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GEO THERMAL ENERGY OF PAKISTAN ON THE BASIS OF ABANDONED OIL AND GAS WELLS

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INTRODUCTION

- In Pakistan, round about 1000 oil and Gas exploratory wells have been drilled
- More then 60 percents wells have been abandoned or dry wells.
- Present study look forward to reutilize these abandoned wells
- Present study shows heartening geothermal gradient exception in lower Indus Basin

❖ Aeromagnetic survey has also disclosed significant prediction for the “hot dry rock” geothermal energy in western part of the Pakistan.

❖ For electricity production hot dry rock (HDR) geothermal environment offers massive potential.

❖ Hot dry rock energy comes from moderately water-free hot rock found at a depth of more then 4,000 meters.

❖Geothermal field is one of the tectonic/volcanic anomalies.

❖The HDR system depends on the artificial simulation of tight formations

❖Fluid circulated in closed circuit mode where as reservoir pressure is managed by balanced production and injection rates in multiple well arrays.

❖ Current study shows the matchless application of collection data of Oil and Gas exploratory wells.

Energy Resources and Consumption

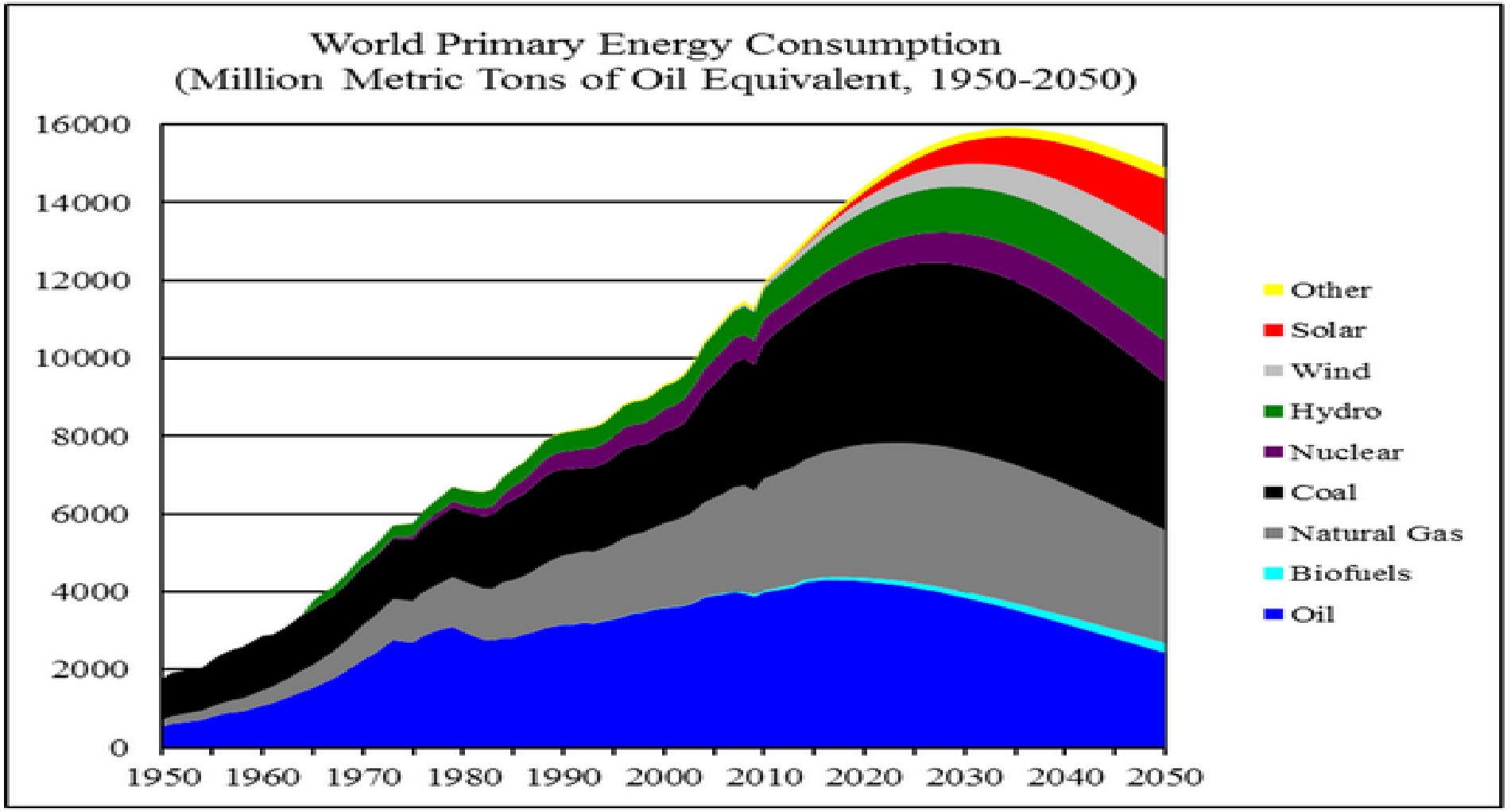
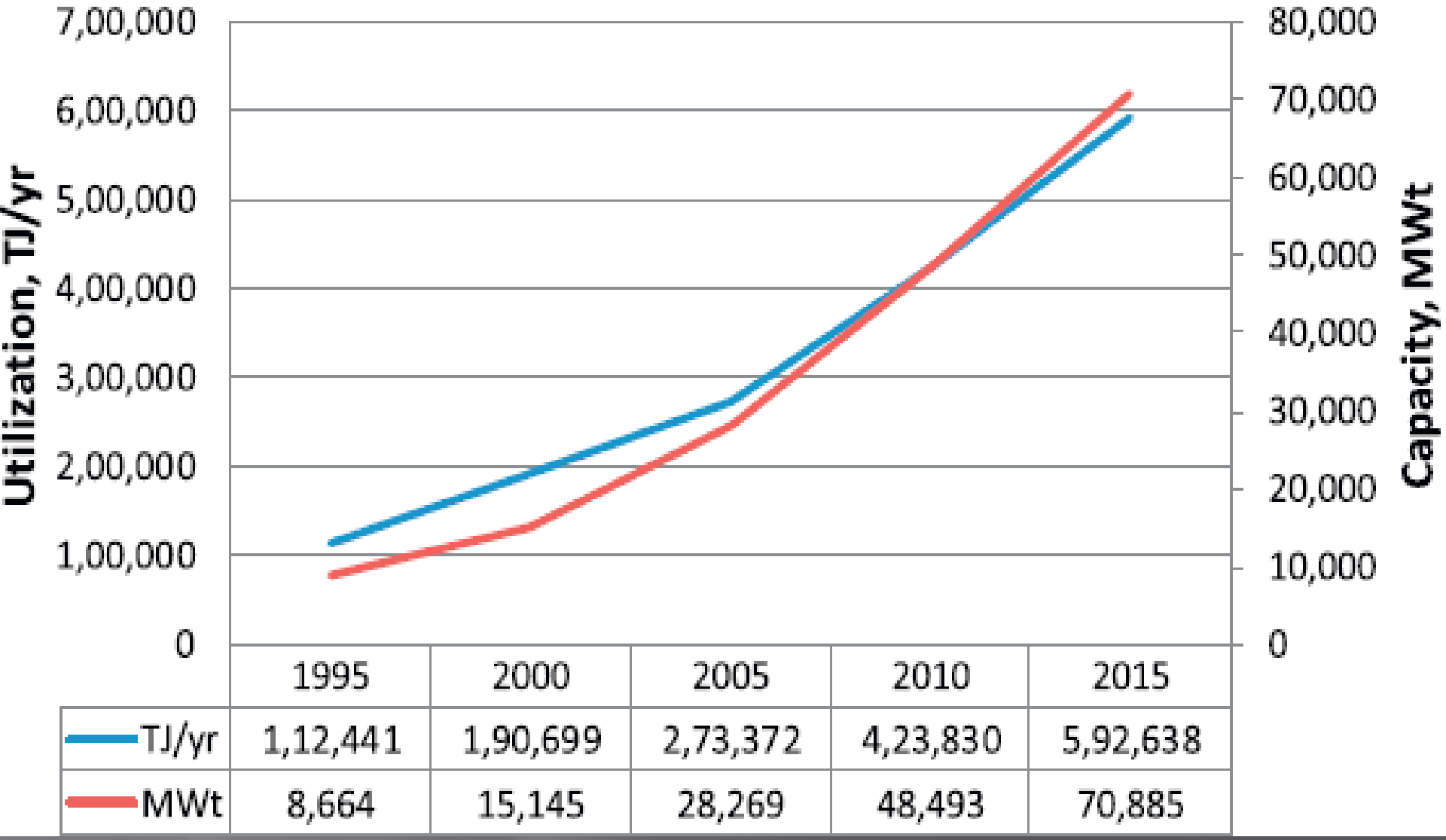


