

# Genesis of the high gamma sandstone of the Yanchang Formation in the Ordos Basin, China

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**Abstract:** Recently, more attention has been paid on the high gamma sandstone reservoirs of the Yanchang Formation in the Ordos Basin, China. These high gamma sandstones have logging characteristics different from conventional sandstones, which influences the identification of sandstone reservoirs. Zhang et al (2010) proposed that the high gamma sandstones of the Yanchang Formation might be the result of re-deposition of homochronous sedimentary tuffs or previous tuffs as a part of the sandstone. However, we present a different viewpoint: 1) few tuffs or tuff debris have been found in the high gamma sandstones of the Yanchang Formation; 2) high gamma (or high Th content) sandstones of Yanchang Formation are not related to either clay minerals or feldspar; 3) the heavy minerals in the sandstone reservoirs of the Yanchang Formation are dominated by zircon, which is characterized by abnormally high Th and U contents, up to 2,163 ppm and 1,362 ppm, respectively. This is sufficient to explain the high gamma anomaly. The conclusion is that the high gamma value of the Yanchang Formation sandstones might be caused by zircon with high Th and U contents in sandstones rather than from the tuff components.

**Key words:** High gamma sandstones, reservoir, zircon, Yanchang Formation, Ordos Basin

## 1 Introduction

The Ordos Basin has many energy minerals including coal, oil, gas and uranium. Research in recent years indicates that the Cretaceous, Jurassic, Triassic, Permian and Carboniferous of the basin all have high gamma anomalies, which are mainly caused by enrichment of uranium (Tan et al, 2007; Zhao et al, 2006; Zhao, 2005). Large-scale uranium deposits have been formed in local regions, such as the Dongsheng region (Zhao, 2005; Wu et al, 2006; Zhang, 1994).

In recent years, hydrocarbon reservoirs were discovered in sandstones with high gamma radioactivity anomalies in the Yanchang Formation in the Jiyuan and Baibao regions in the Ordos Basin. The high gamma logging characteristics of this kind of sandstones are inconsistent with those of conventional sandstones. Therefore, sandstones and mudstones cannot be distinguished effectively using gamma logging curves. High gamma sandstones may be easily mistaken for mudstones, and effective reservoirs might be overlooked.

Recently, Zhang et al (2010) discussed the reservoir characteristics of high gamma sandstones in the Yanchang Formation, and proposed that the relatively high

gamma sandstones might be caused by re-deposition of homochronous sedimentary tuffs or previous tuffs as a part of sandstones. We consider the above view point is doubtful and make discussion with Professor Zhang. The authors also consulted with geologists exploring for this type of oil reservoirs.

## 2 High gamma sandstones in the Yanchang Formation

The analysis and research of high gamma sandstones in the Yanchang Formation show that tuff seldom occurs as a component of this type of sandstones. Taking the Chang 4+5 in well Y91 as an example (Fig. 1), the gamma value of 1,893–1,898 m interval is 70–90 API; it is interpreted as mudstone or non-reservoir according to conventional logging interpretation standard. However, drill cores indicate that this interval is oil-bearing fine sandstones with porosity of 8%–12% and permeability of  $(0.5-1) \times 10^{-3} \mu\text{m}^2$ . Table 1 shows the original thin section records of high gamma sandstone samples from corresponding intervals. It can be seen that the clastic components are dominated by quartz and feldspar with content varying from 21.6% to 28% and from 40% to 46%, respectively. High contents of mica, phyllite, and dolomite exist in debris, and fillings consist of chlorite and reticular clay.

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Received November 7, 2011