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Development of Geothermal Resources in Indonesia

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ABSTRACT

The Geological Survey of Indonesia is continuing to inventory and map geothermal areas of Indonesia.

Exploration drilling was started in 1972 in the Dieng mountains. An extensive report on this drilling was presented by the state-owned electric company at the Ninth World Energy Conference held in Detroit in 1974.

An expanded geothermal exploration program was initiated in 1973 with assistance from New Zealand.

At the beginning of 1974 the state oil company, Pertamina, started its geothermal development program in previously determined priority areas, mainly located in Java and Bali. Additional areas in West Java (Danau) are being explored and more surveys are being made to accelerate the drilling program that was revived in September 1974 in Kamojang. Two wells have been successfully drilled and four more are scheduled for this area.

GEOTHERMAL AREAS OF INDONESIA

Kawah Kamojang

Geological field work has been completed in Kawah Kamojang, but detailed and accurate mapping were made difficult because of the weathered ash and heavy forest cover. Aerial photographs proved invaluable in identifying most of the geological units.

The Kawah Kamojang geothermal field is located in the

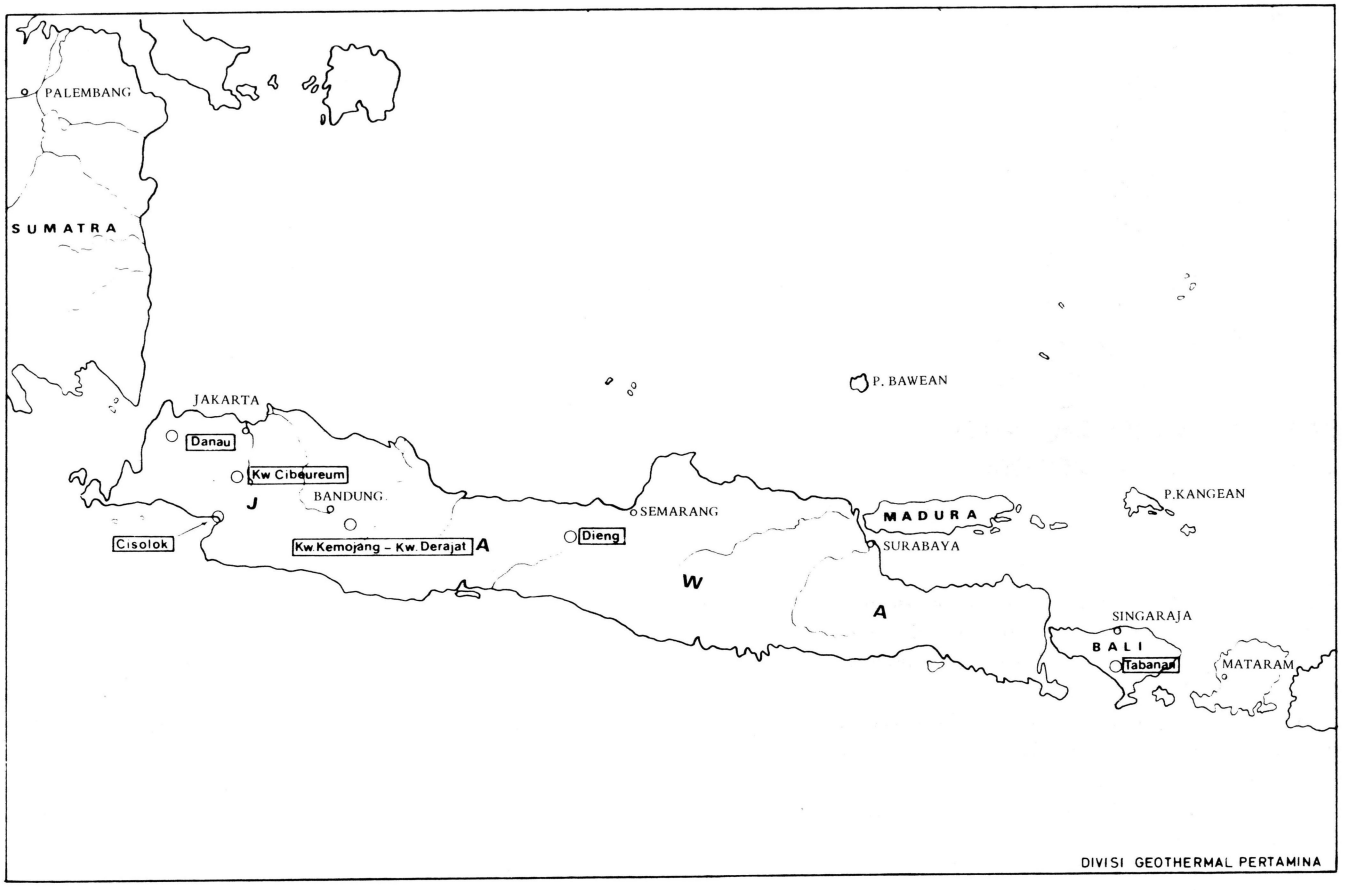

Figure 1. Indonesia geothermal development program (Pertamina) 1974–1976.