Fig. 1. Increasing and decreasing trends of different energy sources from 1950-2050

❖Based on the present increasing trends of the world's population and energy demands, it is expected that the conventional sources for the energy generation will be exhausted by the end of present century (Fig.1).

❖According to the research report of (Tariq, 2004) based on the information of Ministry of Petroleum and Natural Resources, Pakistan is suffer energy crises from 2014 to 2025

Geothermal Capacity And Annual Utilization



	1995	2000	2005	2010	2015
TJ/yr	1,12,441	1,90,699	2,73,372	4,23,830	5,92,638
MWt	8,664	15,145	28,269	48,493	70,885

Fig.2: The installed direct-use geothermal capacity and annual utilization from 1995 to 2015(Lund et al, 2016)

❖In 2000, approximately 8,000 megawatts (MW) of geothermal electrical generation capacity was present in more than 20 countries (Beck, 2006).

❖There is an evaluation 15,000 MW of generation capacity in geothermal resources worldwide in 2008 and 46 countries were producing power from geothermal energy (Zahoor,2008).

❖An estimation of the installed thermal power for direct utilization at the end of 2014 was 70,885 MWt approximately 2218 well were drilled in 42 countries (Lund, 2016).

Hot Dry Rock Geothermal Energy

- The source of this energy is the earth's internal heat.

- In the upper portion of the earth there are distinct variations in the distribution patterns of geothermal heat flow.

- Earth's heat flows from its interior toward the surface ,the tectonic processes further increase the distribution pattern of the geothermal energy regimes.

