The wet wind from the Black Sea is blocked off by the Black Sea Mountains, therefore the Hopa area have much rain falls through a year. The climate of the area is of so-called " Black Sea type", recording highest rain and snow falls in Turkey (Metal Mining Agency of Japan, 1970). The vegetation in the area is very thick. The precipitation from September to March is especially much, showing average monthly precipitation of 300mm. The rain changes to snow from November. The highest temperature in the summer reaches to 35℃, and lowest to 5℃ below zero.

The vegetation is similar to that of Japan, consisting of thick conifers and broadleaf trees, and also grasses. Tea trees are planted on southern flanks of mountain ranges, even on steep slopes in the Tunca area. The virgin forest covers the eastern Murgul area, while the western Murgul area becomes the naked rock zone where there are few trees.

2-4 Infrastructures

Arhavi Town has the population of about 10,000, facing the Black Sea, belonging to Artvin Prefecture. The base camp of the survey team has been set up in this town. The town is spread around the mouth of the Kabisre River. The Route 20 runs along the Black Sea coast, connecting principal cities, and some long distance bus services connecting to Ankara, Trabzon, and Artvin are available. Banks, post offices, hotels, and other infrastructure are well equipped, and tea processing is one of its principal industries here.

Chapter 3 General Geology

3-1 Outline of Turkish Geology

The Anatolia Peninsular constitutes a part of the Alpine-Himalaya-Indonesia Mountains, and four tectonic belts extending east to west, the Pontides, Anatolides, Taurides, and Border Folds, align from the north to south. The Arabian and African Plates have surged from the south to the Eurasia Plate, and the Arabian Plate is in fault contacts with the Eurasia Plate by the Zagros Fault. The African Plate submerges underneath of the Aegean Volcanic Arc. The southern terrane of the North Anatoria Fault is pushed out due to the collision with the Arabian Plate, therefore the Anatoria Fault is the first class right-lateral active fault at present.

These plate activities have caused the Alpine Orogeny since the early Jurassic,

and especially it has become very regional since the Paleogene. As the result of such activities, the area has uplifted as a mobile belt associated with igneous activity from the marine basin of the Tethys Sea in late Paleozoic time.

The Anatolides is situated in the central axis zone, and the terrane is composed of basement rocks and overlying ophiolite. The Taurides situated in the front-arc side of the Anatolides is mainly composed of Mesozoic limestone deposited in the Tethys Sea. The Pontides is of the jointed terrane of the Anatolides and Taurides due to the contraction of the Tethys Sea, and its basement rocks are composed of Devonian to Carboniferous metamorphic rocks and intrusive rocks such as granitoid. In the back-arc side of the Anatolides, the black Sea was expanded in the late Cretaceous, and the Mesozoic flysh-type sedimentary rocks have been deposited in the back-arc basin, and finally some marine volcanic rocks have been erupted. Associated with this volcanic activity, some volcanogenic massive sulphide deposits have been formed along the Black Sea coast.

3-2 Outline of Geology in Survey Area

The survey area is situated in the coastal area of the Black Sea, and geologically in the northeastern part of the Pontides. The basement rocks of the Pontides consist of Devonian to Carboniferous metamorphic rocks such as gneiss and schist, and Paleozoic intrusive granitic rocks. Six stratigraphic unites overlie the basement rocks, upper Carboniferous to lower Cretaceous, upper Cretaceous to lower Eocene, middle to upper Eocene, Oligocene to Miocene, and Pliocene to Quaternary from the bottom.

The coastal area of the eastern Black Sea is underlain by the upper Cretaceous to the lower Paleocene volcanic rocks, which are accompanied by volcanogenic massive sulphide deposits such as Murgul, Çayeli, and Cerattepe etc.

Güven et al (1992) classified the upper Cretaceous to the lower Paleocene into the Çatak Formation mainly composed of andesitic-basaltic volcanics, and Kızılkaya Formation mainly composed of dacitic volcanics, and Çağlayan Formation composed of andesite-basaltic lava, pyroclastics, and part of dacitic volcanics in ascending order.

The Kızılkaya Formation is correlated with the Alemağaç Formation in the Tunca area and the Murgul Formation in the Murgul area, and the Çağlayan Formation is correlated with the Çağlayan Formation in the Tunca area and the Ardiç

Formation in the Murgul area.

The Kaçkar granitic rocks are distributed in the south of the Hopa area.

3-3 Geological Structure

Figure I-3-1 shows the extracted lineaments from LANDSAT TM images and MTA's extraction result using the same images (MTA, 2002). From the figure, the northeast to southwest, northwest to southeast, and north-northwest to south-southeast systems are recognized in the Hopa area, and the former two systems are dominant. Circular structures are seen in many places, and that of seen in the Tunca area is several kilometers in diameter. Regarding these structures, MMAJ (2001) reported that the northwest to southeast system reflects this area's geological structure, i.e. the boundary between the Pontides and Anatolides, and the northwest to southeast system are extensively seen in the upper Cretaceous volcanic rocks distributed in the Black Sea coast area. The distribution of the circular structures are concentrated in the upper Cretaceous volcanic rocks as same as the northwest to southeast lineaments.

