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准噶尔盆地大地热流特征与岩石圈热结构

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The characteristics of heat flow and lithospheric thermal structure in Junggar Basin, northwest China

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摘要

沉积盆地现今大地热流和岩石圈热结构特征是岩石圈构造-热演化过程的综合反映和盆地热史恢复的约束条件,对盆地动力学研究和油气资源评价具有重要意义.作者系统分析了准噶尔盆地2000年以来新增的102口钻孔的系统测井温度和400余口钻孔的试油温度资料,采用光学扫描法测试了15口钻孔共187块代表性岩石热导率,首次建立了准噶尔盆地岩石热导率柱,新增了11个高质量的(A类)大地热流数据,分析了准噶尔盆地大地热流分布特征,并揭示了其岩石圈热结构.研究表明,准噶尔盆地现今地温梯度介于 11.6~27.6℃/km,平均21.3±3.7℃/km,大地热流介于23.4~56.1 mW/m^2,平均42.5±7.4 mW/m^2,表现为低地温梯度、低大地热流的"冷"盆特征.准噶尔盆地大地热流与地温梯度分布规律基本一致,主要受控于基底的构造形态,东部隆起最高,陆梁隆起次之,乌伦古坳陷、中央坳陷和西部隆起较低,北天山山前坳陷最低.准噶尔盆地地壳热流介于18.8~26.0 mW/m^2,地幔热流介于16.5~23.7 mW/m^2,壳幔热流比值介于0.79~1.58,属于典型的"冷壳冷幔"型热结构.准噶尔盆地地幔热流值与莫霍面起伏一致,隆起区地幔热流高,坳陷区地幔热流低.

关键词 地温梯度, 热导率, 大地热流, 岩石圈热结构, 准噶尔盆地

Abstract:

The characteristics of present-day heat flow and lithospheric thermal structure, which are the comprehensive reflections of lithospheric tectono-thermal evolution and constraints of thermal history reconstruction, are very important for basin dynamics research and hydrocarbon resource assessment in sedimentary basins. We report 11 newly measured high-quality terrestrial heat flow data based on systematical well-logging temperature data in 102 new boreholes, oil-testing temperature data in over 400 new boreholes and detailed thermal conductivity testing using optical scanning method of 187 representative samples in 15 wells. The results show that the present-day geothermal gradient varies from 11.6 to 27.6℃/km with a mean of 21.3±3.7℃/km, while the heat flow ranges from 23.4 to 56.1 mW/m^2 with an average of 42.5±7.4 mW/m^2. The Junggar basin appears to be a cool basin in terms of its thermal regime. As the same as geothermal gradient, the distribution pattern of heat flow is controlled by basement structure and shows the following characteristics. (1) Relatively high heat flow values over 45 mW/m^2 are confined to the Eastern Uplift and the Luliang Uplift. (2) The Wulungu Depression, Central Depression and Western Uplift are characterized by low heat flow values about 40~43 mW/m^2. (3) The lowest heat flow (33.9 mW/m^2) occurs in the Southern Depression. The terrestrial heat flow consists of crust heat flow varying from 18.8 to 26.0 mW/m^2 and mantle heat flow varying from 16.5 to 23.7 mW/m^2. The Junggar basin is typical of 'cold crust and cold mantle' thermal structure, with the ratio of crust heat flow and mantle heat flow ranging from 0.79 to 1.58. The mantle heat flow values are consistent with the fluctuation of Moho surface, that is, uplift zone has higher mantle heat flow than the sag zone.

Keywords Geothermal gradient, Thermal conductivity, Heat flow, Lithospheric thermal structure, Junggar

Basin

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