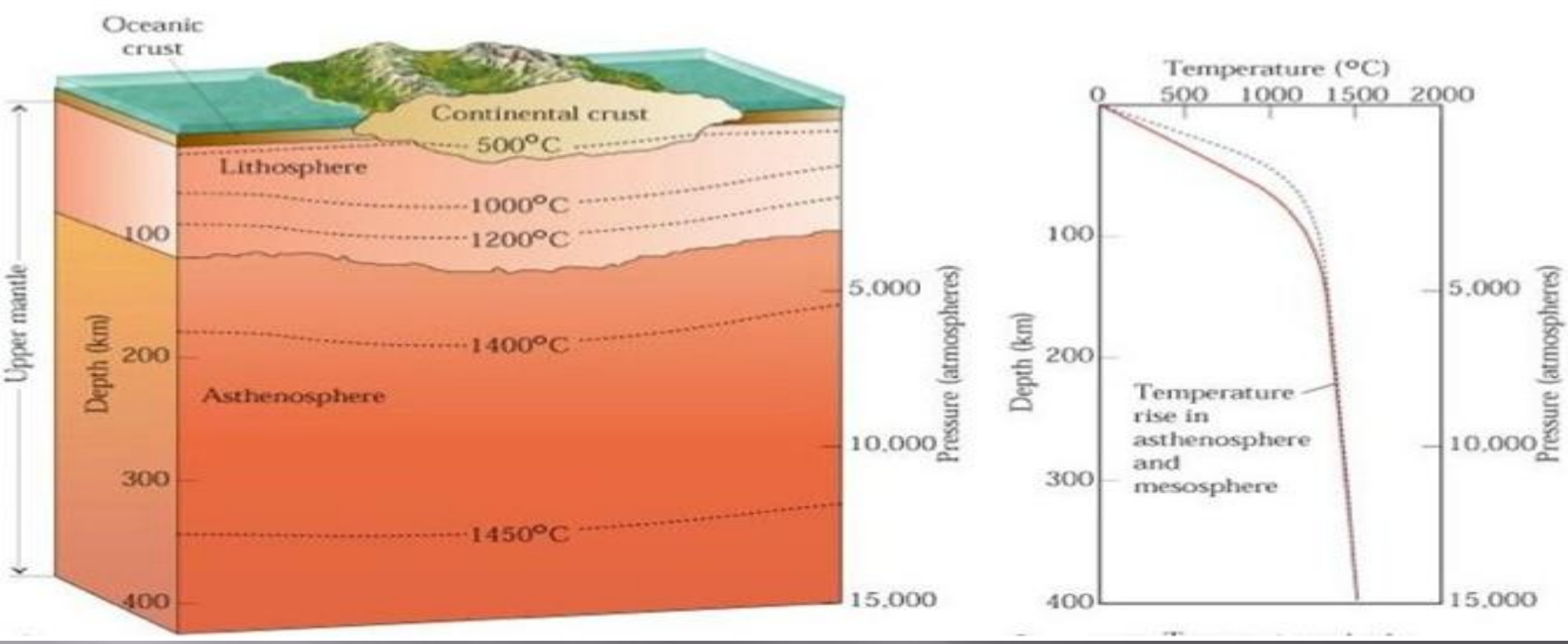


Fig.2: Generalized interior of the earth showing increase of temperature with depth.

❖ Hot dry rock geothermal resources are much deeper than hydrothermal resources. Hot dry rock energy comes from comparatively water-free hot rock found at a depth of about 4,000 meters or more (fig-2).