Regarding relationship between the Japanese Kuroko-ore deposits and geological structure, many investigators have pointed out that Japanese Kuroko-ore deposits are distributed being accompanied with some depression structure. In Turkey, Japan Petroleum Corporation (1998) has conducted an investigation program for the geological structure of the Black Sea coast in the northeastern Turkey using Satellite image data. The company has clarified that the volcanogenic massive sulphide deposits are distributed around some circular structures in some specific stratigraphic horizon, and emphasized that the study of geological structure is the very important tool for the exploration of massive sulphide deposits.

3-4 Mineralization and Alteration

As shown in Figure I-3-2, many volcanogenic massive sulphide deposits such as the Murgul, Cerattepe, Çayeli, Peronit, and Kutunit Deposits are distributed in the Hopa and surrounding areas, and the Tunca Deposit is in the Tunca area. These ore deposits are in the upper part of the upper Cretaceous Kızılkaya Formation, same as the Alemağaç Formation in the Tunca area, and some stockwork and disseminated sulphide ore deposits exist in the lower part. The Sivrikaya Deposit is of only lower

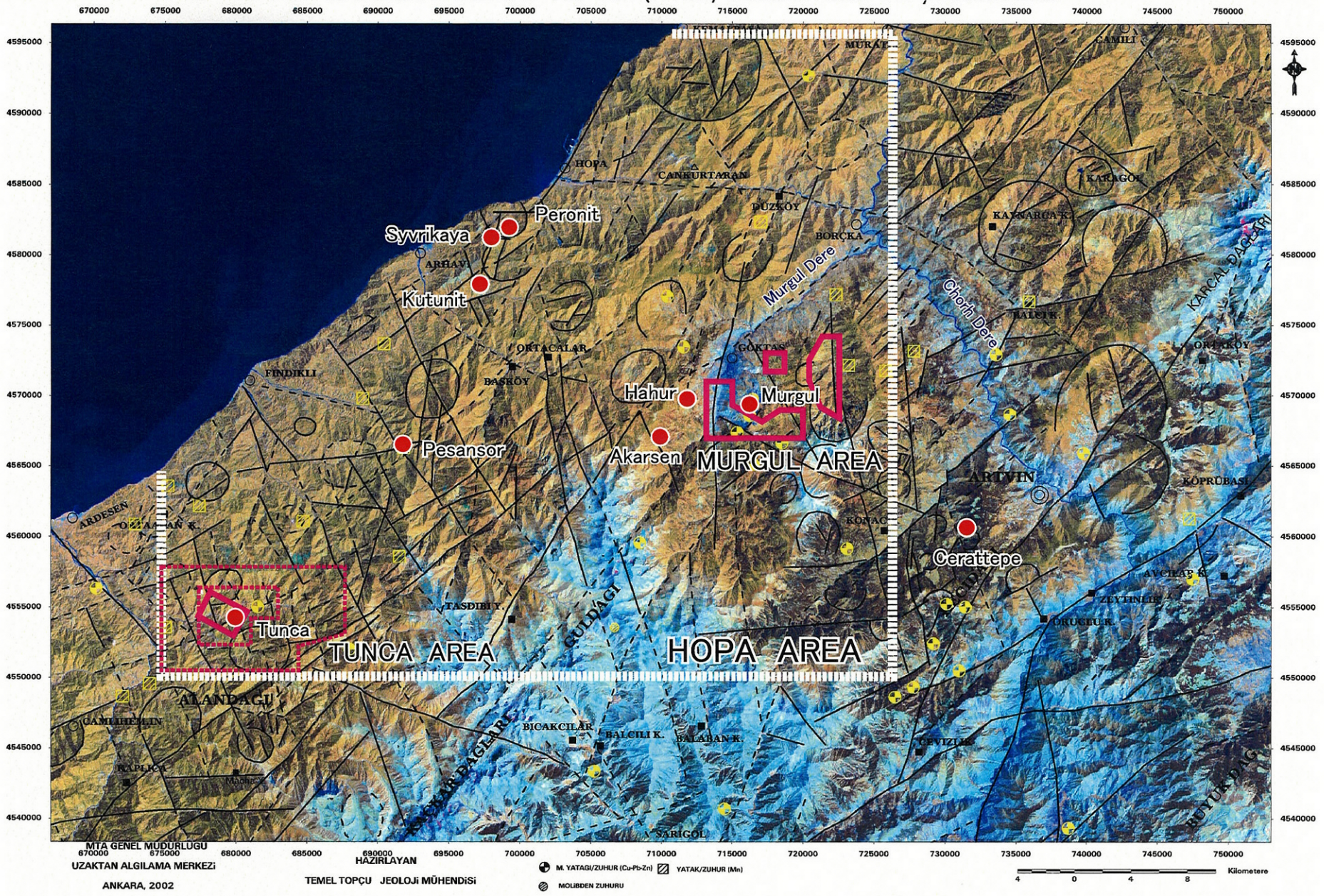

Fig. I -3-1 Photogeological Interpretation Map and LANDSAT TM Image of the Hopa Area

