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GEOTHERMAL RESOURCES IN INDIA

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ABSTRACT

A heat flow map constructed for India (Panda, 1983) was used to delineate the anamolous geothermal areas. These areas were further classified according to low, medium and high prospects. About 29 geothermal prospective areas have been identified, which are found to be associated with fourteen major geothermal provinces. Preliminary estimation of the accessible geothermal resources of these provinces are in the range of 11×10^8 to 984×10^8 MW-year with a total resource potential of about 3244×10^8 MW-year.

INTRODUCTION

As interest has grown in the field of geothermal investigation, an approximate heat flow map was constructed to the scale of 1:5 million, which covers the entire subcontinent of India. It is aimed to delineate the geothermal prospective areas and to assess their energy potential.

GEOTHERMAL MAPPING

Data on heat flow and geothermal gradients were obtained from various agencies like NGRI (Gupta, Hari Narayan and Gour, 1976; Gupta, 1981), GSI (Krishnaswamy, 1976; Krishnaswamy and Ravi Shankar, 1980), DSDP (1972), ONGC (Panda, 1983), OIL (Handique and Bharati, 1981) and Bangladesh (Khan and Hussain, 1980) and some other data were indirectly generated over India, Nepal and Cylon (Sarkar, 1980) using the relationship of heat flow and radiometric age (Verma, Hamza and Panda, 1970). At present 1010 heat flow data were compiled and when averaged over a 1° x 1° grid, they cover 186 grids, both on land and on sea.

The distribution of the geothermal data is far from uniform and data are missing mostly from the Deccan Trap and Vindhyan areas. The highest concentration of measurements is in sedimentary basins. Nevertheless, the approximate heat flow map (Figure 1) provides first order information regarding the geothermal conditions over the entire Indian sub-continent. The map will be modified from time to time with the availability of more data.

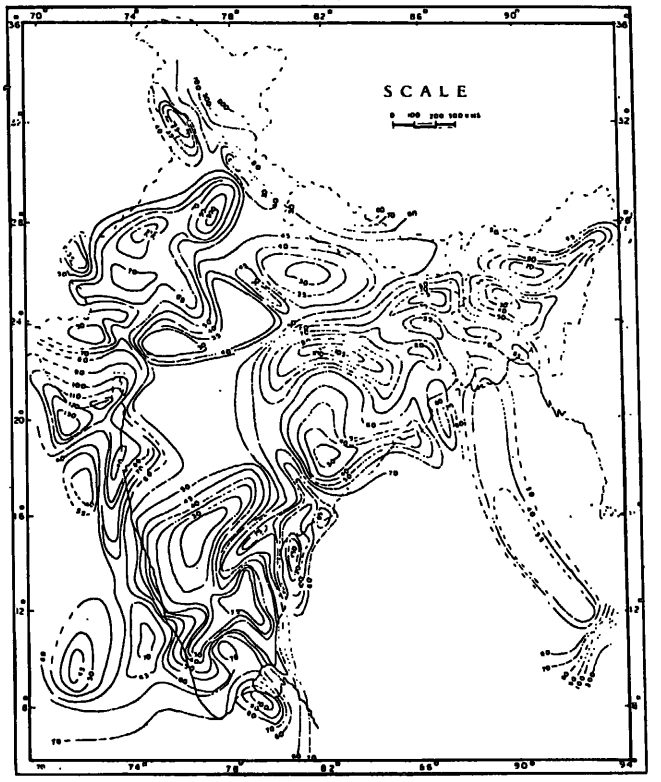

Figure 1. Heat flow (mW/m^2) map of India

GEOTHERMAL RESOURCES POTENTIAL

The promising regions for the prospects of geothermal energy are generally marked by high heat flows. The regions having heat flow value above 70 mWm^{-2} are considered here as prospective geothermal areas. There are about 14 geothermal provinces identified, and are classified as:

i) low prospects; heat flow in the range of 70 to 100 mWm^{-2},
ii) medium prospects: heat flow between 100 and 130 mWm^{-2}, and
iii) high prospects: heat flow over 130 mWm^{-2}.