❖ Some preliminary studies have been carried out for the identification of hydro-geothermal sources in Pakistan (Younas et al., 2016)

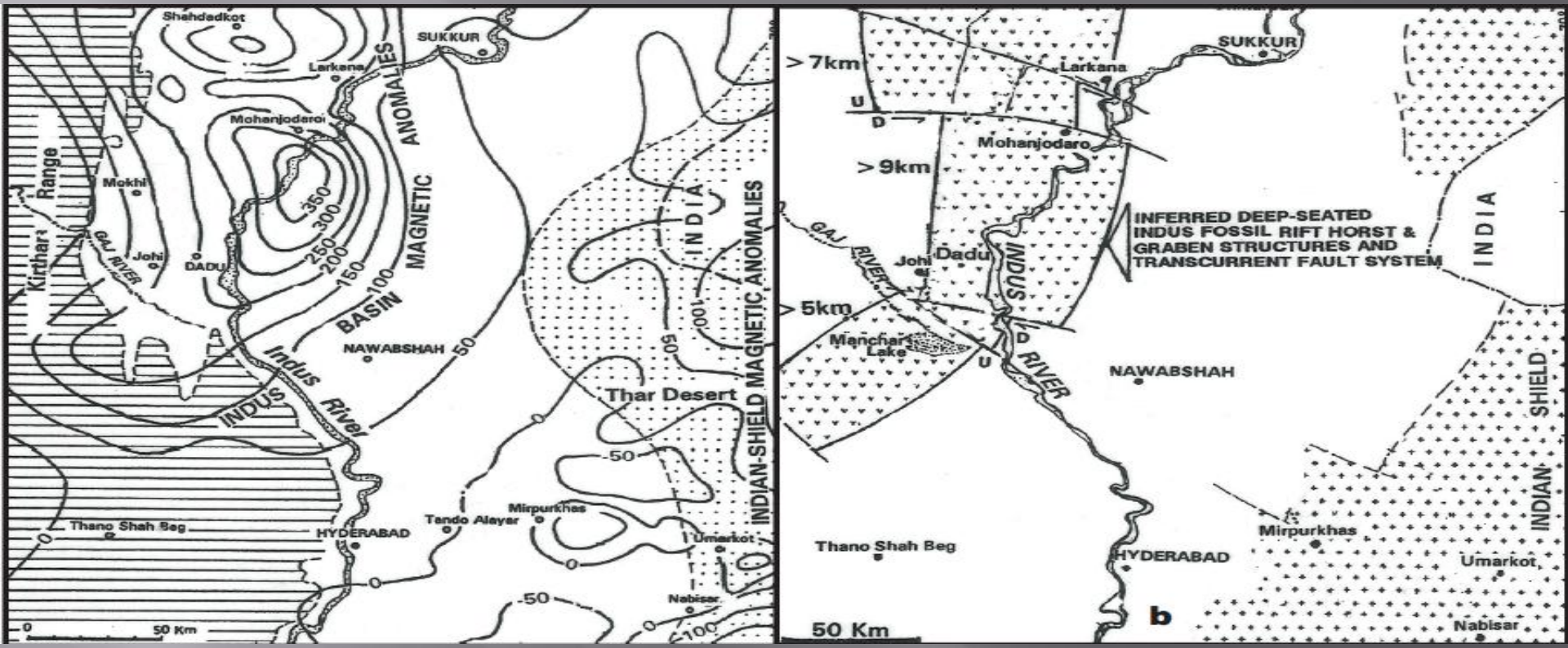
❖But no work is done to study the HDR source potentials in Pakistan.