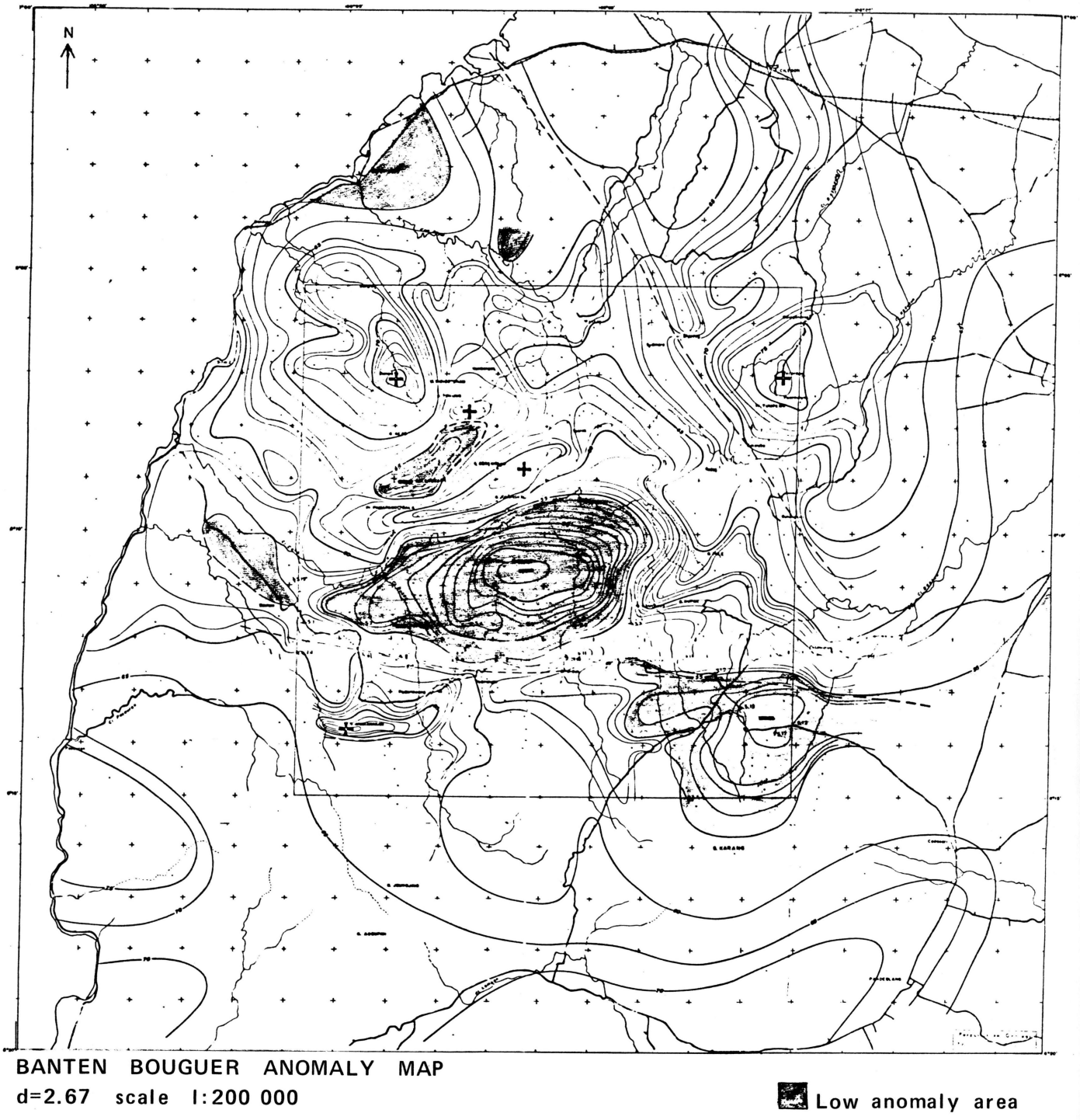

Figure 2. Banten Bouguer anomaly map (d = 2.67).

older part of a structural depression of a large volcano complex, the Gandapura-Guntur. Drilling in this area has revealed the formation consists of andesite, tuffs, and breccia.

A resistivity survey was made of the Kamojang area using a Schlumberger array with fixed electrode spacing of $AB/2$ = 500 m and four soundings with spacings up to a maximum of $AB/2$ = 1000 m. Most of the hydrothermal features lie in an area with apparent resistivity of less than 10 ohm·m. It appears the conditions responsible for the low resistivity are structurally controlled. Soundings show the anomaly area is underlain by rocks with a resistivity of about 3 ohm·m down to at least 500 m. The area enclosed by the 10 ohm·m contour is approximately 5.5 km.[2]

At present, exploration drilling is done by an Enex crew from New Zealand, assisted by Indonesians, using a Failing Model DMX drilling rig mounted on a GMC 198 in. W.B. truck chassis. The object of the drilling is to evaluate the geothermal potential for power generation (probably 30 MW) and to complete all wells, either bringing them into production or plugging them. Four wells (average 600 m depth) have been drilled—two are productive.

