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**Summary/Notes**: The objective of this research was to study thermally anomalous areas associated with hot waters in the County of Caldas Novas, State of Goiás, Brazil. Data collection was conducted using a 50 cm. soil thermometer and a PT5 Precision Radiation Thermometer.

The temperature data, processed by a Trend Surface Analysis Program, indicated the presence of four principal anomalies designated the town of Caldas Novas, Corrego Tucum, Fossa da Ribeira Quente and Lagoa Pira petinga.

These areas were re-verified in the field. In the area of the town of Caldas Novas, of 14 deep wells drilled, 8 revealed water temperatures from 33 to 41°C, 2 contained hot mud, 1 contained sulfurous water measured at 29°C. Two dry wells were also encountered.

REMOTE SENSING APPLIED TO THE PROSPECTING OF GEOTHERMAL ANOMALY
IN CALDAS NOVAS COUNTY - STATE OF GOIÁS - BRAZIL

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ABSTRACT

The objective of this research was to study thermally anomalous areas associated with hot waters in the County of Caldas Novas, State of Goiás, Brazil. Data collection was conducted using a 50 cm soil thermometer and a PRT-5 Precision Radiometric Thermometer. The temperature data, processed by a Trend Surface Analysis Program, indicated the presence of 6 principal anomalies designated the town of Caldas Novas, Córrego Tanum, Pousada do Rio Quente and Lagoa Pirapetanga. These areas were re-verified in the field. In the area of the town of Caldas Novas, of 14 deep wells drilled, 9 revealed water temperatures from 33 to 41°C. I contained soil mud, 1 contained sulfurous water measured at 28°C. Two dry wells were also encountered.

1. INTRODUCTION

This research project refers to the application of remote sensing techniques to geothermal prospecting of hot water in a mid-western region of Brazil.

The study area, County of Caldas Novas, in the State of Goiás, has an area of approximately 1,000 km² and is located from 17°51’S to 17°55’S. The rivers of Piracicaba and Corumbá are natural limits at the west and east side of the county respectively.

A general survey was first conducted using LANDSAT imagery at the scale of 1:1,000,000 to situate the study area in the regional geology. Aerial photographs of 1:60,000 were then used to elaborate a geologic map of the study area. To obtain significant data in a thermal-anomaly area, several considerations should be examined, such as solar effects, target materials, depth of measurements, and local geology.

The target material is a schist derived soil, and is considered to be homogeneous in terms of conductivity.

All measurements were made at a constant 50 cm depth, the subsurface temperature measurements were made with a soil thermometer having an absolute precision of 0.2°C, at pre-dawn.

2. METHODOLOGY

For subsurface temperature measurements a thermometer measuring soil temperature at 50 cm with a precision of 0.2°C was used. Soil temperatures were also detected remotely by the Precision Radiometric Thermometer (PRT-5), which has a precision of ±0.1°C. Collection stages were established in two phases.

First, temperatures of 147 points regularly distributed in the study area...
along roads, with a minimum distance of 3 km between any two points were measured. Based on these data points 4 major temperature anomaly subareas were detected: the town of Caldas Novas, Córrego Tucum, Pousada do Rio Quente and Lagoa Pirapetinga.

Secondly, rectangular or square grids of the size varying from 300 to 600 m were imposed on each subarea and the soil temperature of the cross points were taken. The collected data were run in a computer using the trend surface analysis program which shows, in a map format, the temperature tendency of the region. Based on this map, residue curves were drawn and the thermal-anomaly areas were identified.

A geological study of the area was also carried out.

3. RESULTS AND DISCUSSION

The visual interpretation of LANDSAT imagery revealed a continuous NW-SE lineament extending to the northeast of Parema Basin, where important intrusions such as Araxá, Castelo 1 and 11, and Patrocínio, etc. are located. Based on the results of visual interpretation of aerial photographs, field work and existing literature, a geologic map (1:60,000) was constructed for the study area.

The principal geologic units are represented by two metamorphic groups, Araxá and Castelo. Araxá group is constituted by one inferior unit of quartzites and one superior unit of mica schist and intercalating amphibolite and limestone sheets. Castelo group is constituted predominantly by mica schist-quartz-schist and is overlaid by the Araxá group. Both groups belong to the Brazilian cycle (600-900 m.y.).

The Tertiary-Quaternary coverages are mainly detritus-laterite and alluvial deposits.

Two distinct fields involving all the pre cambrian rocks are observed in this region. Among the large anticlinal and synclinal forms, Serra de Caldas is the most outstanding brachyanticlinal. The preferential axes of folds are NNW-SSE with the axial plane dipping NE.

Two principal trend faults with the directions N60°E (dextral transcurrent faults) and N60°W (vertical faults) were noted. The well developed fractures and faults constituted the main control system for the studied aquifers. These geologic data, integrated with the results of trend surface analysis at the first sampling stage, gave the following conclusions:

- four major thermal-anomaly areas were detected: the town of Caldas Novas, Córrego Tucum, Pousada do Rio Quente and Lagoa Pirapetinga. Among these areas, Córrego Tucum was not known for the occurrence of its thermo-mineral water before this survey.
- a good concordance was found between residue curve maps generated by temperature measurements utilizing thermometer and PRT-5. These results show the viability of using, in this area, an airborne thermal scanner for thermal-anomaly detection since the difference of the measured temperature in the study area was more than 8°C (i.e., max. of 25°C and min. of 17°C).
- a relative temperature increase was observed toward the direction of Serra de Caldas.

The four thermal-anomaly areas, detected in the first stage, were then studied in detail and resulted in a map of 1:15,000. These areas with residue curves of note than 1.9°C were considered anomalous.

The studied results had been confirmed, later in May 1978, when 14 new wells were drilled in the only explored area of the study region – the vicinity of the town of Caldas Novas (Figure 1). The significant results obtained among these
14 wells are:

- nine wells with 3,000 to 25,000 GPH outlet through pumping have depth varying from 80 m to 150 m and a temperature range from 33°C to 41°C.
- two other wells have not mud at a depth of approximately 600 meters.
- another well has a sulfurous water flow at 200 m depth with 14,000 GPH at 29°C.

All of the thermo-mineral water explored in the region are for touristic purposes. Thus, no hydrogeologic data is available for a better rational control of exploration or a better understanding of the qualitative and quantitative compartments of the aquifer network. However, the existence of thermo-mineral hot waters in the unexplored areas of Corrego Tujuca, Pouso do Rio Quente and Lagoa Piropentinga should not be neglected.

REFERENCES


National Aeronautics and Space Administration - NASA LANDSAT Data Users Handbook Maryland.