weight, 300 m length and 45 m breadth. Access channel is 19 m deep, 265 m width and 4 km length.

Transportation to Santa Marta is made by road using the route Cuestecitas - La Florida - El Ebanal - Santa Marta, with 187 km length. The road is paved with exception fo La Florida - El Ebanal sector, which is 27 km length. Carbosan facilities, located in Sociedad Portuaria Regional (SPR) of Santa Marta are used in said city.

Coal flow projected for 2010 and port movement generated by the district are shown in the following tables:

**Table 4.4 Barrancas district coal flow (kt)**

Routes	2003 flow	2010 flow
Barrancas - Puerto Bolivar	22.730	29.400
Barrancas - Cuestecitas - El Ebanal - Santa Marta	600	600

**Table 4.5 Port movement generated by Barrancas district (kt)**

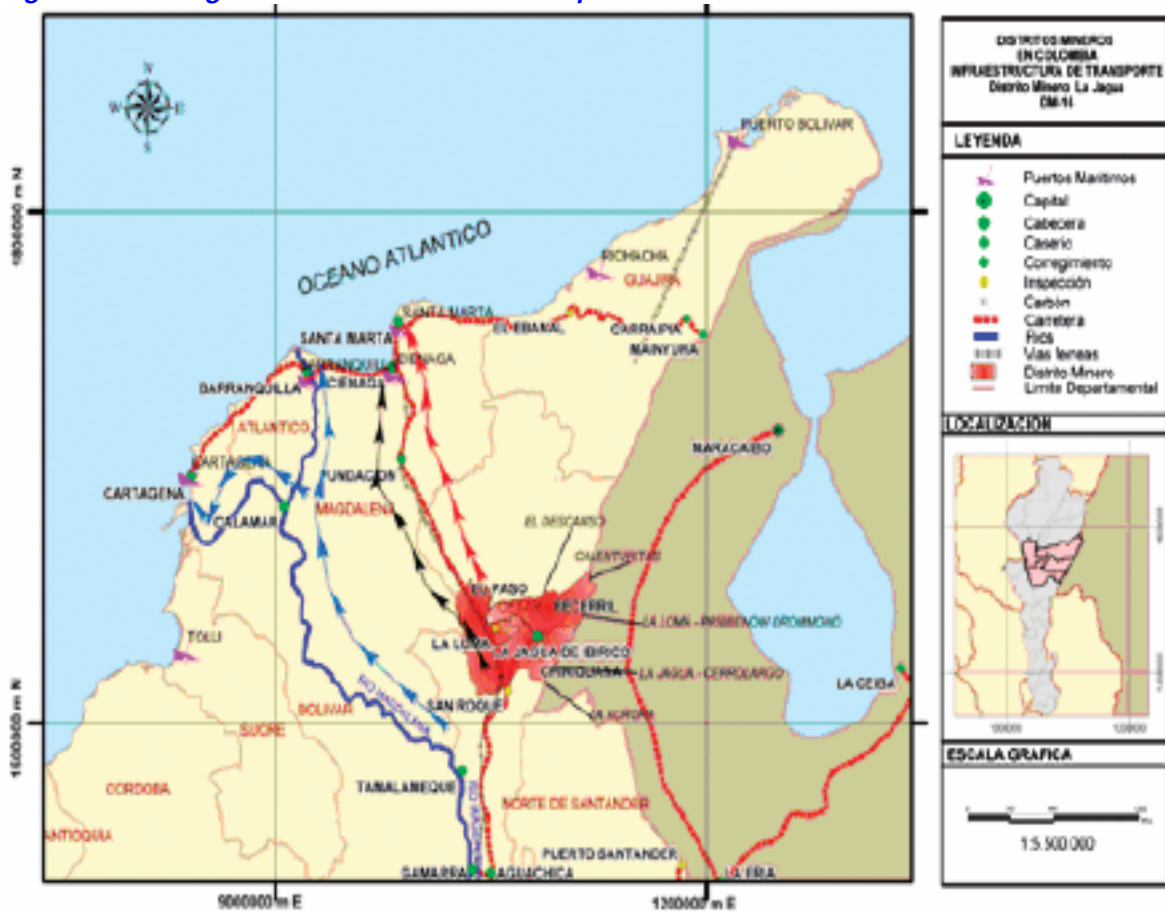
Production	SPR Santa Marta	Puerto Bolivar	Total
22.584	600	22.730	23.330



### 4.3.2 La Jagua de Ibirico district

Mining activity of the district is performed in La Loma and La Jagua zones. The first one, located at 100 km south of Valledupar, is accessed by the road that from Bogota and Bucaramanga goes to Santa Marta and Barranquilla, or by the branch that from San Roque goes to Valledupar and Riohacha. The region is crossed by Ferrocarril del Atlantico, which was recovered to Santa Marta for coal transportation. The second, located at 115 km of Valledupar, is accessed by the road that goes from San Roque to Valledupar and the Atlantic Coast.

Figure 4.2 La Jagua de Ibirico district - transportation infrastructure



Drummond Company Inc., Carbones del Caribe S.A., Carboandes S.A. and Consorcio Minero Unidos S.A. operate at La Jagua de Ibirico district. During 2003 the district production reached the maximum level, of 21.2 Mt distributed as: Drummond exploitation in La Loma contributed with 77.4% of total, Carbones del Caribe 10.9%, Carboandes 6.6% and Consorcio Minero Unido 4%.

*Table 4.6 La Jagua district coal exports, 1998-2003 (kt)*

Company	1998	1999	2000	2001	2002	2003	2004 pr
Drummond	6.330	6.794	8.678	12.290	12.688	16.397	20.454
Carboandes	1.100	826	420	314	526	1.053	394
Carbones del Caribe	1.340	1.414	2.020	1.706	1.640	1.454	1.942
Consorcio Minero Unido	640	649	750	713	789	1.011	1.058
Sororia				180	79	32	33
C.I. Prodeco							612
Norcarbón							65
<b>TOTAL</b>	9.410	9.683	11.868	15.203	15.722	19.947	24.558

Source: Report to the Congress of the Republic 2004-2005, Ministry of Mines and Energy (pr): Preliminary

The district offer projections indicate that in the short term it will become the coal production leader in Colombia and it is assumed that its whole offer will be destined to the international market, mainly to the Atlantic market countries.

- **Coal transportation and port infrastructure**

Coal from La Jagua district in Cesar is exported through the American Port. Co terminals (Drummond's property) and of Prode docks co in Cienaga, of Sociedad Portuaria Regional docks and of Cementos del Caribe in Barranquilla and of Colclinker docks in Cartagena.

Up to American Port Co., Drummond uses the railway La Loma - Cienaga of 190 km length, by which trains with 100 train cars are moved, each with 51 t. unit capacity.

Up to Prodeco, Santa Marta, Barranquilla and Cartagena ports, the road La Jagua - La Loma - Cienaga is used; it has 200 km length and is totally paved.

Up to Barranquilla and Santa Marta the road transportation and combined road - railway is used. In the first case, the road La Jagua - Barranquilla with 312 km length is used, there the coal is transferred to the river for its final journey up to Cartagena (405 km).