❖Current research study is first time being discussed here to identify the HDR geothermal energy potential in Pakistan.

Hot Dry Rock Geothermal Energy Potential In Pakistan

- The eastern part of Pakistan, is characterized by a broad north-south trending sedimentary basin, formed during sea-floor spreading .(Powell,1979; Biswas, 1982; Zaigham,1991)

- The focal area of current study ,is about 250 km broad and enclosed by the Thar Desert on the east and by the mountainous region of fold and thrust belts in Pakistan on the west.



(a)The southern Indus basin magnetic anomalies (b)the inferred deep-seated fossil failed rift in the southern Indus basin.(Zaigham,1991)

- In early1990s,a north-south trending southern Indus fossil-failed rift structure was identified, based on the detailed analysis of the archive aeromagnetic data(fig.4a)
- The depths of these inferred rift segments(i.e., the horsts and grabens) were estimated as 5Km for southern, 9Km for central, and 7Km for northern (Fig.4b).

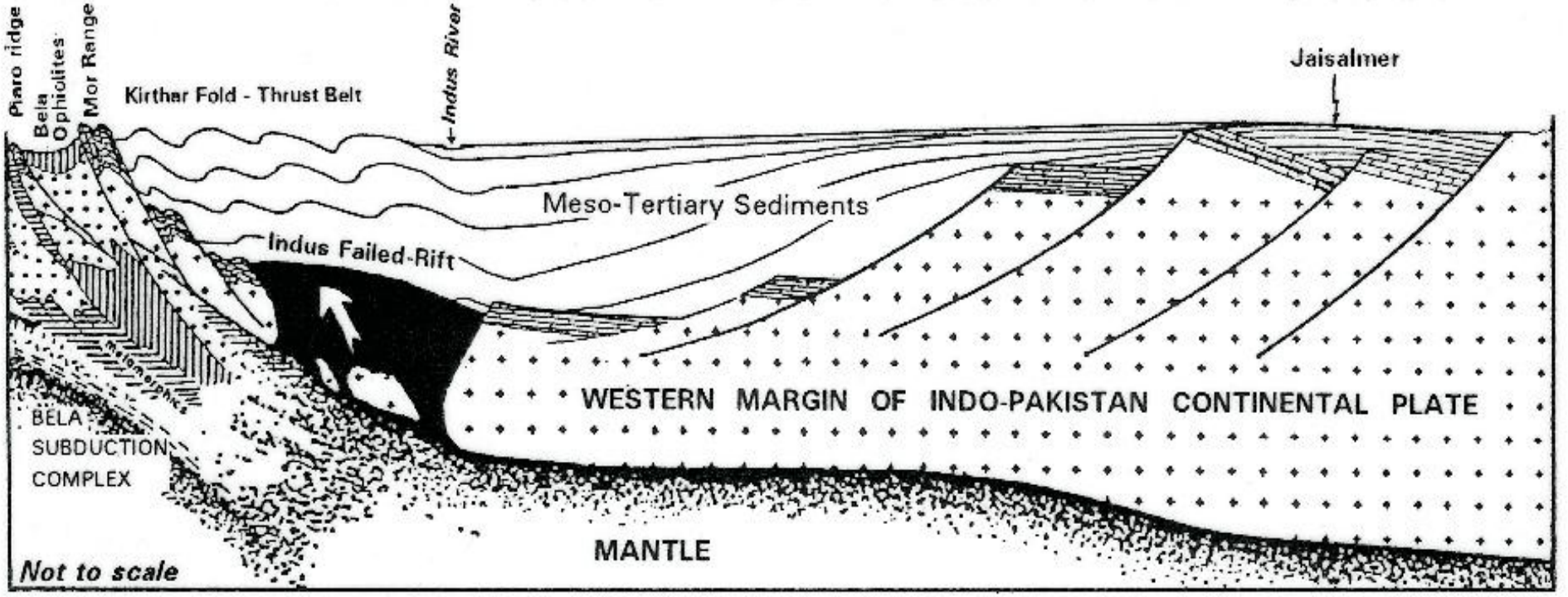


Fig 5: schematic fossil-failed-rift model illustrates the resent-day tectonic setting in the southern Indus basin (zaigham, 2008)

❖ The rifting-tectonic environment encourages the high heat flow to the upper crust from the interior of the earth, the schematic tectonic model of southern Indus basin(fig 5) shows the considerable prediction for the development of relatively higher geothermal anomalies within the basin.

❖ Similarly, in the southeast of the Indus Failed-Rift, another fossil-failed rift was also identified as Thar Rift based on the modeling of seismicity data (Zaigham et al., 2000).

❖ These rift structures demonstrate admirable environments for the development of hydrocarbon source rocks, adequate heat for thermal maturity, and structures for seals and reservoirs in the south-eastern region of Pakistan.

❖Since 1868 till july-2016, round about 1000 Oil & Gas exploratory wells have been drilled down to depth ranging from +230m to +6400m in Pakistan (HDIP, 2016).

❖ Satellite image of exploratory wells shows the exploration trend (Fig-6) initially in the northern part of the Pakistan (Postwar plateau, Makran offshore regions, Suleiman range) drilling exploration started but in last four decade, many wells have been drilled in southern Indus basin.

