# 1. Introduction

## 1.1 Background of the Survey

The United Mexican States is preeminent among metal mining countries in Central America. The Mexican government is promoting policies to introduce foreign capital into the mining sector and at the same time allowing private companies including foreign-owned enterprises access to national mining concessions. As a result, domestic and foreign private companies are actively carrying out exploration and mining development projects, which lead to the discovery and development of large-scale base metal deposits.

The Tizapa mine and Rey de Plata mine are distributed in the volcanic massive sulfide deposit zone of Central Mexico. Japan has been highly regarded for the volcanic massive sulfide deposit exploration technique which contributed to the discovery of these deposits.

COREMI obtained a mining concession of the Zacualpan area situated between the Tizapa mine and Rey de Plata mine. The Mexican government requested Japan to conduct a mineral exploration survey of the Zacualpan area in July 1997. In response to this request, a project finding investigation was carried out in February 2000, the Zacualpan area was chosen as a project target area because of its high geological potentiality, and an S/W was concluded on December 12, 2001. At the request of Mexico, the Japanese government decided to conduct the investigation of deposits such as geological, geochemical, and geophysical surveys and commissioned the execution of the investigation to Japan International Cooperation Agency (JICA). JICA, in turn, decided to commission this investigation to Metal Mining Agency of Japan (MMAJ) because JICA judged the investigation would belong to a special field of geology and geological exploration for mineral resources.

## 1.2 Purpose of the Survey

The purpose of this investigation is to evaluate the geological condition and

mineralization and to discover new deposits by conducting geological, geochemical, and drilling surveys in the Zacualpan area of Mexico. At the same time, the investigation aims to do technical exchange with counterpart agencies during the investigation period.

## 1. 3 Overview of the Area

### 1.3.1 Location and Access

The Zacualpan area is situated to the southwest of Mexico City, in Guerrero and Mexico states. Principal villages in the survey area are Zacualpan, Ixcateopan Ixcapuzalco and Teloloapan having population 16,000 is the largest village around the area, to the south of the survey area. Base camps for the survey have been set at Teloloapan and Zacualpan. The survey area is situated in the administrative districts of the above village names.

Access to Teloloapan from Mexico City is possible in three hours by vehicles through the highway via Iguala. To reach Zacualpan from Mexico City, it is possible to use the highway through Toluca, taking the same hours. An outline of the access is shown as follows.

| | 200km | | 65km | |
|---|---|---|---|---|
| Mexico City | ---------- | Iguala | ---------- | Teloloapan |
| | 2 hours | | 1 hour | |

A branch paved road from Highway No.51 connects Teloloapan and Ixcapuzalco. Other paved roads from the northeast of the survey area to Zacualpan and from the east to Ixcateopan are available. There exist other gravel roads connecting each village, but it will become hard to use those roads in rainy season.

### 1.3.2 Topography, Climate and Vegetation

The survey area is geographically in the Sierra Madre del Sur (Raiz 1959) and included in the Balsas-Mexcala sub-province near by the Neo-volcanic axis.

The northern area is in a high altitude area and shows many steep V-shape

valleys, but its altitude is getting lower toward south. The topography in the southern area shows relatively gentle low land area. The Sultepec River in the west end of the area is 700 meters in lowest altitude and Cerro Tentacion to the south of Zacualpan is 2,710 meters, highest in the area.

The drainage systems in the area are divided into three, separated by the Cerro Tentacion. The Sultepec River system occupies about 60 percent of the whole survey area and rivers running down to the southwest from the watershed have been formed in the system area. The Los Sabinas River system occupies the southeast part of the survey area and rivers running down to the south and southeast have been formed. The San Jose River system occupies about 10 percent of the whole area at the northeast end and rivers running down to the east have been formed. These systems constitute branches of the Balsas River.

The climate in the area is of tropical to subtropical and its rainy season is from the end of June to October, dry season from November to May. The average annual rainfall is 1,100 to 1,400 millimeters and the average temperature is 18℃ in Zacualpan.