Cargo volumes for road and railway projected at 2010, as well as the port movement of coals coming from this district, are shown below:

**Table 4.7 Barrancas district coal flow (kt)**

Routes	2003 flow	2010 flow
La Loma - American Port Co - Drummond	16.396	28.000
La Jagua - Cienaga - Santa Marta	2.700	6.880
La Jagua - Tamalameque - Barranquilla/Cartagena	850	0
La Jagua - Tamalameque - Barranquilla/Cartagena	434	0

**Table 4.8 Port movement generated by La Jagua district (kt)**

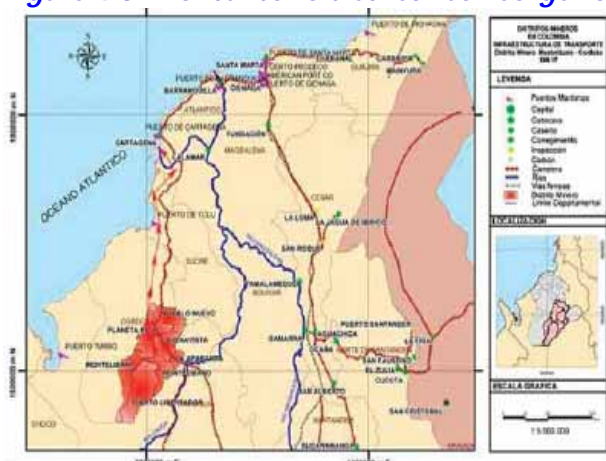
District	Production	SPR Santa Marta	Prodeco	American Port Co - Drummond	Cartagena Drummond	Total
La Jagua	21.152	845	1.855	16.396	850	19.946

### 4.3.3 Montelibano district - San Jorge Zone

Coals of this district have been located in San Jorge river valley, between San Jeronimo and Ayapel hills, in Cordoba department. Access to this zone is made by Troncal de la Costa by the road that from Planeta Rica goes to San Jorge high and from Montelibano to Puerto Libertador.

Since 1993 Carbones del Caribe started the open pit exploitation of La Guacamaya mine in Puerto Libertador municipality. Almost all its production is used to meet the needs of Tolcementos in Tolu and Colclinker in Cartagena. A small volume, 50 kt approx., is sold to Cerro Matoso plant.

**Figure 4.3 Montelibano district - San Jorge zone. Transportation infrastructure**



- **Coal transportation infrastructure**

Coal transportation is done by road to Cartagena using the road Puerto Libertador - Montelibano where it crossed with the Caucaasia - Monteria - Cartagena road. The district production is destined to internal consumption and goes to Cartagena and Cerromatoso plant in Montelibano. Its volume and projection are shown in Table 4.9. It is worth mentioning that trials of fluvial transportation using the Magdalena river and its tributaries were performed some years ago. However, at present, only the road transportation is used.

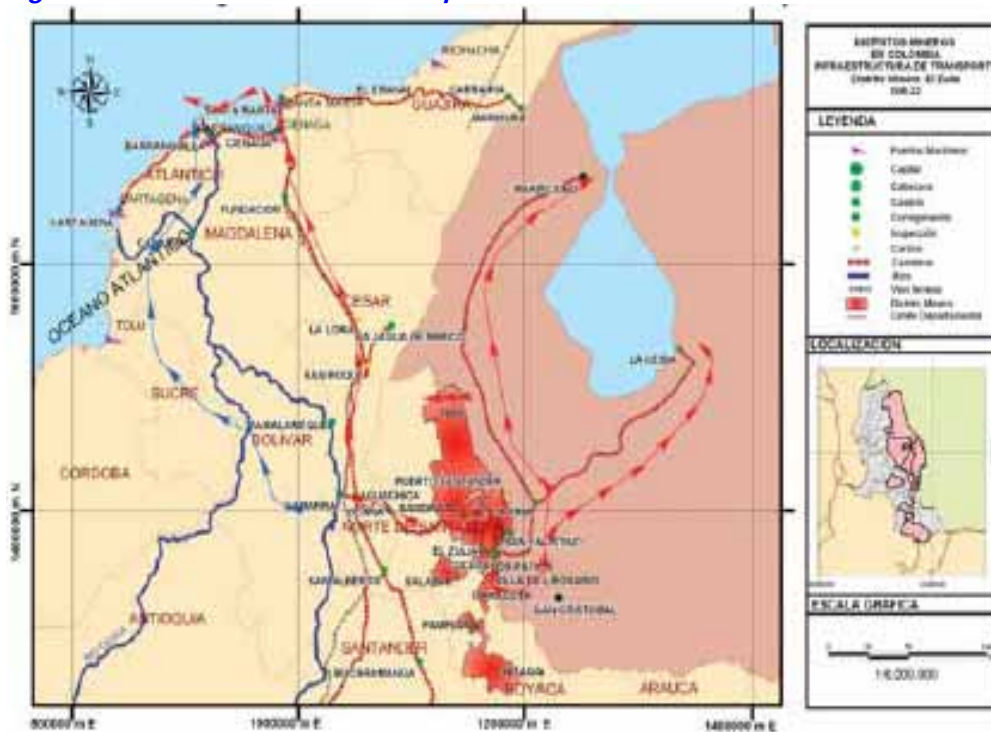
*Table 4.9 Montelibano district - San Jorge Zone coal flows (kt)*

Routes	2003 flow	2010 flow
Montelibano - Cartagena	154	225
Montelibano - Cerro Matoso	50	75

### 4.3.4 El Zulia district

This district is the third coal exporter after Barrancas and La Jagua de Ibirico. The production zones of the district are four: Zulia - Chinacota - Tasajero and Pamplona - Pamplonita, Catatumbo and Salazar. The two first are important for their coking coal potential and the second ones are thermal coal producers for internal consumption and export.

*Figure 4.4 El Zulia district - Transportation infrastructure*



Most miners devoted to coal production are associated to cooperatives that allow them trading a good part of the product, such as Asocarbon and Asominor. The largest company of the region and also exporter is Prominorte S.A., with an approximate monthly production of 12 kt.

*Table 4.10 Coal production, export and consumption of El Zulia district, 1988-2004*

Company	1998	1999	2000	2001	2002	2003	2004 pr
Production (kt)	960	787	760	929	929	1.600	1.283
Exports (kt)	560	525	424	872	657	1.069	1.073
Apparent consumption (kt)	440	262	336	57	272	531	210

Source: Report to the Congress of the Republic 2004-2005, Ministry of Mines and Energy (pr): Preliminary

Coal exporters operating in the district and coal volumes traded in 2003 are the following:

*Table 4.11 Coal exports of El Zulia district, 2003*

Exporter companies	Volume
Conminas	410.000 t
Colcarbes Ltda.	210.000 t
Corcarbon	340.000 t
CI IRT	100.000 t
Carbones del Caribe S.A.	150.000 t
Prominorte	150.000 t
<b>TOTAL</b>	<b>1.300.000 t</b>

Source: interviews to producers and traders, Cucuta, March 2004

- **Coal transportation and port infrastructure**

Most of the district coal is exported through Venezuelan ports using the roads Ureña - La Fria - Maracaibo (428 km), Ureña - La Fria - La Ceiba (352 km), Puerto Santander - Orope - La Ceiba (298 km) and Puerto Santander - Orope - Maracaibo (333 km). There is also a coal flow through Puerto Santander, at 54 km from Cucuta, where there exists an old binational railway bridge, enabled for vehicles traffic but with limited capacity (less than 10 t). Transportation through Venezuelan territory is subject to the inconveniences of the road international transportation, which implies delays in border crossings, controls along the journey and fluctuation in the foreign exchange of the local currency.

There are also roadways to Barranquilla using the road Cucuta - El Zulia - Ocaña - Aguachica - Barranquilla, with 667 km length. This road is paved with exception of 20 km sector. An alternate rout could be the combined transportation from Capulco port, near Gamarra, where coal could be shipped to Barranquilla.

Generated and projected coal flows in the district are shown in Table 4.12. It might be observed the foreign trade movements and the internal consumption that meets Norte de Santander demand. This last movement is made through the regional roads.

