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PROSPECTIVE GEOTHERMAL FIELDS IN CAMBAY BASIN, INDIA

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ABSTRACT

Geothermal gradients determined in Cambay basin are in the range of 20 to 75° C/km. A geothermal gradient map for the basin has been prepared to delineate the sites of geothermal resource development. Six geothermal fields have been identified and their geothermal resource potential has been estimated to be in the range of 21.76 to 369.78 x 10^{12} kWh, with a total of 369.78 x 10^{12} kWh over an area of 5257 km^2.

INTRODUCTION

Vast resources of geothermal water at 120° C and steam blow-out at places have been encountered, in general, in Cambay basin within the depth of 2000 m, during oil and gas exploration. The formation temperature measured is as high as 166° C at 3140 m and the depth at which hot water of 110° C has been encountered is as shallow as 30 m. The consistent observation of high geothermal gradients throughout the basin led us to identify the regions of higher geothermal anomalies and to assess their geothermal potential.

GEOLOGY AND TECTONICS

The Cambay basin is an intracratonic graben striking north northwest and flanked by the Aravali swell or anticlinoria containing igneous and metamorphic rocks of Precambrian age on the northeast and east, and the Saurashtra Uplift constituting the Deccan lavas of Cretaceous to early Tertiary age on the west. Towards the north, it is separated from the Kutch and Rajasthan basins through the basement saddle or uplift and on the south it extends through the Gulf of Cambay, the Bombay offshore basin to as far south as the Ratnagiri offshore basin.

The structural development of the basin is traced back to the major epeirogenic movement of the post Proterozoic period. The oldest known sediment in the basin overlying the Precambrian basement is of Jurassic to Late Cretaceous age. It is followed up by numerous tensional faultings and riftings accompanied by large scale eruption of volcanic lava flows called the Deccan trap, and subsidences. Since Tertiary till Recent time, the deposition of sediment has continued. These post-trappean sediments ranging in thickness from 1800 to 5000 m act as a good blanket to store heat and also constitute a good reservoir rock.

PROSPECTIVE GEOTHERMAL FIELDS

There are about 1200 wells very closely drilled for oil and gas exploration in Cambay basin. The geothermal gradients are determined for most of the wells, and are in the range of 19 to 75° C/km. The lower values are observed in the northern part of the basin and higher gradients are associated in the central part. These values, averaged over 5′x 5′ grids, were used to construct a geothermal gradient map (Figure 1). The geothermal gradient contours were drawn at an interval of 5° C/km. The areas having geothermal gradients higher than 40° C/km are considered here as prospective geothermal areas. The map reveals six prospective geothermal fields. They are at Kadi, Nawagam, Cambay, Kathana, Dhadal and Olpad and occupy a total area of 5257 km^2.

ESTIMATES OF GEOTHERMAL RESOURCE

The geothermal resources of the prospective geothermal fields have been estimated by the volumetric stored-heat method. The average temperature and specific heat capacity over each stratigraphic unit up to a depth of 2500 m were determined and used to calculate the accessible geothermal resource. The total accessible geothermal resource over all stratigraphic units was estimated for each prospective geothermal field (see Table 1). It ranges from 21.76 x 10^{12} kWh over Olpad field to 116.41 x 10^{12} kWh over Cambay field. The total geothermal resource potential of the basin is 369.78 x 10^{12} kWh over an area of 5257 km^2.

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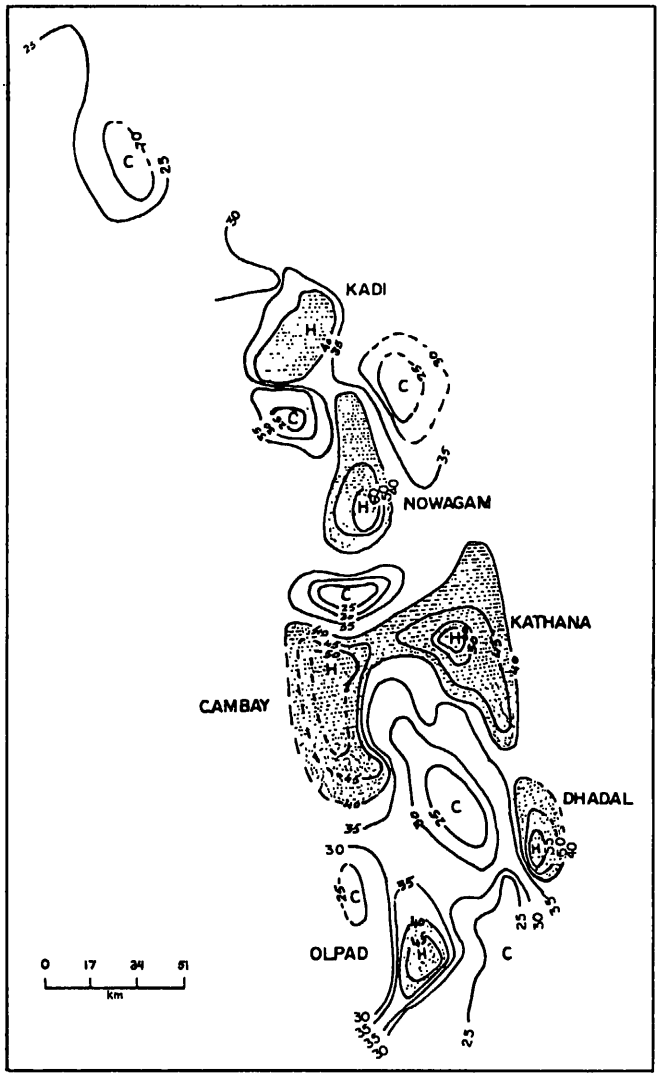

Figure 1. Geothermal gradient (°C/km) map of Cambay basin

Table 1. Prospective geothermal fields, their area and resource potential

Geothermal field	Areal extent in km^2	Accessible geothermal resource in $x10^{12}$ kWh
Cambay	1675	116.41
Kathana	1332	92.57
Nowagam	918	62.97
Kadi	540	41.31
Dhadal	486	34.75
Olpad	306	21.76
Total	5257	369.78