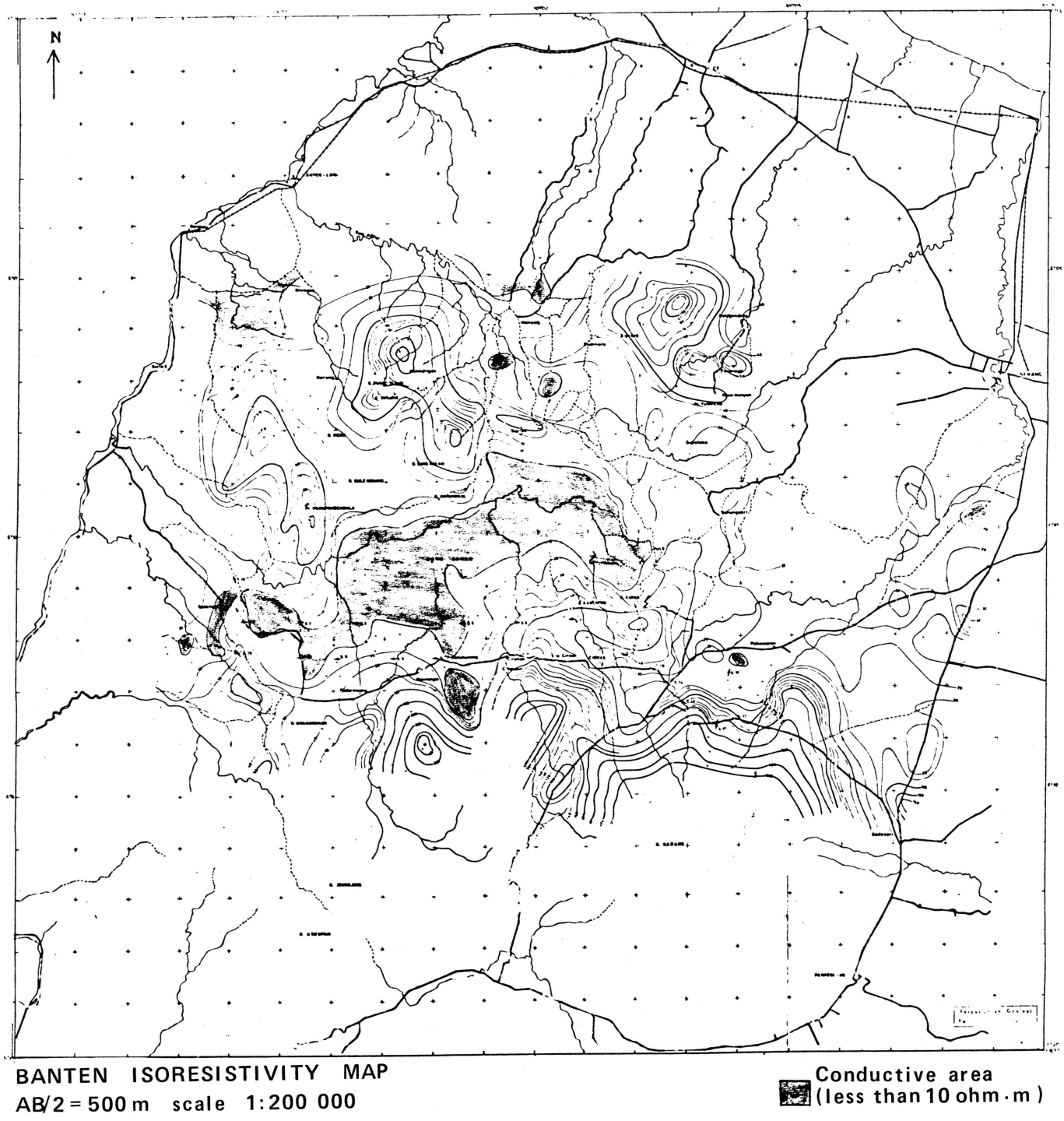

Figure 3. Banten isoresistivity map ($AB/2$ = 500 m).

Kawah Derajat

The Kawah Derajat thermal area lies about 12 km southeast of the Kamojang area. Geological mapping is in progress here with aerial photographs again providing good guidance for the field work.

Resistivity measurements with fixed spacing ($AB/2$ = 500 m) were made and it was found that this area too is surrounded by low apparent resistivities with values less than 10 ohm·m.

More geophysical work and mapping is being done in 1975 and it is hoped that exploration drilling can begin in 1976.

K. Cibeureum (G. Salak)

Some geochemical surveys have been done in the K. Cibeureum area, but many more geological mapping and geophysical surveys will be necessary after completing the aerial photographs. Access to the area is difficult because of heavy forest.