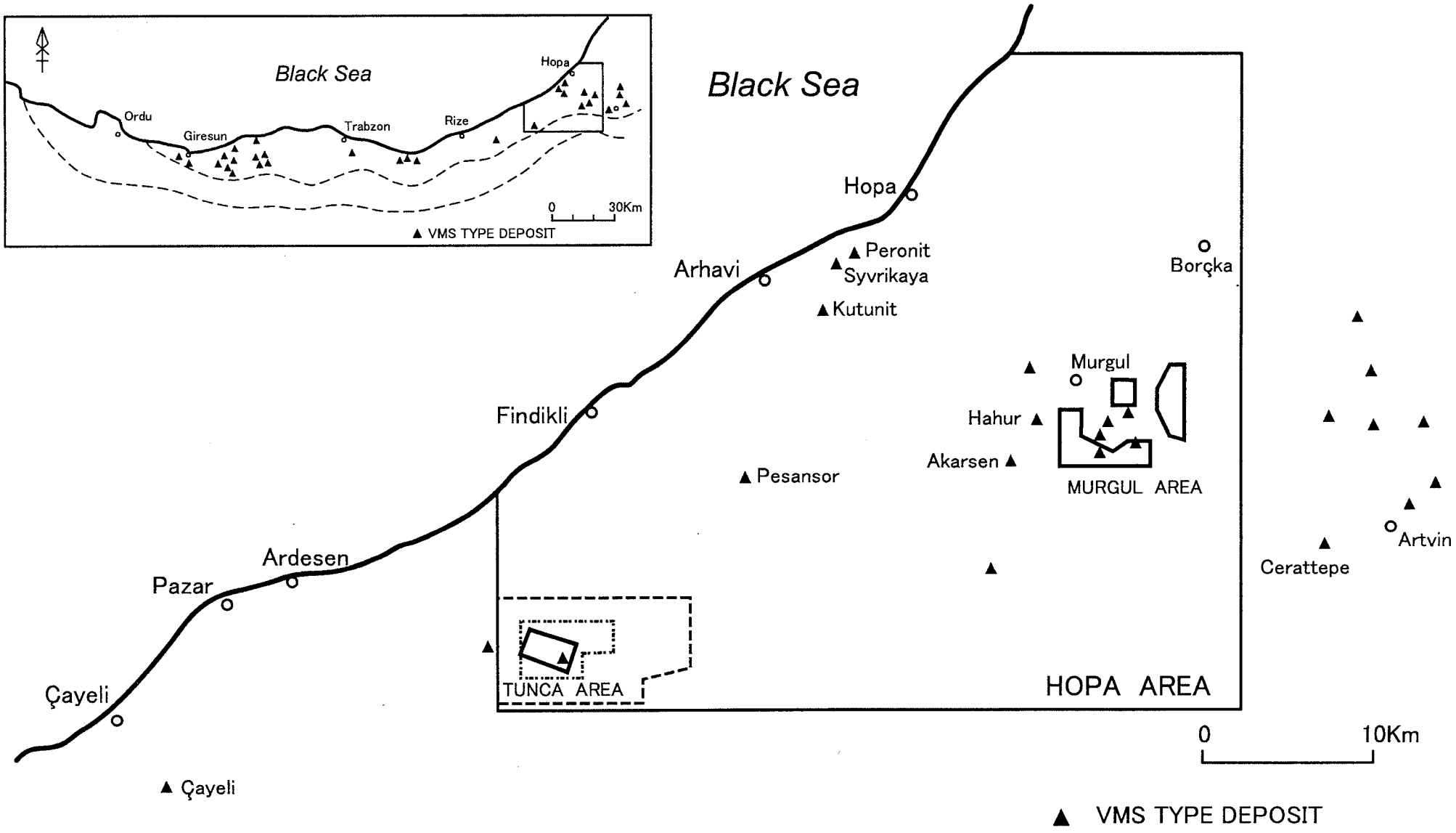

Fig. I -3-2 VMS Type Deposits Around the Hopa Area

stockwork and disseminated ores, lacking massive ore. The calcareous mudstone and basalt lava of the Cağlayan Formation overlies these deposits.

It is thought by some investigators that the massive sulphide deposits in the eastern Pontides have been formed by duplicated mineralization, and the associated igneous rocks and genetic time of the Peronit and Kutunit Deposits are different from those of the Tunca, Murgul, and Cerattepe Deposits.

Kaolinization, sericitization, and chloritization are recognized in the surrounding areas of the Murgul Deposit. An alteration zone of smectite, chlorite, kaolinite, mixed layers clay, smectite, illite, naclite, and siderite surrounds the Çayeli Deposit (Çağatay, 1993).