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塔里木盆地热液流体活动及其对油气运移的影响

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摘要:

塔里木盆地奥陶系灰岩孔洞和裂缝中都可以见到大量的方解石充填,可以分为三种类型,即孔中方解石胶结物、CI方解石脉和CII方解石脉。CII方解石脉具有较高的 $^{87}\text{Sr}/^{86}\text{Sr}$ 比值,位于 $0.709103\sim 0.710593$ 之间,平均值为 $0.709538$ ;较轻的碳氧同位素组成,其 $\delta^{13}\text{C}_{\text{PDB}}$ 值位于 $-5.67\%\sim -1.70\%$ 之间,平均值为 $-2.95\%$ , $\delta^{18}\text{O}_{\text{PDB}}$ 值位于 $-14.28\%\sim -7.88\%$ 之间,平均值为 $-10.39\%$ 。CII方解石脉中的流体包裹体具有较高的均一温度,各样品平均值位于 $120.0\sim 180.0^\circ\text{C}$ 之间。孔中方解石胶结物和CI方解石脉在同位素组成和流体包裹体均一温度上较为一致,但都与CII方解石脉有着显著的差别。综合比较各项分析测试结果,认为CII方解石脉的形成与深部热液流体作用有关,而孔中方解石和CI方解石脉则是从地层水中沉淀形成的。从热液流体中沉淀形成的CII方解石脉中可见一定数量的油气包裹体,并且包裹体气相成分中除含有 $\text{CO}_2$ 外,还含有一定量的 $\text{CH}_4$ 和 $\text{C}_2\text{H}_6$ 等有机组分。这些特征表明了热液流体在从深部向浅部活动过程中携带并促使了油气向浅部地层的运移。CII方解石脉所具有的较轻的碳同位素组成是有机成因的 $\text{CO}_2/\text{CO}_3^{2-}$ 在热液流体溶解携带油气时混入进了热液流体中的结果。热液流体主要通过降低原油粘度、减小油水界面张力来减小油气运移阻力,并能携带部分油气,从而促使油气沿断裂裂缝体系向浅部地层运移。

英文摘要:

A great number of calcites were found filling in pores and fractures of the Ordovician limestone in the Tarim Basin, northwestern China. The calcites can be separated into three categories: calcite cements in pores, CI calcite veins and CII calcite veins in fractures. The  $^{87}\text{Sr}/^{86}\text{Sr}$  values of the CII calcite veins are relatively high, ranging from 0.709103 to 0.710593, and are 0.709538 in average. Both oxygen and carbon isotopic compositions of the CII are relatively light. The  $\delta^{13}\text{C}_{\text{PDB}}$  values are  $-5.76\%\sim -1.70\%$ ,  $-2.95\%$  in average, and the  $\delta^{18}\text{O}_{\text{PDB}}$  values are  $-14.28\%\sim -7.88\%$ ,  $-10.39\%$  in average. Homogenization temperatures of fluid inclusions in CII veins are relatively high, ranging from  $120.0^\circ\text{C}$  to  $180.0^\circ\text{C}$ . The calcite cements and CI calcite veins are similar in isotope composition and homogenization temperature, but both of them are considerably different from the CII veins. Based on the data, the CII veins were thought to be related to hydrothermal fluids, and the calcite cements and CI veins were precipitated from formation waters. There are a certain number of oil and gas-bearing fluid inclusions in the CII veins. And the gas phase of the fluid inclusions contains not only  $\text{CO}_2$  but also some organic fractions, such as  $\text{CH}_4$  and  $\text{C}_2\text{H}_6$ . Such features demonstrate that the hydrothermal fluids had carried as well as impelled oil and gas to migrate upward when they flowed from deep to shallow strata. The relatively light carbon isotopic composition of the CII veins can be attributed to the interfusion of some  $\text{CO}_2$  or  $\text{CO}_3^{2-}$  of organic genesis when the hydrothermal fluids carried oil and gas. The hydrothermal can not only decrease force resisting to hydrocarbon migration by decreasing hydrocarbon viscosity and interfacial tension but also carry some hydrocarbons. In that, the hydrothermal propels hydrocarbons migrating upward along fault-fracture system.

关键词: [塔里木](#) [热液流体](#) [油气运移](#) [方解石脉](#) [同位素](#)

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