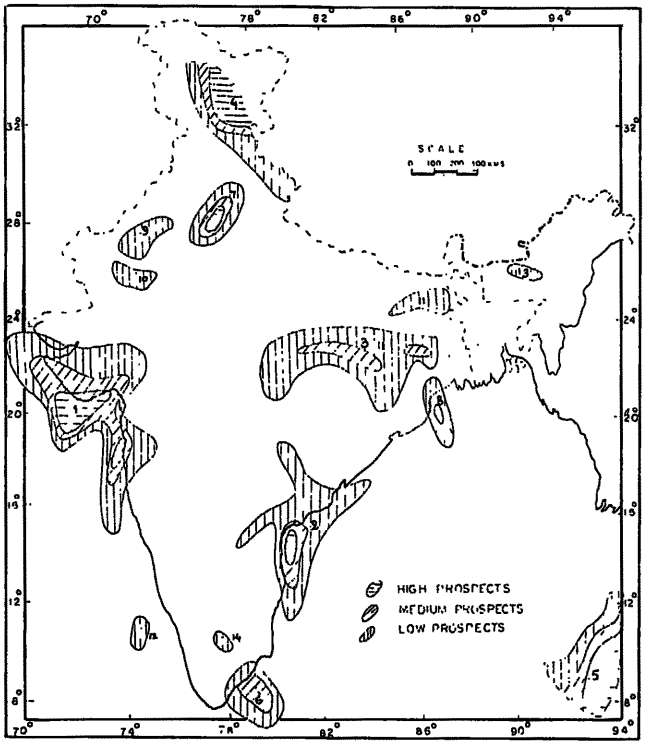

Figure 2. Map showing potential geothermal resource prospects, India. Numbers correspond to those in Table 1.

The distribution of the geothermal areas for geothermal exploration with their potential prospects on the basis of the above classification is shown in Figure 2.

There are about 29 prospective areas, out of which seven are high prospects, nine are medium prospects and 13 are low prospects. Most of the geothermal areas are associated with six major geothermal provinces. They are the Himalayan tectonic belt, Cambay-Bombay graben, Krishna-Godavari graben, Sone-Domodar graben, Andaman volcanic zone, and Haridwar-Delhi ridge. The other geothermal provinces are Bikaner, Jodhpur, Laccadive, Manner, Salem, the Bengal basin, Monghyre, and the Gauhati anomalies. Preliminary assessment of the geothermal resources down to 5 km depth has been estimated by the volumetric stored-heat method. In this case, the crustal rocks are divided into a series of depth intervals corresponding to their stratigraphic units and their average temperature and specific heat are used to estimate the accessible geothermal resources.

Over the area a geothermal province spreads, the range of heat flow values and the estimated accessible geothermal resources are elucidated in Table 1. All the geothermal provinces occupy a total area of 1071 x $10^9 m^2$ and show a total geothermal resource of 3244.35 x 10^8 MW-years.

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Table 1. Geothermal Provinces, Their Areas, Heat Flow Values and Geothermal Resources

Geothermal Provinces	Approx. Area in 10^9 m^2	Heat flow range mW/m^2	Geothermal Resources Down to 5 km in 10^8 MW-year
1.Bombay-Cambay	312.00	70-130	984.41
2.Krishna-Godavari	190.00	70-160	599.48
3.Sone-Damodar	178.50	70-110	525.65
4.Puga-Manikaran	102.50	70-800	301.85
5.Andaman Island	67.25	70-230	212.19
6.Maner Basin	55.00	70-100	173.53
7.Delhi-Sohna	47.50	70-300	114.94
8.Bengal-Basin	32.50	70- 85	102.56
9.Bikaner area	27.75	70- 75	81.72
10.Jodhpur area	17.50	70- 75	51.53
11.Monghyr area	20.50	70- 80	45.23
12.Laccadwip area	7.50	70- 75	23.66
13.Gauhati area	7.50		16.56
14.Salem area	5.00	70- 75	11.04
Total	1071.00		3244.35

REFERENCES

D.S.D.P., 1972, Initial report of Deep Sea Drilling Project, v. 22, p. 1813.

Gupta, M.L., Hari Narayan and Gour, V.K., 1976, Geothermal provinces of India as indicated by studies of thermal springs, terrestrial heat flow and other parameters: Proceedings, Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, May 1975, v. 1, p. 387-396.

Gupta, M.L., 1981, Surface heat flow and igneous intrusions in the Cambay Basin, India: Journal of Volcanology and Geothermal Research, v. 10, p. 279.

Handique, G.H., and Bharali, B., 1981, Temperature distribution and its relation to hydrocarbon accumulation in upper Assam Valley, India: Bulletin, American Association of Petroleum Geologists, v. 65, no. 9, p. 1633.

Khan, M.A.M. and Hussain, M., 1980, Geology of Bangladesh gas fields: Offshore South East Asian Conference, Feb., 1980, SEAPEX.

Krishnaswamy, V.S., 1976, A review of Indian geothermal provinces and their potential for energy utilization: Proceedings, Second United Nations Symposium on the Development and Use of Geothermal Resources, San Francisco, May 1975, v. 1, p. 143-156.

Panda, P.K., 1983, Geothermal maps of India and their significance in resources assessments: Symposium Petroliferous Basins of India (Abstracts).