



The General Situation of Geothermal Resources in Ordos Basin

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Citation: Deng et al., 2019. The general situation of geothermal resources in Ordos Basin. *Acta Geologica Sinica* (English Edition), 93(supp.2): 164–165.

Abstracts: Geothermal resources refer to the thermal energy in rocks and geothermal fluids that can be scientifically and reasonably developed in the crust under the current technological, economic and geological conditions, and their associated useful components. Geothermal resources can be divided into dry-hot rock geothermal resources, hydrothermal geothermal resources and shallow geothermal resources according to their occurrence state underground. There are seven main exploration methods for geothermal resources, including collection and analysis of regional geological data, interpretation of aerial and satellite photographs, geothermal geological survey, geochemical survey, geophysical exploration, geothermal drilling and dynamic monitoring. By summarizing the previous research results, geothermal geological survey, regional structure and basement fracture analysis of the Ordos Basin, oil and gas drilling in major oil and gas fields of the Ordos Basin and analysis of geothermal data of groundwater exploration, high-pressure physical property test and pressure recovery test data, the geological conditions of geothermal formation, characteristics of geothermal reservoirs and geothermal resource distribution characteristics and geothermal utilization mode of the Ordos Basin are analyzed. The main research results are as follows: (1) There are four main controlling factors of geothermal formation in Ordos Basin, namely regional structure, basement structure, basement fault and stratum lithology. The faulted basins around the Ordos Basin are zonally distributed, faults are well developed, seismicity is active, fault activity is strong, and geothermal gradient is higher than that in the basin. This regional geological structure pattern controls the distribution of geothermal resources. In the basement uplift area of the Ordos Basin, due to the upwelling of upper mantle material, local high temperature zones can be formed. During the upward migration of deep heat flow along the rock strata, high temperature anomalous zones can be formed in the core area of the uplift. Abnormal high temperature may occur near basement faults, especially active basement faults. (2) The heat source in Ordos Basin is geothermal heating type, and the source of hot water is mainly deep circulating water heated by tectonic movement. The geological factors controlling the thermal rheological change of sedimentary layers are mainly the metamorphic heat of radioactive materials and the variation of geothermal heat flow value with the depth of Moho surface. Geothermal reservoirs in Ordos Basin are mainly distributed in the Cretaceous Luohe Formation sandstone aquifer series and the

Ordovician Majiagou Formation carbonate karst aquifer series. The main geothermal caprock with Cretaceous Luohe Formation as thermal reservoir is Cretaceous sandstone interbedded with mudstone. The Ordovician carbonate karst geothermal caprock is mainly composed of Cretaceous, Permian, Triassic and Carboniferous sandstone and mudstone. Geothermal conduction in Ordos Basin is carried out not only through strata, but also through faults. (3) The average temperature of the surface isothermal zone in the Ordos Basin is 11.5 °C. The geothermal gradient increases linearly with the depth. The geothermal gradient varies in the range of 2.2–3.1 °C/100m. The average geothermal gradient is 2.9 °C/100m. The change of the geothermal gradient is directly controlled by the lithological structure of the stratum. Geothermal flow value in Ordos Basin ranges from 43 to 70 mW/m², with an average of 61.8 mW/m². It belongs to the mesothermal type. Geothermal flow isoline distributes nearly East-West in the Yimeng uplift in the north of the basin and Weibei uplift in the south. Geothermal flow isoline distributes nearly north-south and north-east in the western Shanxi fold zone, northern Shanxi slope and western margin fault zone of the basin. In general, the geothermal flow value has a trend of high in the East and low in the West and high in the South and low in the north. (4) The geothermal field of Mesozoic strata in Fuxian-Ganquan area of Ordos Basin is characterized by high in the southwest and low in the northeast. The high-value areas are island-shaped, mainly distributed in Niangniangmiaogou, Shuimogou and Dadonggou areas. There are obvious geothermal anomalies in L108 and L110 wells, and the geothermal gradient is higher than 4.0 °C/100m. The geothermal field of Mesozoic strata in Dingbian-Jingbian-Wuqi area of Ordos Basin is characterized by NW-SEE distribution, increasing trend toward southwest and northeast, and island distribution in high value area of local geothermal gradient. (5) The Paleozoic strata in Yanchang oil and gas area of Ordos Basin are characterized by a north-south distribution, with high temperature in the West and low temperature in the East as a whole. (6) Oil and gas wells in Dingbian and Wuqi areas of Yanchang Oil and Gas Zone in Ordos Basin are generally deep, and the deep horizon temperature is higher, which is the preferred area for oil field development of geothermal resources. It is suggested that the combined development mode of “deep well geothermal heating power generation + shallow ground source heat pump + underground heat exchanger and heat pump system” should be adopted in the development of geothermal resources, and the auxiliary development mode is to transform

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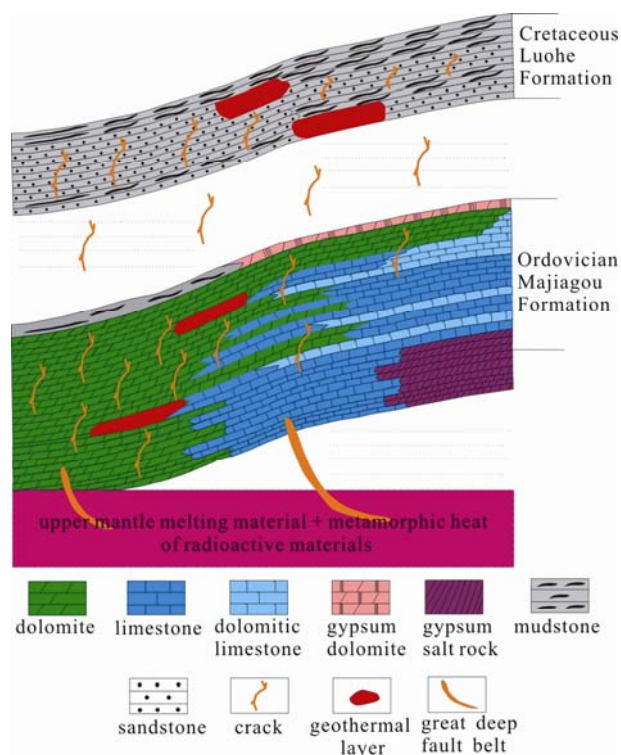


Fig. 1. Model map of geothermal resources in Ordos Basin.

abandoned wells and drill new geothermal wells.

Key words: Ordos Basin, geothermal resources, regional structure, basement fracture, Luohe formation, Majiagou formation, heat flux conduction

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