**Table 4.12 Coal transportation flows of El Zulia district (kt)**

Routes	2003 flow	2010 flow
Cucuta - Barranquilla		
Cucuta / Puerto Santander - La Fria - La Ceiba	270	576
Cucuta / Puerto Santander - La Fria - Maracaibo	689	1.244
<b>Other roads Norte de Santander</b>	530	960

District exports are made through Barranquilla and Venezuelan ports on Maracaibo lake (Palmarejo and Bulk Wayuu near Maracaibo city and la Ceiba at southeast the lake).

**Table 4.13 Port movement of El Zulia district (kt)**

Production	Barranquilla SPR and CC	La Ceiba Venezuela	Maracaibo Venezuela	Total
1.600	110	270	689	2.669

In coal transportation the border crossing is a critical factor in this district. In fact, the Francisco de Paula Santander bridge of Ureña shows congestion and the border proceedings take up to 10 hours. In Puerto Santander the cargo limits in the international bridge demand a double operation: in small trucks (3 t to 4 t capacity) the border is crossed up to Orope where the store site is. In Orope the coal is transferred to trucks with variable capacity between 33 t and 35 t for transportation to export port. For facilitating said operations, it has been proposed to construct a new international bridge in Guaramito, basically dedicated to coal transportation.

#### 4.3.5 Paz del Rio District

In this district there is a varied mining offer, but the main volume and export potential product is coal. A large part of its production is exported as thermal, metallurgic coal or transformed in coke. It also supplies the region market and the industries of Antioquia, Tolima and Valle del Cauca.

Figure 4.5 Paz del Rio district - transportation infrastructure



- Coal transportation and port infrastructure

It has been estimated that two thirds of coal exports originated in the district are made through Buenaventura port. For such purpose, the Duitama - Bogotá - Buenaventura is used, where the construction of double lanes in Duitama - Bogotá and Bogotá - Girardot was recently awarded. The third part of remaining exports are made through Barranquilla port. Coal transportation flows originated in the district are shown below:

Table 4.14 Coal transportation flow, Paz del Rio district (kt)

Routes	2003 flow	2010 flow
Boyaca - Tunja - Barbosa - Bucaramanga - Barranquilla	410	948
Boyaca - Tunja - Bogotá - Ibagué - Buenaventura	240	557
Sogamoso - Bogotá - Cali	200	463
Sogamoso - Bogotá - Medellín	90	203
Sogamoso - Bogotá - Ibagué	60	145
<b>Other roads Boyaca</b>	<b>900</b>	<b>2.084</b>

It is about export movements and internal consumption. Besides, there is a high movement in regional roads to assist the Boyaca department demand.

On the other hand, district exports are made through Barranquilla and Sociedad Portuaria de Buenaventura, as it might be observed in Table 4.15.

*Table 4.15 Port movement of Paz del Rio district (kt)*

Production	Barranquilla	SPR Buenaventura	Total
1.900	410	240	650

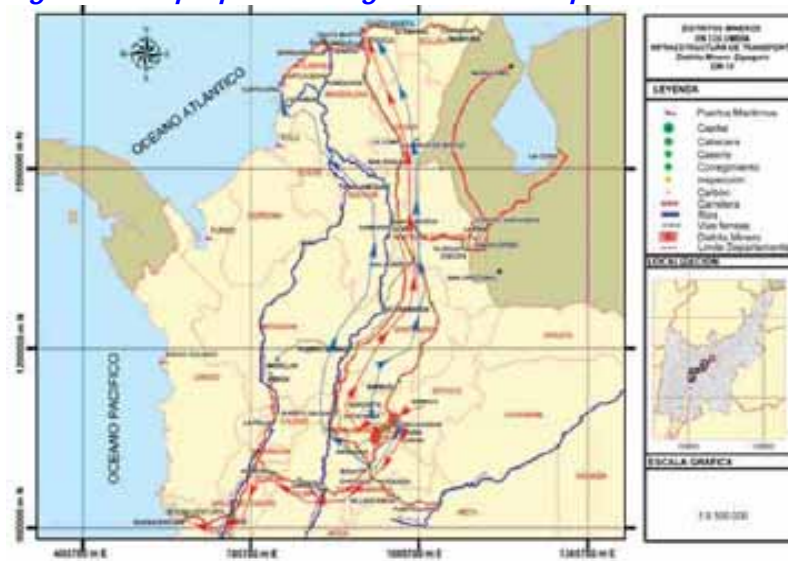
It has also been proposed for this district the possible use of the railway taking advantage of the lines recovery that is being made within the vial concession of Atlantico (Belencito - Bogota - Santa Marta line). Likewise, the combined transportation option is open using the paving of the road Barbosa - Velez - Puerto Araujo and from it to the Atlantic coast by railway or the Magdalena river.

### 4.3.6 Zipaquira district

The coal zone of the district has been defined by the extension of the outcrops and sub-outcrops of Guaduas formation and/or equivalent lithological units that contain coal levels. This zone is the third in importance in the country, with a total of 241.9 Mt measured reserves and 538.7 Mt indicated reserves.<sup>66</sup>

The main access ways to this district are the road Bogota - Ubaté - Chiquinquirá - Tausa - Lenguazaque - Cucunuba - Samacá, from which several small roads are derived which drive to the mining exploitation sites and the northeast railway that reaches Lenguazaque.

*Figure 4.6 Zipaquira mining district - transportation infrastructure*



<sup>66</sup> Empresa Colombiana de Carbón Ltda. - Ecocarbón, *Plan de desarrollo del Subsector Carbón 1999-2010 (Carbon subsector development plan 1999-2010)*, Bogotá 1998.



Coal exports of this district are made through Buenaventura in the Pacific Ocean and Barranquilla in the Atlantic Ocean. In the first case, the road Lenguazaque - Bogota - Ibague - Buga - Buenaventura is used with 586 km length. In the second case, the Lenguazaque - Bucaramanga - Barranquilla is used with 894 km length. In the future, once the Velez - Landazuri - Puerto Araujo paving is completed, it will be possible to use the combined transportation road - railway from this last port, or have by road a more favorable geometric layout for coal transportation.

It is also of importance in this district the so called Troncal del Carbon, the road that communicates Tierra Negra, Cucunuba, Lenguazaque and Samaca, municipalities where the main coal mines of Boyaca and Cundimarca high lands are located.

The coal transportation flows, generated and projected, of the district are summarized below:

*Table 4.16 Zipaquira district transport flows (kt)*

Routes	2003 flow	2010 flow
Lenguazaque - Ibague - Armenia - Buenaventura	389	605
Lenguazaque - Bucaramanga - Barranquilla	100	151
Lenguazaque - Bogotá - Ibague - Cali	250	391
Tierra Negra - Cucunuba - Lenguazaque - Samaca and others	760	1.173

Foreign trade flows destinations are Barranquilla and Buenaventura ports (Sociedad Portuaria Regional and the Dock 13 of the Fondo Rotatorio de la Armada).