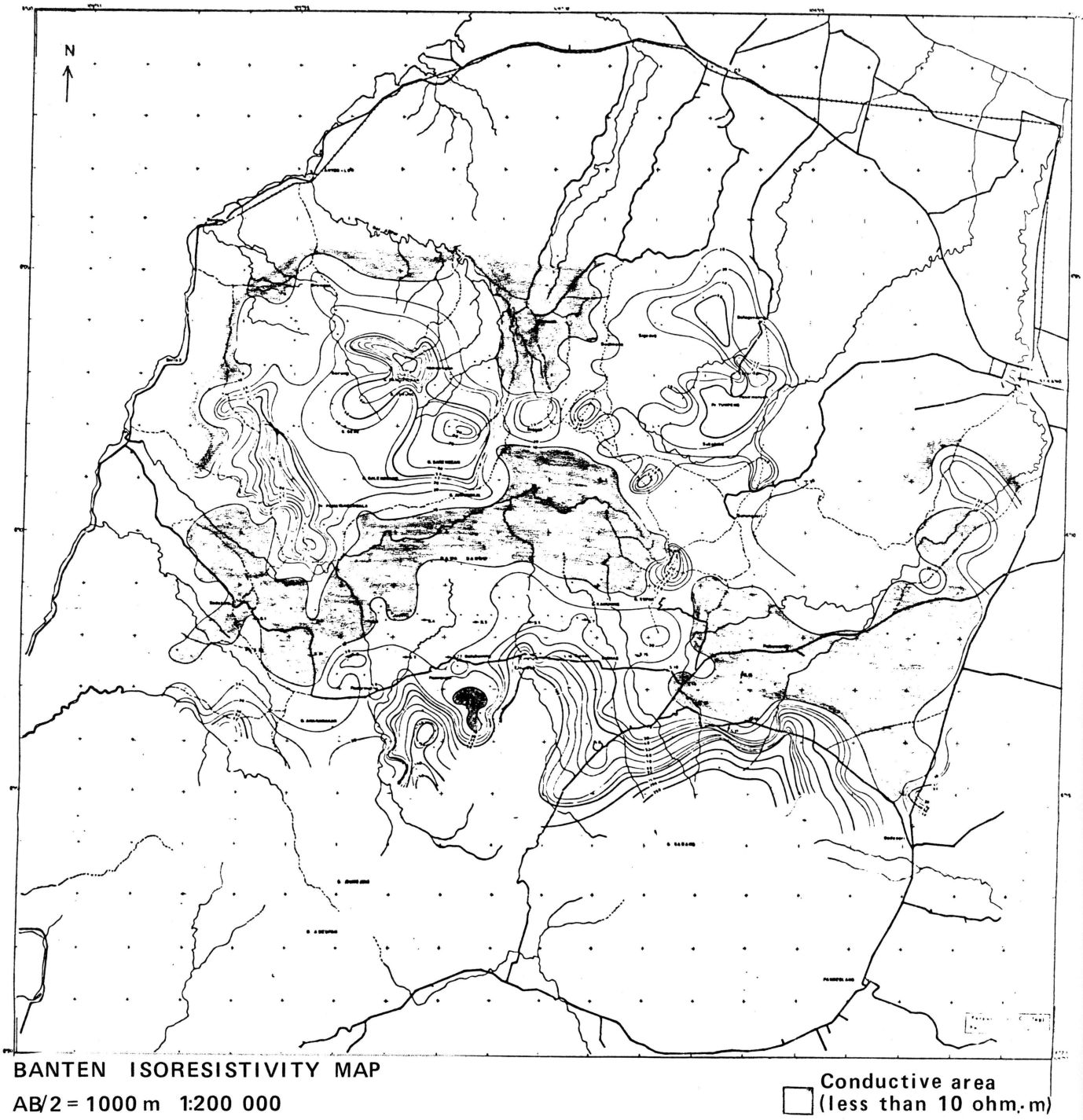

Figure 4. Banten isoresistivity map ($AB/2$ = 1000 m).

Cisolok-Cisukarame

The Cisolok-Cisukarame area has been surveyed for resistivity using fixed spacings of $AB/2$ = 500 m. This reconnaissance survey shows that the resistivity pattern is diffuse and does not yet define a source area from which thermal waters might originate. This area's accessibility is also difficult and further exploration surveys are planned.

Dieng

Results of previous work in Dieng have been reported. Additional surveys are considered necessary before resuming drilling in 1976.

Danau (Banten)

The Banten area (or Danau caldera) is known for its surface manifestations of geothermal interest. Several hot springs exist, but there are no solfatares and fumaroles. The temperature of the hottest of the springs is 67°C.

A geophysical program, together with geological and geochemical investigations, is nearly completed. The rocks

forming the caldera wall are andesite lavas and tuffaceous sediments. A northwest-trending fault across the area has been detected. Most of the springs are located on this fault line.

A gravity survey was conducted in which 600 stations (approximately 4 points/km^2) were measured. The Bouguer map shows a negative anomaly of some 12 to 15 mgal and clearly delineates the Danau caldera (Fig. 2).

Electric mapping was used for reconnaissance and two spreads, $AB/2 = 500$ m and $AB/2 = 1000$ m, were used for every point. The results show values from less than 5 ohm·m to several hundreds of ohm·m. All known surface shows are situated within these conductive zones. In addition 50 electric soundings were carried out in the central and southern part, but the interpretation has not been completed (Figs. 3 and 4).

Chemical analyses performed on hot spring waters have identified two promising areas which also coincide with preliminary geological and geophysical conclusions. On gravity maps these areas appear as local negative anomalies and on electrical resistivity maps as conductive zones (apparent resistivity less than 10 ohm·m). Other results of geochemical analysis (isotope chemistry of H_2O and others) are not yet known.

Bali

Boiling springs and fumaroles are not present in Bali, and this is probable evidence for the absence of a high-temperature geothermal field. First results of a geophysical reconnaissance survey made in the area where all the springs are located show that a horizontal flow of thermal fluids does exist. The flow is evidenced by an elongated tongue of resistivities less than 25 ohm·m over a distance of at least 10 km. The first measurements offer little information about the source of this flow. More geophysical work will be done in 1975 to complete an evaluation of this area.