The vegetation in the area is dominated by tall weeds in the lowland area, lower than 1,800 meters in altitude. Some cornfields are partly seen there. In the highland area, pine and oak trees grow scarcely.

### 1.3.3 Outline of Geology

Coney and Campa (1987) and Sedlok et al., (1993) proposed classifications of geological structure zones (Fig. 1) for the whole area of Mexico respectively. The survey area of this report corresponds to the boundary between the Guerrero Terane and Mixteco Terane, based on the classification by Coney and Campa (1987).

De Cserna and Fries (1983), Guerrero et al., (1990, 1991 and 1993), and Elias and Sanchez (1992) demonstrated a very detailed stratigraphic succession and a development history of the geological structure for the volcano-sedimentary rock area. COREMI has started survey programs for massive sulfide ore deposits hosted in the volcano-sedimentary rocks in the area, as a part of “Eje Neovolcanico” project in 1979

for the Tlanilpa-Mamatla-Azulaquez area. Recently Valerie Gold Resources Ltd. was carried out mineral exploration on Mamatla property in 1994-1998.

The survey area is situated in the Teloloapan Terane constituting part of the Guerrero Terane and the Mixteco Terane in the eastern survey area, based on the regional geological structure zone classification.

The stratigraphic succession in the Teloloapan Terane side is the Tejupilco Schist, Villa de Ayala Formation (metavolcanic and sedimentary rocks), Acapetlahuaya Formation, Amatepec Formation (simultaneous difference phase with Acapetlahuaya) and overlying Teloloapan and Pachivia Formations, from the bottom. The Mixteco Terane is consists of the Morelos and Mexcala Formations. These Formatios are unconformablly covered by the Balsas Formation and Tilzapotla Formation of Tertiary age, Cuernavaca Formation of Pliocene and alluvial sediments.

The Guerrero Terane has undergone the Laramide orogeny in early Tertiary time (Salinas et al., 1994) and shows ductile deformation, isoclinal folding and thrust faulting extending north to south. Generally it shows an east vergence. On the contrary, the Mixteco Terane shows no ductile deformation, and it is said that the Terane has undergone compaction stress from east to west.

A fault group trending northwest to southeast appears in this area after the Laramide orogeny. It is possible that this fault group has been formed in a tension field from northeast to southwest. Vein type ore deposits nearby Zacualpan are hosted in this fault group.

### 1.3.4 Mining and Mining Actiity

A private company was aggressive for mining activity for the Azulaquez massive sulfide deposit in the area from 1915 to 1920, and it is said that the Aurora, Capire, San Francisco, Guadalupe, Cruz Blanca and San Antonio deposits were developed at that time (Ochoa et al., 1985). These mines were closed because of deletion of ore reserves.

Peñoles Company conducted a geophysical and drilling program in this district in 1975, but they withdrew from the Azulaquez district.

Valerie Gold de Mexico S.A. de C.V. started exploration in the Mamatla propaty from 1994, exploration methods included airborne and ground geophysical surveys, geological and geochemical surveys and drilling survey. Most exploration methods are concentrated in Capire-Aurora area, and reported 1.2mt of ore reserve grading 73g/t Ag, 1.13% Zn, but the company withdrew from this area in 1998.

La Campana Company operated the Rey de Plata mine, about 10 kilometers southwest of Teloloapan, applying open-pit and underground mining methods from 1946 to 1949. The main target was silver. Afterward, Peñoles conducted a drilling and underground adit exploration program from 1975 to 1991 and confirmed around 2,000,000 tons of massive sulfide ore reserve after 24,000 meters drilling. Recently Industria Peñoles S.A. de C.V. , Dowa Mining Co., Ltd. and Sumitomo Corporation started operation of Ray de Plata mine in October 2,000 at a rate of 3,000tones per month. But it was suspended because of low price of Zn in December 2001.

In Zacualpan, many vein type ore deposits of silver, lead and zinc have been developed since the Spanish colony time, however only the La Cuchara and Alacrán mines are in 350 tons a day operation by El Provenir de Zacualpan S.A. de C.V. at present.