

Research Advances

Geothermal Field and Tectono-Thermal Evolution since the Late Paleozoic of the Qaidam Basin, Western China

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The Qaidam basin is the largest intermountain basin inside Tibet, and is one of the three major petroliferous basins in western China. This study discussed the geothermal field and tectono-thermal evolution of the basin, in an effort to provide evidence for intracontinental or intraplate continental dynamics and basin dynamics, petroleum resources assessment, and to serve petroleum production.

1 Geothermal Field of the Qaidam Basin

Geothermal field of the Qaidam basin was analyzed based on system steady-state temperature measurements, oil-testing temperature and thermal conductivity of drill holes. We report 17 newly measured high-quality terrestrial heat flow and detailed thermal conductivity of the basin. The results show that the present-day geothermal gradient varies from 17.1°C/km to 38.6°C/km with a mean value of 28.6±4.6°C/km, and that the heat flow ranges from 32.9 mW/m² to 70.4 mW/m², averaging 55.1±7.9 mW/m². Geothermal field exhibits apparent differences in different tectonic units of the Qaidam basin: the Kunbei thrust belt and Yiliping depression are "hot zones"; the Qilian thrust belt is a "warm zone"; and the Sanhu depression, Oulongbuluke uplift, Delingha depression are "cold zones". The present heat flow of the Qaidam basin suggests that, the basin experienced complicated tectonic events in its late development stage. The present heat flow of the Qaidam basin is higher than that of the Tarim and Junggar basins. However, it is lower than the Mesozoic-Cenozoic fault basins in eastern China, and is also lower than the mean heat flow of 63 mW/m² in China (Hu et al., 2000). It is generally a "warm basin". The distribution of geothermal field may be controlled by crustal structure, thermal conductivity, and basin structures.

2 Tectono-Thermal Evolution since the Late Paleozoic

Based on present geothermal field, the burial history, uplift and denudation and thermal history of the Qaidam

basin were studied through a combined analysis of apatite fission track and zircon fission track ages with modeling of fission track length distribution. Integrated with thermochronological dating, this study analyzed the tectonic evolution of the Qaidam basin combined with regional tectonic setting. The results show that, the basin has experienced six phases of tectonic movements since the Late Paleozoic: phase I (254–199Ma), when the Mesozoic-Cenozoic tectonic evolution was started; phase II (177.0–148.6Ma), when the great change of paleoclimate from warm-humid one to dry-oxidative one occurred; phase III (87–62Ma), during which the eastern Qaidam basin uplifted rapidly and suffered denudation, with erosion rate greater than 500m/Ma, and the prototype of Oulongbuluke uplift was also formed at the end of Cretaceous, however, the depression basin was developed under the weak compressive tectonic regime in the northern basin; phase IV (41.1–33.6 Ma) which was considered as a response to early collision between the India and Eurasia plates; phase V (9.6–7.1 Ma) and phase VI (2.9–1.8 Ma). The present tectonic features of the Qaidam basin was developed after uplift and great structural deformation, resulting from the intense extrusion since the end of Miocene (9.6–7.1 Ma and 2.9–1.8 Ma). In general, the Qaidam basin was formed early but the structures finalized late; the process of basin was relatively quiet, while the later reformation was strong. The structural reformation of the Qaidam basin was mainly controlled by the Yanshanian movement (III, 87–62Ma), the middle and late Himalayan movement (9.6–7.1 Ma and 2.9–1.8 Ma). The transfer, extension and geodynamics related to the Tibet plateau uplift should be further studied.

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References

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