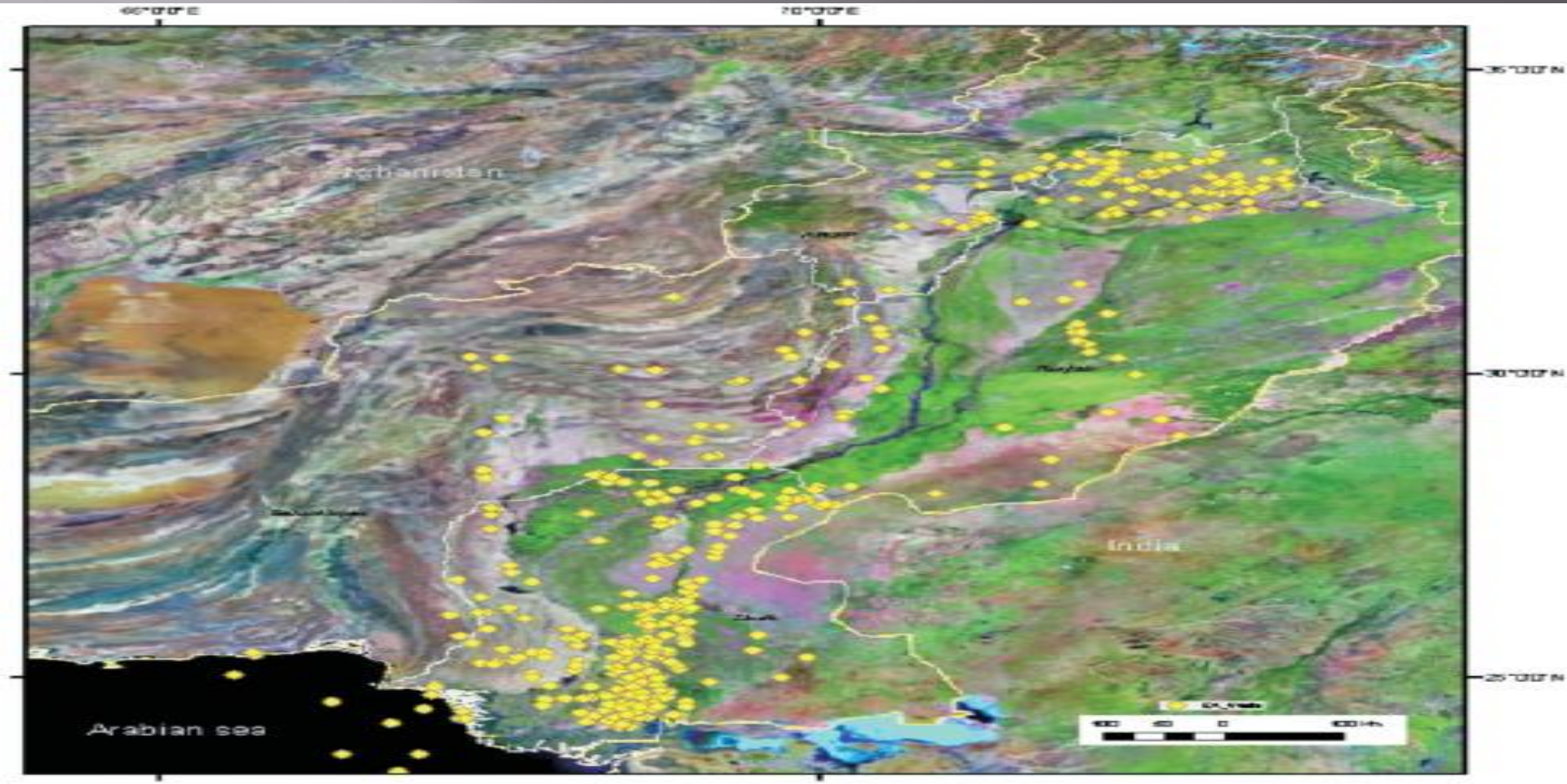


Fig.6: Solid circles show the location of Oil and gas exploratory drilled wells in Pakistan plotted on the map

❖ The data of these exploratory Oil and Gas wells will be an excellent and valuable research material for the estimation of Geothermal potential.

❖ In addition the aeromagnetic studies have also exposed significant prediction for the HDR geothermal energy in Kharan-panjgur tectonic depression in western part of Pakistan. (Zaigham et al, 2008).

Pattern Of Geothermal Gradient

❖Satellite image (Fig.7) shows the spatial distribution pattern in relation to the surface tectonic setup around the southern Indus basin and the geothermal gradient anomalies.