*Table 4.17 Port movement of Zipaquira district (kt)*

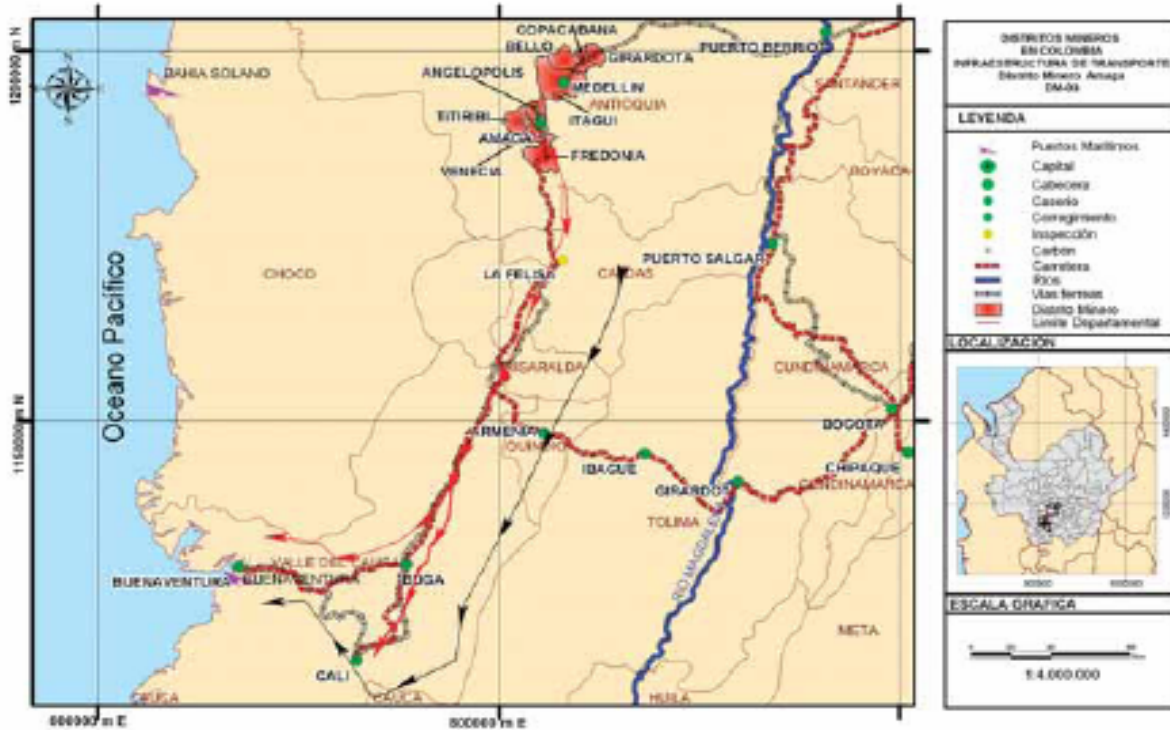
Production	Barranquilla	SPR Buenaventura	FR Buenaventura	ARC	Total
1.500	100	342	47		489

For exports through Atlantic it has been proposed the use of the railway line Lenguazaque - Bogota - Santa Marta, taking advantage of the lines recovery made by Concesión del Atlantico. Also, there are possibilities of combined transportation taking advantage of the road paving Barbosa - Velez - Puerto Araujo and from this last one by railway or river to the shipping ports at the Caribbean coast.

#### **4.3.7 Amaga district**

Villages of this district are communicated with Medellin by the Troncal del Café and by the road that goes from Amaga to Fredonia, Venecia and Bolombolo. This area is crossed by several penetration roads.

Figure 4.7 Amaga mining district - Transportation infrastructure



It has been estimated that 75% of district coal production is destined to Antioquia department consumption, mainly by the cement producing industry and by the textile sector. Around 24% is destined to meet Valle del Cauca industry and the remaining volume is exported through Buenaventura.

- **Coal transportation and port infrastructure**

In 2003 the district production reached 780 kt, from which 10 kt were exported through Buenaventura port, 185 kt were destined to Valle del Cauca industry and 585 kt to Antioquia regional market.

For transportation outside Antioquia the roads Amaga - La Pintada - Cerritos - Buga; Buga - Cali and Buga - Buenaventura are used. For transportation of coal consumed in Antioquia several roads are used, among them Amaga - Medellin. Coal flows moved by road and those projected are shown below:

Table 4.18 Transportation flows, Amaga district (kt)

Routes	2003 flow	2010 flow
Amaga - Buenaventura	10	0
Amaga - Cali	185	270
<b>Other roads Antioquia</b>	<b>585</b>	<b>630</b>

In this district the reconnection of the railway line La Felisa - Amaga was proposed for offering an alternate transportation to move the coal between Antioquia and Valle del Cauca. This line would connect with Pacific concession and besides, it would allow the origin - destination service for coal export through Buenaventura.

#### 4.3.8 Potential zones

In the national territory there are several potential zones for mining and coal export activity. Some of them are those that State entities have already explored, as those located in Santander department, whose reserves are estimated in 463.6 Mt.<sup>67</sup> Said areas are San Luis, the most important, Paramo El Almorzadero with antracitic coal, Vanegas - San Vicente de Chucurí - Cascajales river, Opon river - Landazuri, Capitanejo - San Miguel and Miranda and Molgovita.

On the State account zones of Cordoba, Antioquia, Cauca, Cundinamarca, Santander and Norte de Santander were explored, reaching in some cases the mining prefeasibility or feasibility stages. Under such perspective, pursuant to article 355 of the Mines Code, the mining authority has the power to bid the areas where the State has made geological-mining prospection investments.<sup>68</sup> In such case, the areas subject to said regulation are:

- El Carmen - Catatumbo in Norte de Santander department
- Paramo El Almorzadero in Santander and Norte de Santander departments
- El Hoyo in Cauca department
- San Luis in Santander department
- San Jorge in Cordoba department
- Amaga - Venecia - Bolombolo in Antioquia department
- Tibita in Cundinamarca and Boyaca departments

For those potential zones there are projects that would facilitate coal transportation up to the internal consumption centers or up to the export ports. To that extent, in El Carmen and Catatumbo zone, it is important to improve the Rio de Oro - La Gabarra - Tibu - Astilleros road; likewise, to improve the connection Tibu - Puerto Santander, which would allow an integration with El Zulia district. In the zones of Paramo del Almorzadero in Santander and in el Hoyo in Nariño - Cauca, there are main roads such as Capitanejo - Malaga - Pamplona - Cucuta and Mojarras - Popayan - Cali. In the zone of San Luis, Santander, the presence of the vial network around Barrancabermeja allows the transportation, directly by road to the ports or through the combined transportation road - railway or road - river. In the zone of San Jorge, Amaga - Venecia - Bolombolo, San Jorge and Tibita, the same infrastructure available in San Jorge, Amaga and Zipaquirá districts could be used.

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<sup>67</sup> LT. Geoperforaciones y Minería Ltda. Informe Preliminar (Preliminary Report), Bogotá, 2004

<sup>68</sup> Ministry of Mines and Energy, *Memorias al Congreso de la República (Report to the Congress of the Republic)*, 2003

#### 4.4 INFRASTRUCTURE EVALUATION

##### 4.4.1 Available infrastructure for coal transportation

Coal moving from mines to ports in Atlantic and Pacific Colombian coasts and in the Atlantic Venezuelan coast, as well as the transportation means used, are shown below:

*Table 4.19 Origin, destination port and transportation mean*

Departments	Export port	Transportation mean
Antioquia	Buenaventura	Road
Boyaca - Cundinamarca	Buenaventura	Road
Boyaca - Cundinamarca	Barranquilla	Road
Boyaca - Cundinamarca	Cartagena	Road
Córdoba	Cartagena 1	Road
Guajira (Cerrejón Central Comunidad)	Carbosan (Santa Marta)	Road
Cesar	Carbosan (Santa Marta)	Road
Cesar	Prodeco	Road
Cesar	Barranquilla 2	Road
Cesar	Barranquilla	Road
Cesar	Cartagena Colclinker	Road
Cesar La Loma	American Port Co	Railway
La Guajira	Puerto Bolivar	Railway
Norte de Santander	Maracaibo	Road
<b>Norte de Santander</b>	Maracaibo	Road

1/Colclinker consumption

2/Part for Cementos del Caribe consumption

The infrastructure used for coal transportation is formed by the following railways, roads and fluvial ways:

*Table 4.20 Coal transportation infrastructure*

Mean	Work	Length (km)	Capacity (t/year)	Districts
Railway	Cerrejon line	150	29.000.000	Barrancas
	La Loma - Santa Marta line	220	22.000.000	La Jagua de Ibirico
	Paz del Rio line	39		Paz del Rio
Roads	Cuestecita - Santa Marta	180		Barrancas
	La Loma - Santa Marta and La Loma - Cartagena	Santa Marta 217 Cartagena 358		La Jagua de Ibirico
	Lenguazaque - Bogota - Buenaventura vial corridor	586		Zipaquirá - Paz del Rio

	Lenguazaque - Bogota - 1091 Barranquilla vial corridor		Zipaquirá - Paz del Rio
	Norte de Santander vial corridor	La Ceiba 300 Maracaibo 415	Zulia
	Amaga - Bolombolo - Cali	568	Amaga
<b>Combined: Fluvial and road</b>	La Loma - Tamalameque and Barranquilla - Cartagena	Fluvial 406 and road 113	La Jagua de Ibirico

According to Ministry of Transportation data, in 2002 this infrastructure was used for moving 35.4 Mt approx. of coal. From this total, 88% corresponded to railway transportation, 11% to road and 1% to fluvial.

For 2010 the national coal production has been estimated in 75.8 Mt and for 2020 the estimated goal is 106 Mt, which generates an equivalent transportation demand. In those periods, the export distribution per origin deposit would be as follows:

*Table 4.21 Coal production and exports projection (Mt)*

Year 2010	Cerrejon	La Jagua	Paz del Rio	Zipaquirá	Amaga	Zulia
Produced coal projection Mt/year	30.000	34.800	3.100	4.300	0.900	2.300
Export volume Mt/year	30.000	34.800	1.505	0.756	0.000	1.920
Year 2010	Cerrejon	La Jagua	Paz del Rio	Zipaquirá	Amaga	Zulia
Production goal	42.000	54.000	3.100	4.300	0.900	2.300
<b>Export volume</b>	42.000	54.000	0.803	0.617	0.000	1.358

#### 4.4.2 Freight and operation costs

The investigated road transportation freight vary pursuant to the source consulted. Between La Jagua and Santa Marta there are values per ton that range between US\$7.90 and US\$9.00 and between Lenguazaque and Buenaventura said values range between US\$15.00 and US\$17.00. Costs per t-km get to a maximum of US\$0.056. Railway costs are more homogeneous than road costs.

In fact, they have less variation per t-km and are below US\$0.01. The estimated fluvial transportation cost for Tamalameque - Cartagena is US\$3.78 per ton, according to Carbones del Caribe, which is equivalent to US\$0.01 per t-km.

In order to supplement the freight information, the evaluation models of the Ministry of Transportation costs and other studies were used. Said calculations (Table 4.22) reflect the operation costs but, obviously, there are differences between the costs and actual freight, cause by the cargo compensation availability, the vehicles offer, road status and others.

*Table 4.22 Calculated costs for road transportation*

Route	Distance	US\$/t	US\$/t-km
La Jagua - S. Marta	285	7,56	0,027
La Jagua – Barranquilla	312	8,08	0,026
Cerrejón - Santa Marta (Florida Ebanal con pav)	187	5,72	0,031
Lenguazaque – Buenaventura	586	17,78	0,030
Lenguazaque - P. Salgar – Barranquilla	1.091	29,95	0,027
Troncal del Carbón Sin Pavimento	72	4,06	0,056
Cúcuta – Barranquilla	667	18,68	0,028
Cúcuta - La Ceiba	324	8,64	0,027
Cúcuta – Maracaibo	417	10,13	0,024

Costs calculated for fluvial transportation (Table 4.23) increase as the convoys become smaller as in the case of the routes Puerto Araujo - Barranquilla and Puerto Salgar - Barranquilla, where the river conditions make that the type and number of barges be less than the one in other routes such as Tamalameque - Barranquilla.

**Table 4.23 Calculation of fluvial transportation costs**

Routes	Distance	\$/t	US\$/t	US\$/t-km
Tamalameque – Baranquilla	405	13.089	4,55	0,011
Gamarra – Barranquilla	505	15.742	5,47	0,011
Puerto Araujo – Barranquilla	757	28.148	9,79	0,013
Puerto Salgar – Barranquilla	915	47.768	16,61	0,018

Finally, with regard to railways, there not many comparison parameters since only Drummond and Cerrejon projects operate for coal transportation with particular characteristics. The cost calculation between La Loma and Cienaga was made taking the Ministry of Transportation information and other previous studies, resulting in a cost of US\$0.0165 t-km, which includes the toll per ton of US\$2.75. The estimated cost per ton between La Loma and Santa Marta is US\$3.59. For other sectors of the railway network, it was estimated a cost of US\$0.025 per t-km. Concluding, except for the railway transportation between La Loma and Cienaga that must pay the toll, the calculated costs per t-km are consistent with the investigated freight.

#### 4.4.3 Restrictions of the current transportation infrastructure

During the interviews performed with exporters and port operators, their opinion about the infrastructure works that affect or difficult the port capacity expansion for coal export were obtained. The following is a summary of said opinions:

- In La Jagua de Ibirico district the current railway line capacity is saturated and taking into account the priority given to one company for its use, there is not a real access possibility for other users. In addition, the San Roque - Santa Marta road has capacity limitations to support the transportation of the exploitation volume increase that are being planned for this mining district.
- In Paz del Rio and Zipaquirá districts the coal export through Barranquilla ports, using the Magdalena river, has a restriction derived from the river depth during summer time, mainly Barrancabermeja upstream.
- In El Zulia district, the exporters believe it is important the vial connection with Venezuela, but they estimate it is necessary to complete the paving of Cucuta - Ocaña - Aguacalara way in order to have a route for the coal export through Colombian ports.

#### 4.4.4 Available port infrastructure for coal shipping

At present there are ten maritime terminals in Colombia for coal export, eight in the Atlantic coast and two in the Pacific coast. In six of them the general cargo or other bulk products docks are used while Cerrejon, Drummond and Prodeco ports were built specially for coal.

Prodeco and Drummond terminals carry out the load to barge operation by means of conveyors to load the barge and load ship operations made off shore. At Cerrejon terminal in Puerto Bolivar the direct load to ship is done by means of conveyors and a lineal type load equipment to ship. Table 4.24 shows the terminals location and characteristics for coal shipping.

*Table 4.24 Port infrastructure for coal export*

Terminal	Location	Operative system	Load capacity (Mt/año)	Ship capacity (dwt)
Carbosan 1/	Santa Marta	Direct load	3.0	70.000
Prodeco 1/	Santa Marta	Barges and off shore platform	5.0	180.000
Cementos Caribe 1/	Barranquilla	Direct load	1.0 3/	35.000
Colclinker 1/	Cartagena	Direct load	1.0 3/	65.000

Puerto Mamonal S.A.	Cartagena	Dock	0.2	10.000
Sociedad Portuaria Regional de Barranquilla 1/	Barranquilla	Dock	0.5	20.000
American Port Co. 2/	Ciénaga	Barges and off-shore platform	25.0	180.000
Puerto Bolivar 1/	Puerto Bolívar	Direct load	29.0	180.000
Sociedad Portuaria Regional de Buenaventura 1/	Buenaventura	Dock	0.6	35.000
<b>Muelle 13 1/</b>	Buenaventura	Dock	0.35	35.000

1. Information obtained during the visits to terminals.

2. Information obtained from Augusto Jimenez' presentation in McCloskey Coal Conference of the Americas 2004.

3. Capacity depending on requirements of other products moving by the port

For the purpose of evaluating the specialized port infrastructure existing in ports and terminals of the Atlantic and Pacific coasts, their current characteristics and expansion plans foreseen by their owners and operators were evaluated. The basic information of the three terminals under planning or construction was included: Aguadulce port in Pacific coast and Carbones del Caribe port in Cienaga (under construction) and Puerto Zuñiga in Santa Marta. Also, the existing port facilities on Maracaibo gulf in Venezuela, in Maracaibo and La Ceiba were evaluated, through the El Zulia coal is exported.

