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Detrital zircon (U-Th)/He and fision track data of natural deep borehole samples and its geological significance

Nansheng Qiu (1) and Change Cai ()

(1) State Key Laboratory of Petroleum Resource and Prospecting, China University of Petroleum, Bejing 102249, China (qiunsh@cup.edu.cn), (2) State Key Laboratory of Petroleum Resource and Prospecting, China University of Petroleum, Bejing 102249, China

The zircon (U-Th)/He and fission track (FT) thermochronometry has been used as a thermal indicator to study thermal history of the deep sedimentary basin at high temperature. The closure temperature of helium and annealing temperature of FT are important parameters for the zircon (U-Th)/He thermochronometry. In this paper, the zircon He closure temperature and FT annealing temperature were studied by establishing the evolutionary pattern between zircon He and FT ages and zircon burial depth based on the data of natural borehole samples obtained from the Cenozoic strara in the Bohai Bay and Tarim basins, which have different thermal settings. The results show that the zircon He closure temperature of natural samples in the sedimentary basin is approcimately 195°C, higher than the temperature obtain from the thermal simulation experiments (183°C). The high He closure temperature resulted from long term radiation damage accumulation and sufficient grain radius. In addition, two zircon FT age profiles from different thermal background show that there exist different annealing temperatures. The ZFT annealing temperature is about 160°C in the deep borehole of Tarim basin with low thermal background. However, the ZFT annealing temperature is about 210°C in the deep borehole of the Bohai Bay basin with high thermal background. We also point out that effective uranium concentration and radiogenic 4He concentration have apparent influence on the zircon He and FT ages. This study is a revaluation of the conventional zircon He closure temperature and annealing temperature. Thus, properly understanding the ZHe/ZFT ages, closure /annealing temperatures, and their influence factors, ZHe/ZFT dating can provide the true explanation of the testing zircon He/FT ages, and has a great guiding significance in the studying of the evolution of source rocks and the process of hydrocarbon accumulation in the deep sedimentary basin.