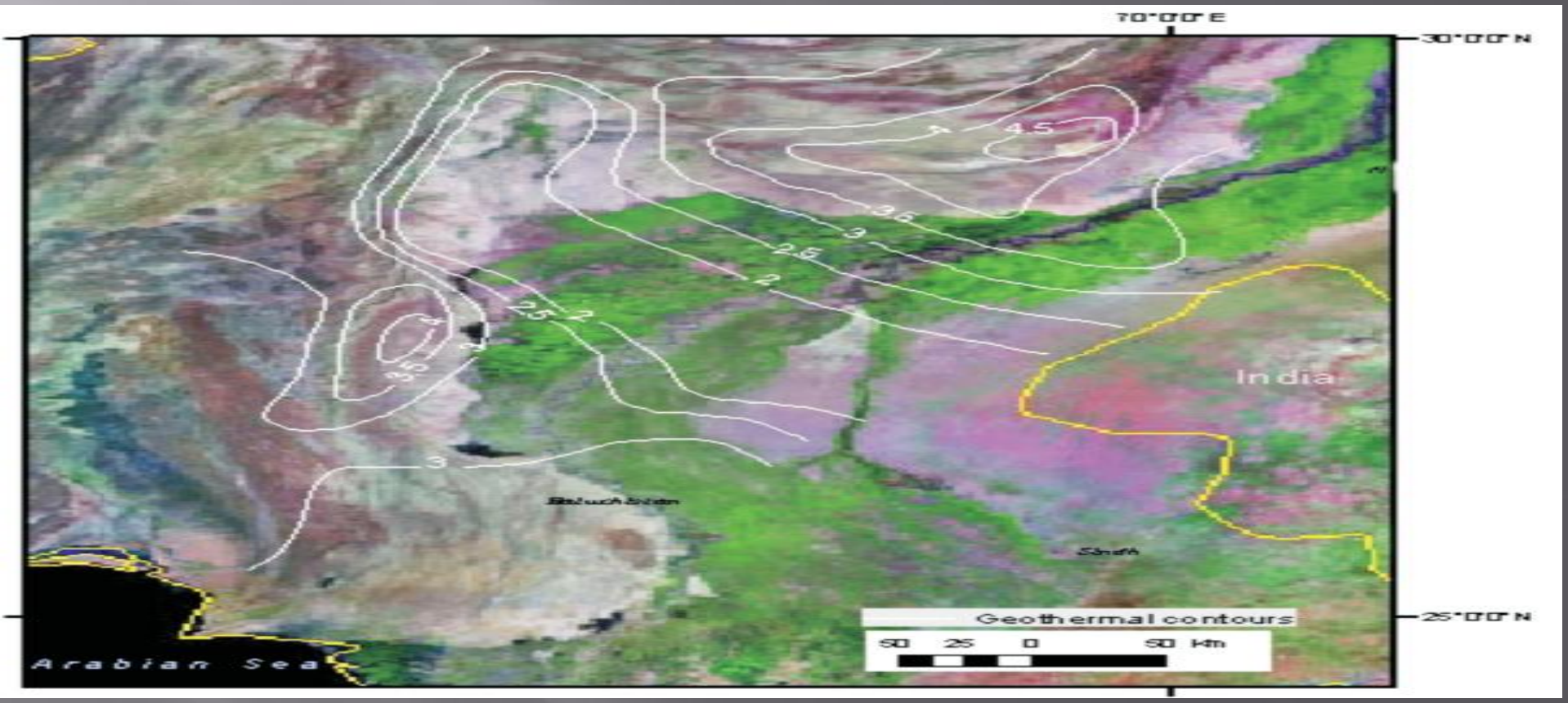


Fig 7: overlay of isothermal gradient contours shows the anomalous distribution pattern with respect to Indus basin

❖The high gradient anomalies are inferred to be associated with faulted segments of the Indus fossil failed-rift.

❖In eastern part of the Axial Fold-Thrust Belt, the Giandari Oil and Gas well encountered an abnormally high geothermal gradient of 4.1°C/100m (Khan and raza, 1986).

❖ in the south and southeast at Sui and Mari, the normal geothermal gradient were recorded ranging between 3.0 and 3.49°C/100m.

CONCLUSIONS & RECOMENDATIONS

❖There is need to study the HDR resources to overcome the energy crises and for the commercial development of Pakistan.

❖More than 600 exploratory wells have been abandoned, which roughly account for 70% cost of total investment of petroleum industry.

❖The data of these wells laying in dead-record can play a vital role for the generation of electricity if the archive data, relevant to the purposed research study should be utilize then capital cost of HDR exploration project can be minimized.

Thank You