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The key technology of Micro area visualization in the application of the oil and gas exploration and development

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1 Introduction

Micro area visualization technology is one of the most reliable and most intuitive technological means for our engineers on solving difficult reservoir problems. This not only can be clearly definite such as Oil and gas occurrence of geological problems in the process of oil and gas exploration, but also can be solved remaining oil distribution and mechanism of exploitation problems in the process of oil and gas development. However, as the oil and gas exploration difficulty increased gradually, the existing micro area visualization technology cannot meet

the needs of today's oil and gas exploration and development situation. There are many technical problems in many aspects such as accurating visualization of microscopic pore structure, Oil and gas enrichment state, Oil and water distribution in the pore after water flooding and polymer flooding and porosity character, scaling, distribution of oil and water after asp flooding. All of these are needed to realize visualization technology from static to dynamic, from 2 d to 3 d technology breakthrough urgently.

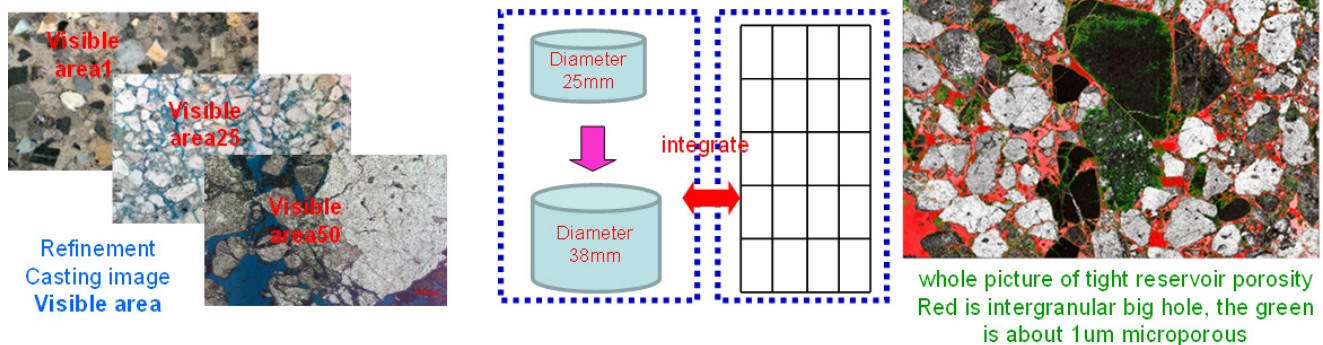


Fig.1 Laser scanning confocal digital image matching technology

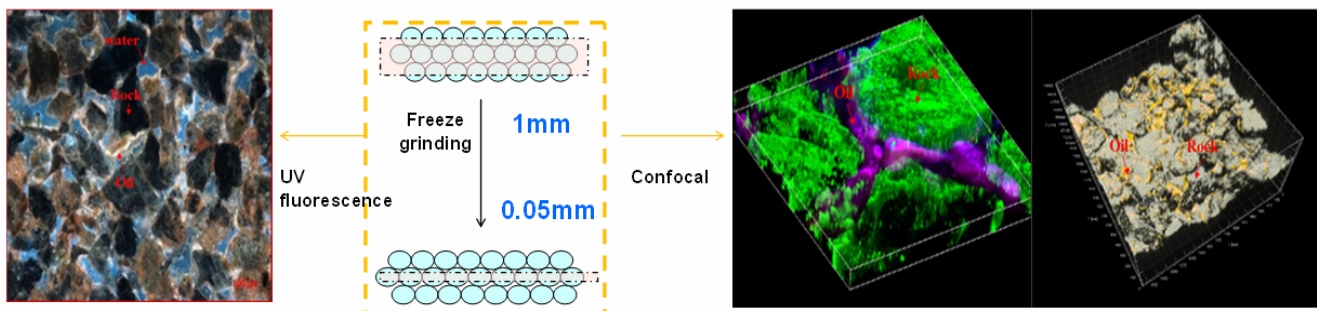


Fig.2 Frozen core grinding slice oil-water rock technology

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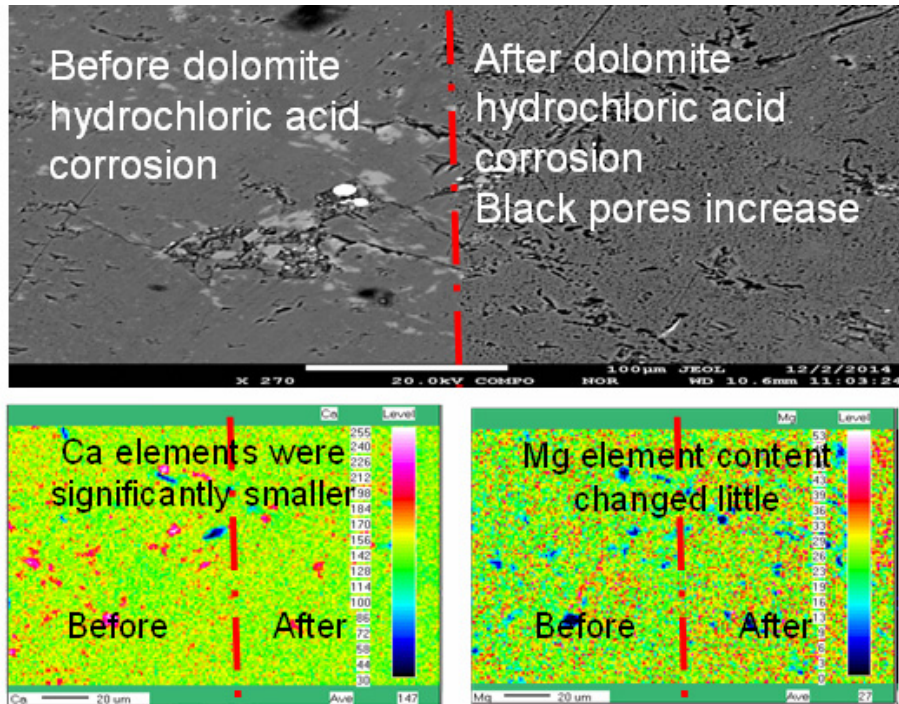


Fig.3 Scanning electron microscopy and electron probe of evaluating microscopic reservoir technology

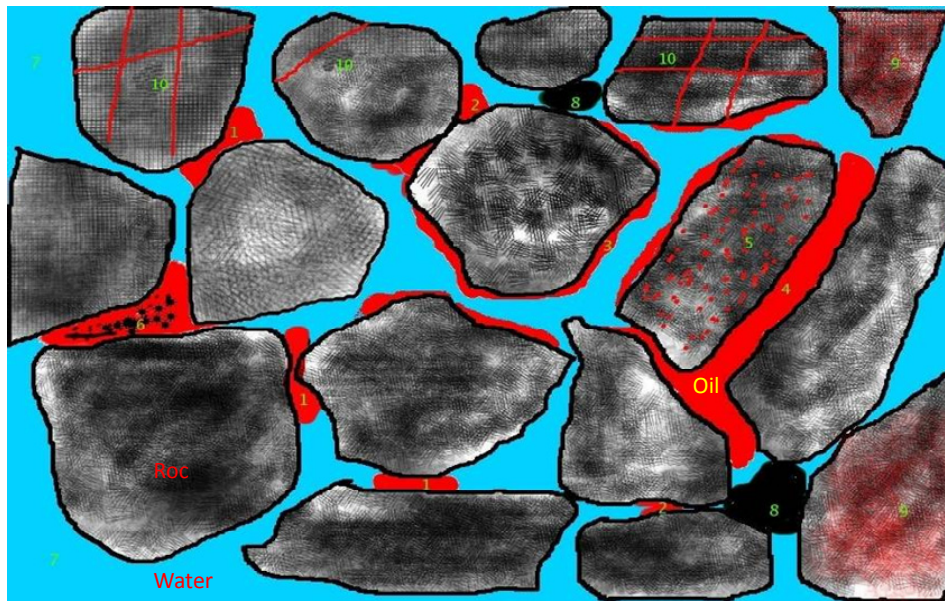


Fig.4 The diagram of remaining oil distribution type

1: Throat remaining oil; 2 Corners remaining oil; 3: Pore surface film remaining oil; 4: Tufted remaining oil; 5: Particulate adsorption remaining oil; 6: Grain between adsorption remaining oil; 7: 8

2 Introduction

The study aimed at the development of the field dynamic, realized the breakthrough in the following key technologies:

2.1 Key technology 1

First of all, a high precision digital image matching technology is established which makes the thin section

observation horizon expanded 50 times under the same precision. It overcomes Technical problems which can not observe the panorama of whole rock under microscope in the past (Fig.1).

2.2 Key technology 2

Second, frozen core grinding slice oil-water rock technology is established which Keeps oil-water in rock in their original state. Although the thickness of rock slices is