In addition to the aforementioned port projects, several port projects in both Atlantic and Pacific oceans have been proposed. At the Atlantic there are two offers on new options of the Bocas de Ceniza (Barranquilla) port, denominated Sociedad Portuaria de Palermo for coal moving and Sociedad Portuaria de Bocas de Ceniza at the Pacific, besides of Aguadulce port above mentioned it has been proposed the Dagua river delta, where solid bulk could be handled.

According to the information obtained during the interviews and visits carried out during the study as well as with information contained in recent consulted reports, information shows that they vary between US\$1.42 and US\$6.25 per ton.

Comparison to fees of other international specialized ports allow to conclude that in Puerto Bolivar and American Port Co. terminal which move around 20.000 kt / year, their costs are comparable to most of the world coal ports, while small ports that move less than 5.000 kt /year generate a surcharge to the Colombian coal of US\$2 to US\$3 per ton.



## 4.5 INFRASTRUCTURE PROJECTS PRIORITY TO COAL MINING

### 4.5.1 Coal internal transportation perspective

It has been estimated that in 2010 the coal national production will total 75.8 Mt. Production of La Guajira and Cesar mining projects oriented to export, will reach 64.8 Mt. which will be transported basically through railways. The remaining production will have to move through the shared railway infrastructure (for such purpose the recovered Atlantic lines will be used), the Magdalena river (Yuma project for fluvial navigation recovery) and roads such as paving Velez - Landazuri - Puerto Araujo road (for Cundiboyacense high lands coal), El Burro - Tamalameque (Cesar) and El Ebanal - Florida (Guajira).

It has been foreseen for 2010 a 6.7 Mt production in Boyaca and Cundinamarca. A few more than the third part of production will be oriented to export (coking coal) thus, it is required to have port options, both in Atlantic and Pacific, and with an adequate infrastructure for internal transportation. In the first case, the unimodal transportation possibilities by railway and road have been studied, as well as the combined transportation by railway - river (transfer center at Magdalena Medio), road - railway (transfer center in Puerto Araujo) and road - river (transfer center in Puerto Araujo).

Coal production in Norte de Santander projected for 2010 is 2.9 Mt and will keep transporting by road. To that extent, the solutions regarding binational transportation facilitation are important.<sup>69</sup> As an alternate route, in the event of any difficulty for the use of Venezuelan ports, the Cucuta - Ocaña - Aguaclara - Gamarra - Capulco is available; it allows intermodal connections road - railway and road - river.

Amaga coals with a projected production of 0.9 Mt in 2010 will be transported by road to Valle del Cauca. However, since at present it has been proposed to reconnect the national railway network between Bolombolo and La Felisa, this mean could be a transportation alternative.

Finally, the production of other coal mining centers such as Jamundi and Montelibano - San Jorge shall keep transporting by road since it is low cargo volumes (below 0.5 Mt in 2010) and destined to local market.

### 4.5.2 Port infrastructure perspective

Currently, it is necessary to enlarge the American Port Co. capacity to allow the coal export from La Loma and El Descanso, whose combined production will reach 40 Mt in 2020, mainly

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<sup>69</sup> The construction of a new international bridge has been proposed for diminishing the transport distance and even the construction of a binational railway.

due to Drummond increases. Project funding should be obtained or granted directly by Drummond.

After 2010, it will be necessary to enlarge the Puerto Bolivar capacity to meet the export goal of 42 Mt in Barrancas district. Project funding should be obtained or directly granted by Carbones del Cerrejon LLC.

Upon Glencore consult, owner of coal deposits in Cesar that were of Carbones del Caribe, it was confirmed that the negotiation did not include the port since the latter was constructing in Cienaga. Likewise, it was reported on the development and consolidation of La Jagua and Calenturitas deposits exploitation, that for 2004 - 2020 scenario might reach 13.7 Mt. This could make it necessary to put forward the designs and construction of Puerto Integrado de Carbon - PIC (Coal integrated port) before the expiration of the current concession of Prodeco port in year 2009. Funding of this project could be obtained or directly granted by the beneficiary companies, i.e., Glencore and the other La Jagua deposits exploiters, with exception of Drummond.

For the foreseen export volumes in the period 2004 - 2010 from El Zulia district, at first no new port projects are required in the Maracaibo gulf area, unless the new Catatumbo coal deposits exploitation generate additional volumes so important that they dominate the available port capacity and the Palmarejo port potential, cases where such investments should be carried out by the new projects investors.

Carbosan terminal in Santa Marta will, for sure, keep on exporting coal from Comunidad del Cerrejón; however, given the purchase of Carbones del Caribe, it is quite probable that coal from La Jagua de Ibirico, currently exported through said terminal, will concentrate at Prodeco's terminal and later at PIC. Therefore, an available capacity between 1.5 Mt and 2 Mt of per year of coal from the country interior, might be available.

For the coal export from Zipaquirá and Paz del Rio districts, there will be availability of port capacity at the following terminals: SPRBUN and Muelle 13 of Buenaventura at Pacific coast. At the Atlantic coast, the available capacity in Carbosan terminal in Santa Marta, in the SPRB terminals and in Sociedad Portuaria del Norte in Barranquilla, as well as in Sociedad Portuaria de Mamonal terminals and possibly in Muelles el Bosque in Cartagena. Added capacity of Atlantic coast terminals is enough for the foreseen coal volumes from interior.

The Buenaventura port (SPRBUN and Muelle 13) should increase their capacity and improve the operation to allow the coal volume export of Cundiboyacense high lands, projected for 2010 and following years. These works should be financed by the terminals concessionaires. Should any problem arise for achieving the required port capacity increase, or due to environmental restrictions for being in the city's constructed area, there is the Aguadulce project option, although its construction depends on the general feasibility of the port project and not only on the coal available for export. Such investments should be made by the private sector.

### 4.5.3 Priority projects

In order to prioritize the investment plan on infrastructure works, it is a previous and necessary condition to have the technical and financial feasibility studies of the projects available for comparison and priority purposes. In this case, this essential analysis elements is not available for many of the works identified as necessary for reaching the coal export projections and goals, consequently it has been required to use the alternate methodology by defining some objective criteria that might be qualified and weighed, such as the possibility of increasing or not the ore export capacity when having the infrastructure, like the cost-efficiency and an elemental financial criteria like the recovery investment term by savings in transportation costs.

