Tectonothermal evolution of Shizhu subbasin, central China, as revealed by thermochronology and virtrinite reflectance data

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As a part of Sichuan basin, Shizhu subbasin located at eastern Chongqing, is a potential petroleum explortation area. For the purpose of establishing the tectonothermal history of Shizhu subbasin, apatite fission track of seven samples and vitrinite reflectance of five samples collected from Jurassic sandstones were carried out.

The apatite fission track ages rang from 88.2±8.6 to 54.1±9.1Ma and mean track lengths vary from 11.3±1.8 to 10.6±2.4μm. Vitrinite reflectance values rang from 0.97 to 0.86, which show that these samples undergo the max. palaeotemperature at 149~134°C according to Barker & Goldstein [1]. On the basis of Ro analysis, using the AFTsolve program [2], modeled time-temperature thermal history of typical sample indicate that the tectonothermal evolution of Shizhu subbasin since late Cretaceous can be divided into three stages, (1) a phase of rapid cooling at 100~81Ma, (2) following by a period of relative thermal stability phase at 81~13Ma, (3) and then a new rapid cooling stage during 13Ma to resent. It is believe that tectonic deformation of Shizhu subbasin began at 100Ma, which benefit to the gas reservoir coming into being formed with good match of tectonic-developing stage and hydrocarbon generation stage. The late Himalaya (13Ma) tectonic movement controlled late stage accumulation of hydrocarbon, and structure traps developed in this stage are favorable for petroleum seeping from reconstructed-redistributed paleo-reservoir.

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The "real effect" for thermo-equilibrium Ca isotope fractionation with temperature variation

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The isotope variations of Ca in carbonate are indicated to be linearly correlated to the temperatures, found in researches published in recent years [1-4], whether it concerns experiments on inorganic precipitation, calcite or aragonite, or the culturing of foraminifera, or coccoliths in the controled environments. However, these researchers also noticed that $\Delta^{44}Ca_{crystal-solution} < 0$ obtained from their study are inconsistent with findings that both $\Delta^{18}O_{calcite-solution}$ and $\Delta^{13}C_{calcite-solution}$ are > 0 [5, 6]. From results of both oxygen and carbon isotopes, we believe that isotopes in a thermodynamic equilibrium environment appear to be heavier in solid solutions than in aqueous ones. Therefore, precipitations of $\Delta^{44}Ca$ in either inorganic or biogenic processes should be > 0, instead of < 0, unless the precipitation process is not governed by thermodynamic equilibrium, but other mechanisms.

We designed a set of experiments that could quantitatively explore thermodynamic equilibrium fractionation in solid calcium carbonate and its aqueous solution. In our calcium isotopic equilibrium experiment, calcium isotopic and temperature variations appear to be in a negative correlation. At the same time, we obtained $\Delta^{44}Ca_{eq} > 0$, a result that's consistent with $\Delta^{18}O_{calcite-solution} > 0$ and $\Delta^{13}C_{calcite-solution} > 0$.

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