

Dynamic Diagenesis and Porosity Preservation of Sandstone in Bearing-Hydrocarbon Basins of China

Jianfeng Shou, Chunsong Si, Yang Shen, and Huiliang Zhang
Hangzhou Research Institute of Petroleum Geology, PetroChina, Hangzhou, China.

The diversity of sandstone diagenetic mechanisms caused by the complex geological conditions of the bearing-hydrocarbon basins in China could not be reasonably explained by the traditional buried diagenesis theory. Many diagenetic phenomena have been observed that the sandstone compactions under deeply buried or high strata temperature were weaker than that under shallow buried or low strata temperature, and even there was obvious changes of the sandstone compaction in two limbs of an anticline. So we presented the concept about dynamic diagenesis of sandstone, which indicates sandstone diagenesis was the result of integrated processes of deposition, heat flow, tectonic deformation and fluid action and could be classified into thermal diagenesis, tectonic diagenesis and fluid diagenesis. Thermal diagenesis of sandstone was related to strata temperature, geothermal gradient, thermal evolution pathway and geothermal process style. Sandstone compaction became strong with depth or temperature increasing, but it became weaker or porosity became larger with geothermal gradient decreasing at the same temperature. The sandstone porosity in the areas with a low geothermal gradient is $\text{ext}(0.077 + 0.0042 \times T)$ times higher than that in the areas with a high geothermal gradient (here T is the strata temperature). Tectonic diagenesis, which means sandstone diagenesis was also affected by late tectonic deformation during thermal diagenesis evolution in this paper, was controlled by intensity or stress, style and occurrence time of tectonic deformation. Average sandstone compaction increased by 0.1051% for per 1.0MPa increase of tectonic compressional stress which tested by AE method acoustic emission. So the sandstone compaction would enhance in the areas of strong tectonic deformation. Tectonic deformation styles affected the stress distribution of a structure, and thus controlled the tectonic diagenesis. Fluid diagenesis including the influence of fluid properties and fluid activities on diagenesis was very complex, and present research is not far adequate, the paper discusses the sandstone compaction effect caused by fluid properties.