The infrastructure projects were identified according to the coal production projection for 2004-2010 and to the large project goals for 2020. Subsequently, they were grouped in two large categories: works under the Nation's responsibility, whether for direct execution or for promoting their execution, and works under the private sector's responsibility, represented by companies with operation titles of the coal mines under exploitation. Such projects are shown in the following table:

*Table 4.25 Identified infrastructure projects*

<b>Works undertaken by or with the Nation's participation</b>	<b>Works undertaken by the private sector</b>
Increase of the current La Loma - Santa Marta railway line capacity to meet the Cesar producers' needs. Construction of La Loma - La Jagua branch (for La Jagua district coal).	Increase of the current La Loma - Santa Marta capacity to meet Drummond's requirements and the construction of the new line La Jagua - Santa Marta for La Jagua, Calenturitas and El Hatillo deposits (alternate project)
Vial connection with Venezuela Guarumito - La Fria	Railway enhancement Cerrejon mine - Puerto Bolivar
Paving Troncal del Carbon Tausa - Samaca	Enhancement and enlargement American Port Co. port
Paving El Burro - Tamalameque	Enhancement coal Buenaventura port or construction Aguadulce port
Paving El Ebanal - Florida road	Design and construction Puerto Integrado de Carbon, PIC, including the railway branch Don Jaca - PIC
Adaptation Puerto Capulco (work in execution) Feasibility study railway branch La Jagua - Chiriguana and Palestina - Tamalameque	
Works needed for coal export	Works needed for coal export

period 2010 - 2020	Period 2010 - 2020
Construction second line Don Jaca - La Loma when the coal volume to be exported exceeds the current line capacity, with the foreseen capacity increases for 2004 - 2010.	New dock, ship loader and increase of yard capacity in Puerto Bolivar (for 42 Mt)
	Enlargement of port capacity American Port Co in the Papare area (up to 40 Mt)
	Enlargement of railway capacity, Cerrejon mine and Puerto Bolivar (for 42 Mt)

The following criteria, although different than the traditional financial criteria as benefit/cost relation, Internal Return Rate (IRR) or Net Present Value (NPV) of benefits, allowed the infrastructure project comparison and prioritization:

- Criterion 1: Possibility of increasing or not the coal export capacity by having the infrastructure (verification that the work is indispensable for reaching export projections in 2010, since in the event it is not available, said projections will not be met)
- Criterion 2: Cost-efficiency: Less investment per exported coal ton.
- Criterion 3: Financial: term for investment recovery by means of savings in transportation cost (less number of required years).

Each of said criteria was assigned with a percentage weight that allows weighing it with regard to each relative relevance. Such weigh functioned as follows:

Possibility of export capacity increase. The work is essential for reaching the export projections in 2010 (40% weigh).

Cost - efficiency: Less ratio exportable coal investment/volume (30% weigh).

Financial: Number of years for covering the investment with transportation cost reduction (30% weigh).

Rating was made assigning a 100% value to the essential works for reaching the export projection or 0% if there are transportation viable alternatives for moving the foreseen coal volume.

The ratio between foreseen investment (I) and exportable coal volume (V) in 2010 was calculated and 100% of rating was assigned to the project with the minor ratio  $(I/V) = (I/V_{min})$  and the others were assigned with percentages proportional to the ratio I/V of each project, as follows:

$$\%n = (I/V) \text{ min} / (I/Vn).$$

Also, the number of years for recovering the investment was calculated by the savings of transportation cost and 100% of rating was assigned to the project that requires the lesser number of years = (# min) and the others were assigned with percentages proportional to the number of years of each project, as follows:

$$(\#) \text{ min} / (\#n).$$

For estimating the number of years for recovering the required investment, the saving per ton of coal transported between the origin point and the export port was used; such saving is calculated by comparing the transportation costs using the mean or way by which the coal is currently transported versus the costs obtained if the work were constructed. As an annual transported average volume the average between estimated export volumes for 2004 and estimated for 2020 was adopted, assuming a lineal variation.

Table 4.26 shows the result of the priority analysis of projects to be executed directly by the Nation or coordinated by it, using the above described methodology. The works to be financed by the private sector have not been included since their execution priority does not depend on the national government nor the works already in execution since their priority has been defined already, neither the studies because the methodology is not applicable thereof.

**Table 4.26 Priority projects**

Work	Essential for export goal	Investment/ coal volume	Years saving transportation cost	Weighed score	Priority
% Weigh	40%	30%	30%	Total	
Capacity increase current railway La Loma - Santa Marta to meet Drummonds' and third parties' needs	100	42.5	100.0	82.8%	1
Construction railway branch La Loma					
La Jagua (for La Jagua district whole coal)					
Construction second railway line Don Jaca - La Loma, when coal volume to export exceeds the capacity increase of current line La Loma - Santa Marta					
Capacity increase current railway line La Loma - Santa	100	39.9	93.8	80.1%	2

Marta to meet Drummond's needs					
Construction new railway line La Jagua - Santa Marta for La Jagua, Calenturitas and El Hatillo deposits (alternate project)	0	23.9	0.5	7.3%	6
Paving El Ebanal - Florida road	0	100.0	30.4	39.1%	4
Paving Troncal del Carbon Paving El Burro - Tamalameque road	0	25.8	0.7	7.9%	5
<b>Vial connection with Venezuela Guarumito - La Fria</b>	0	47.3	89.1	40.9%	3

In the case of alternate projects for the railway between Jagua de Ibirico district deposits and the ports, two execution alternatives have been considered:

- Alternative 1: Capacity increase of the current railway line to meet Cesar producers' needs and the construction of La Loma - La Jagua branch during 2004-2010 period for La Jagua district coal. Subsequently and perhaps for 2010-2020 period, the second line Don Jaca - La Loma line should be constructed, when coal volume to be exported exceeds the current line capacity with capacity increases foreseen for 2004-2010 period.
- Alternative 2: Capacity increase of the current line to meet Cesar producers' needs and the construction of a new independent line.

The analysis result shows that the priority is for those projects justified by their close relation with coal exploitation activity. In contrast, those infrastructure projects mostly used for transporting other commodities or services, besides of coal, are regarded with less priority.

In conclusion, there are four priority projects, as follows: a) In Cesar and Magdalena departments, the capacity increase of current railway line to meet mining activity expansion needs; the construction of La Loma - La Jagua branch and the construction of the second railway line Don Jaca - La Loma. b) Capacity increase of the current railway and construction of the new line La Jagua - Santa Marta. c) In Norte de Santander department, the connection with Venezuela through Guarumito. d) In Cundinamarca and Boyaca departments, paving the Troncal del Carbon.

STATISTICS ANNEX

## MAIN MINERAL PRODUCTION

2000 - 2005

Mineral	Unit	2000	2001	2002	2003	2004	2005 pr
Metals and precious gems (1)							
Gold	Kg	37.018	21.813	20.823	46.515	37.739	24.918
Silver	Kg	7.970	7.242	6.986	9.511	8.539	5.614
Platinum	Kg	339	673	661	828	1.209	830
Emeralds*	Kilocarat	8.453	5.499	5.391	8.963	9.825	5.831
Industrial minerals							
Salt (2)	T	177.690	184.278	191.554	199.364	231.721	162.941
Sea salt (2)	T	282.188	384.159	335.783	247.901	294.343	311.055
Sulphur (3)	T	91.966	69.344	60.162	73.024	97.586	
Limestone for cement (4)	Kt	18.462	17.707	17.364	19.145	20.004	18.161
Metallic minerals							
Copper (concentrate) (5)	T	9.501	9.243	8.526	7.270	7.840	5.800
Iron ore(6)	T	660.109	636.837	688.650	625.002	642.546	498.623
Ferronickel (1)	T (**)	27.730	38.438	43.978	47.868	48.818	39.696
Fuel minerals							
<b>Coal (1)</b>	<b>Kt</b>	<b>38.242</b>	<b>43.911</b>	<b>39.484</b>	<b>50.028</b>	<b>53.693</b>	<b>12.161</b>

Sources: (1): Minercol (2000 - 2003) Ingeominas (2004 - 2005)

