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Carbonate Cemented Zone in Deep-water Lacustrine Sandstones of Huaqing Area, Ordos Basin: Origin, Distribution and Effect on Reservoir Properties

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1 Introduction

Deep-water lacustrine sandstones of Yanchang 63 are characterized by low porosity, low permeability and ultra low permeability with the porosity of 11.5% on average, the permeability of 0.48×10^{-3} um^2, and form a major oil reservoir in the Huaqing field. These well-sorted, poorly rounded, very fine-grained arkoses and lithic-arkose were deposited in lacustrine turbidite by channel-levee systems terminating in broad lobes according to the distribution of log facies and lithofacies. This article addresses the petrography and associated features, content, distribution, Origin of these carbonate cements and effect on reservoir properties, with the aim to unravel the formation mechanisms of carbonate cements, and to improve the classification evaluation for the Yanchang 6_3 sandstone reservoirs.

2 Distribution of Carbonate Cements

Carbonate cements distribution in the Huaqing area was influence heterogeneous of reservoir and affect fluid flow during production. The size and distribution of cemented zones were mapped using core, log, and thin-section data. Carbonate-cemented zone is characterized by low gamma ray and low acoustic time in well logging curves, with gamma ray curve distinctly low. Carbonate-cemented zones can occur anywhere within deep-water lacustrine sandstone section in the Huaqing area, but they are somewhat more common near the base the channel body and top of lobe body. The thickness is about 0.3-1 m, multiphase in vertical distribution, and laterally extensive calcite layers is about 300 m.

3 Composition

Carbonate cement in sandstone of Yanchang 6_3 mainly consist of calcite, ferro-calcite, ferro-dolomite and siderite, which calcite cements is mainly distribution in the north of area, where ferro-calcite, ferro-dolomite and siderite are distribution in the south of area.

4 Origin of Carbonate Cements

Determining the origin of carbonate cement in sandstone can improve our ability to predict its distribution. Three phases of carbonate cements with different causes and fluid sources were identified by the petrographical and cathode luminescence characteristics. The first-phase cements is calcite cements that intergrowth or coarse flaky, with low content of Fe and Mn, formed under shallow buried open oxidizing environment which is connected with atmospheric water. Calcium originates from atmospheric water. The second phase cements are ferro-calcite that precipitated between point-line contacted particles. Mn content is increased significantly formed maybe relatively deep buried diagenesis environment that relevance to the dissolution of feldspar. Organic acids generated during thermal maturation of organic matter probably provided a source of acid for feldspar dissolution and export into the sandstones. The third phase cements were ferro-dolomite that replacing quartz and feldspar features. The content of Fe was much higher than that of Mn, and formed in alkaline diagenetic environment. Calcium fluid is sourced from the front two-phase cements or syn-sedimentary dissolution of skeletal carbonate debris and carbonate rock fragments in organic-rich basinal siltstones.

5 Effects on Reservoir Properties

The reservoir quality of Triassic deep-water lacustrine sandstones is strongly influenced by carbonate cement

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distribution in the Huaqing area. The volume of carbonate cement is the most important control on permeability. Statistically significant inverse relationships exist between the volume of carbonate cement and both porosity and permeability in the sandstone of Yanchang 6_3 Formation.

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