Trace-element of calcite cement in reservoir rocks as a useful tool defining hydrocarbon migration pattern, Junggar Basin, China

WENXUAN HU[1], JIAN CAO[1], YIJIE ZHANG[2], YUEQIAN ZHANG[2] AND XIAOKANG GAO[1]

[1]State Key Laboratory for Mineral Deposits Research, Earth Sciences Department, Nanjing University, Nanjing 210093, China (huwx@nju.edu.cn)
[2]Xinjiang Oilfield Company, PetroChina, Karamay 834000, China (zhangyj-xj@petrochina.com.cn)

Hydrocarbon migration patterns are becoming increasingly defined using molecular geochemical tools, as well as fluid inclusions in cements. A case study in Junggar Basin suggests that it might also be identified by analyzing trace-element of reservoir calcite cements.

As the Permian source sequences of the Junggar Basin contain many volcanic materials (e.g. basaltic volcanic and volcaniclastic rocks), the hydrocarbon fluid is consequently Mn-enriched. When this Mn-rich fluid traveled from source to trap, it would interact with reservoir hosts, dissolving feldspars and pre-existing calcite cements precipitated from formation fluid, and even resulting in crystallization of new generations of calcite cements. In contrast, marine and formation fluid calcite are often enriched in Mg and Fe respectively. Thus the calcite forming in the hydrocarbon fluid has proportionally high Mn contents relative to Mg and Fe.

EPMA analyses of *ca.* 1, 000 cement samples from migration pathway framework (fault, unconformity, and reservoir rock) for Mn, Mg, and Fe show that the fault calcites is rich in Mn (averagely greater than 1.0 wt.%), the unconformity samples have less Mn (0.1 – 1.0 wt.%), whereas calcites in reservoir rocks attain more Mg and relatively least Mn (generally less than 0.1 wt.%). Fe varies unclearly in these three suits. Therefore, it is inferred that the fault water was more hydrocarbon influenced than in the other two zones, indicating fault is most favorable for hydrocarbon migration. Furthermore, it is also implied the hanging wall of the fault (Mn>2.0 wt.%; Mg<0.5%) takes priority to be charged compared to the footwall (Mn=1.0 – 1.5%; Mg>1.0%).

Modern surface seeps at Karamay have been proved to be manifestation of fault-controlled subsurface pathway. Some of such fault calcites were developed with several tens of zoned thin hydrocarbon intergrowths, along which the content of Mn, Mg, and Fe fluctuate cyclingly, implying that fault was an episodically active conduit for oil-bearing fluid.