(2): IFI Concesión Salinas

(3): Emicauca

(4): Cement production figure reported by ICPC multiplied by 1.4 factor

(5): Acerías Paz del Río

(Pr): Preliminary information: 3Q 2005

\* Equal to exported emeralds

\*\* Conversion factor from pounds to tons: 1 lb = 453.6 g

Prepared by: UPME - Subdirección de Información Minero Energética

**NATIONAL COAL PRODUCTION PER ZONES 2000 - 2005**

*Thousand of tons (kt)*

Coal zone	Projects	2000	2001	2002	2003		2004 pr	
					Thermal	Metallur		
La Guajira	Zona Norte	18.400	19.405	15.035	16.461	0	16.461	20.458
	Carbones Colombianos del Cerrejón	800	1.002	833	800	0	800	601
	Carbones del Cerrejon	2.900	3.269	1.625	4.210	0	4.210	2.307
	Carbones del Cerrejon-Oreganal			584	1.113	0	1.113	1.181
Total La Guajira		22.100	23.676	18.077	22.584	0	22.584	24.547
Cesar	La Loma - Drummond	8.874	12.336	12.967	16.363	0	13.636	20.454
	Carboandes	285	314	798	1.423	0	1.423	394
	Carbones del Caribe (1)	2.020	1.916	1.723	2.310	0	2.310	2.387
	Consorcio Minero Unido	750	713	810	1.023	0	1.023	1.071
	Cerrolargo Centro	100	0	0	0	0	0	0
	C.I. Prodeco S.A.			34	0	0	0	612
	Siminera	0	0	0	0	0	0	0
	Norcarbón	0	16	0	0.5	0	1	77
	Sororia	0	90	54	32	0	32	33
Total Cesar		12.029	15.385	16.385	21.152	0	21.152	25.028
Total Cordoba	La Guacamaya	100	141	119	204	0	204	351
Interior country	Antioquia	700	648	674	780	0	780	257
	Boyaca	1.200	1.765	1.549	1.444	456	1.900	1.204
	Cundinamarca	970	1.029	1.440	1.020	480	1.500	917
	Norte de Santander	760	929	906	1.168	432	1.600	1.283
	Valle del Cauca	294	242	272	269	0	269	106
	Santander	0	0	0	0	0	0	0
	Cauca	89	96	62	39	0	39	-
Total interior		4.013	4.709	4.903	4.720	1.368	6.088	3.767
<b>Total nation</b>		<b>38.242</b>	<b>43.911</b>	<b>39.484</b>	<b>48.660</b>	<b>1.368</b>	<b>50.028</b>	<b>53.693</b>



Source: Minercol 2000 - 2003; Ingeominas 2004 - 2005  
As of 2005 named as Carbones de La Jagua S.A.  
(pr): Preliminary information, 2005 1Q

Prepared by: UPME - Subdirección de información

***NATIONAL COAL EXPORTS PER ZONES AND PROJECTS 2000 - 2004***  
***Thousand of tons (kt)***

Coal zone	Projects	2000	2001	2002	2003			2004 pr
					Thermal	Metallur	Total	
La Guajira	CarrejonZona Norte	19.200	18.058	15.389	17.840		17.840	14.674
	Consortio Carrejon-Patilla	0	0	0	1.987		1.987	5.784
	CarbonesColombianos del Carrejon-La Comunidad	800	1.002	833	750		750	600
	Carbones del Carrejon-La Comunidad	2.941	3.269	2.280	1.842		1.842	2.307
	Carbones del Carrejon-Oreganal	0	0	812	1.060		1.060	1.181
<b>Total La Guajira</b>		<b>22.941</b>	<b>22.329</b>	<b>19.314</b>	<b>23.479</b>	<b>0</b>	<b>23.479</b>	<b>24.546</b>
Cesar	La Loma -Drummond	8.678	12.290	12.690	16.397		16.397	20.454
	Carboandes	270	304	526	1.053		1.053	394
	Carbones del Caribe (1)	1.910	1.759	1.640	1.454		1.454	1.942
	Consortio Minero Unido	750	713	789	1.011		1.011	1.058
	C.I. Prodeco S.A.	0	0	0	0		0	612
	Norcarbón	0	16	0	0		0	65
	Sororia	0	90	54	32		32	33
	<b>Total Cesar</b>		<b>11.608</b>	<b>15.172</b>	<b>15.699</b>	<b>19.947</b>	<b>0</b>	<b>19.947</b>
Cordoba	La Guacamaya		30				0	93
	Interior country	0	60	20	10	0	10	0
	Boyaca	168	187	365	117	533	650	262
	Cundinamarca	254	433	455	215	274	489	370
	Norte de Santander	420	657	657	716	353	1.069	1.073
	<b>Total interior</b>		<b>842</b>	<b>1.337</b>	<b>1.497</b>	<b>1.058</b>	<b>1.160</b>	<b>2.218</b>
<b>Total</b>		<b>35.391</b>	<b>38.868</b>	<b>36.510</b>	<b>44.484</b>	<b>1.160</b>	<b>45.644</b>	<b>50.902</b>

Source: Minercol 2000 - 2003; Ingeominas 2004 - 2005

(1) As of 2005 named as Carbones de La Jagua S.A.

(pr): Preliminary information in review

Prepared by: UPME - Subdirección de información

***GOLD, SILVER AND PLATINUM PRODUCTION PER DEPARTMENT 2002 - 2005***  
***Kilograms (kg)***

Department	Gold						Silver						Platinum					
	2000	2001	2002	2003	2004	2005(pr)	2000	2001	2002	2003	2004(pr)	2005(pr)	2000	2001	2002	2003	2004	2005(pr)
Antioquia	15.098	10.022	10.998	27.071	22.879	15.546	4.084	4.260	4.155	6.481	5.198	3.547	3	2	3	5	5	0
Bolivar	1.539	2.179	1.869	6.875	2.949	2.907	120	162	22	404	204	254	0	0	0	3	1	0
Caldas	605	645	796	1.099	1.331	1.136	919	1.190	1.332	1.358	1.750	1.366	0	1	0	0	0	1
Cauca	423	451	391	446	361	221	27	72	101	52	34	9	1	3	2	3	2	0
Chocó	1.001	855	606	1.204	851	1.187	95	86	60	474	118	138	332	665	652	828	1.193	828
Cordoba	17.267	6.742	5.486	8.211	7.227	3.018	2.660	1.384	1.265	644	927	192	0	0	0	0	0	0
Guania	2	3	1	16	148	63	0	0	0	0	19	5	0	0	0	0	0	0
Huila	1	4	1	7	8	6	0	0	0	0	0	3	0	0	0	0	0	0
Nariño	574	253	163	686	300	135	23	42	20	26	14	11	2	1	1	0	0	0
Risaralda	58	61	67	74	61	24	19	20	24	20	12	7	0	0	0	0	1	0
Santander	281	23	23	94	651	357	17	5	6	10	45	12	0	0	0	0	0	0
Tolima	31	32	135	409	298	181	3	15	2	23	78	60	0	0	0	0	0	0
Valle del Cauca	74	350	191	264	107	83	4	6	n/a	9	3	2	2	1	3	2	0	0
Vaupes	31	13	7	8	12	4	0	0	0	0	2	0	0	0	0	0	0	0
Others(*)	34	182	89	48	557	47	1	1	1	9	129	5	0	1	0	0	7	1
<b>Total</b>	<b>37.018</b>	<b>21.813</b>	<b>20.823</b>	<b>46.512</b>	<b>37.739</b>	<b>24.918</b>	<b>7.971</b>	<b>7.242</b>	<b>6.988</b>	<b>9.510</b>	<b>8.542</b>	<b>5.614</b>	<b>339</b>	<b>674</b>	<b>661</b>	<b>841</b>	<b>1.209</b>	<b>830</b>

Source: 2000 - 2003 Minercol Ltda; 2004 - 2005 Ingeominas

(pr): Preliminary information in review, 1Q 2005

(\*) Others include Amazonas, Caqueta, Putumayo, Quindio and Sucre departments

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