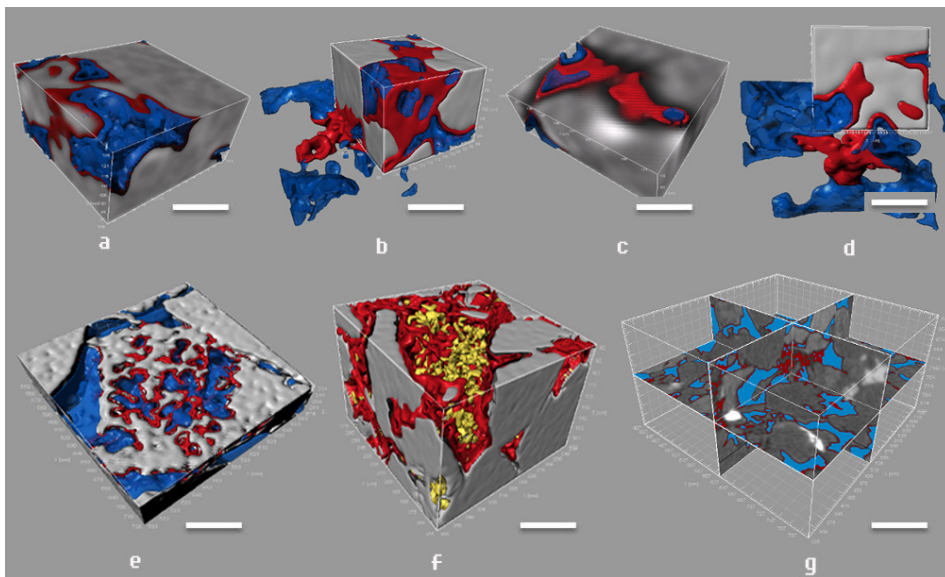


Fig.5 3d CT reconstruction model of Microscopic remaining oil type
 a: Pore surface film remaining oil; b: Tufted remaining oil; c: Throat remaining oil; d: Corners remaining oil; e: Particulate adsorption remaining oil; f: Residual oil emulsion; g: Grain between adsorption remaining oil

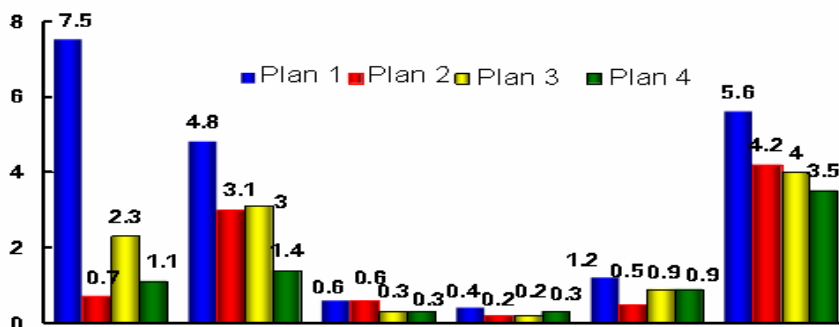
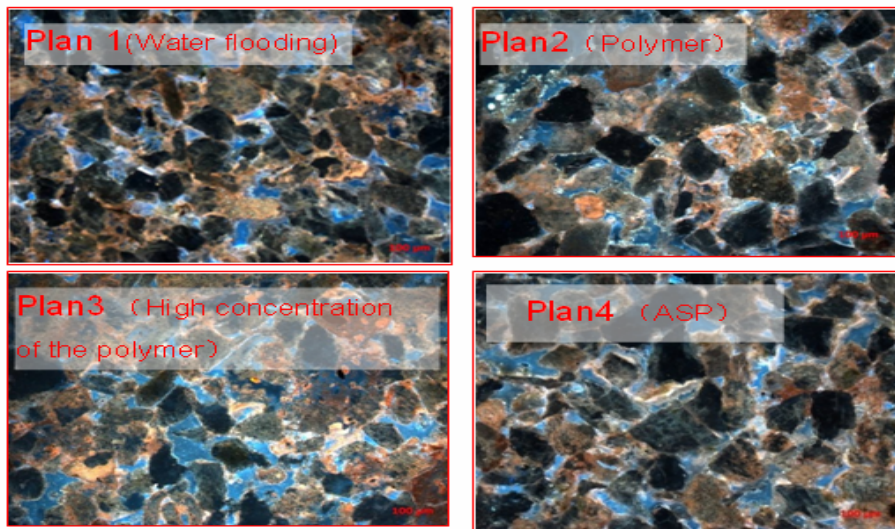


Fig6. Producing degree of remaining oil of different development plans
 1、 Pore surface film remaining oil; 2、 Particulate adsorption remaining oil; 3、 Corners remaining oil; 4、 Throat remaining oil; 5、 Tufted remaining oil; 6、 Grain between adsorption remaining oil

cut from 1 mm to 0.05 mm, the accuracy is improved 20 times. Also, the fluorescence interference which is caused by particles multilayer superposition is avoided, and oil-

water interface of rock is more clearly(Fig.2).

2.3 Key technology 3

Combined with scanning electron microscopy secondary electron image and electron probe back scattering image technology, we find out the distribution relationship of different lithologic pore structure and elements. Also, independent research of development of carbonate rocks in situ micro area acid corrosion experiments has been done, which can get qualitative analysis the change of pore structure before and after corrosion(Fig.3).

2.4 Key technology 4

By confocal laser detection technology series, we get quantitative description of microscopic remaining oil distribution and make the classification of microscopic remaining oil refined. A new classification scheme, make it closer with the reservoir development and stronger practicability(Fig.4).

2.5 Key technology 5

According to the 3d reconstruction of reservoir after water flooding, we got different types of three-

dimensional residual oil distribution by using Micro CT scan. And make it clear that the characteristics of microscopic remaining oil and water in the pore space distribution(Fig.5).

2.6 Key technology 6

According to quantitative characterization of visualization of remaining oil distribution, clarified the influencing factors of microscopic remaining oil distribution and the producing degree of microscopic remaining by different chemical flooding methods(Fig.6).

3 Technology application

The above the micro area visualization technology innovation and improvement, has been widely used in different fields ,such as dense sandstone, carbonate and volcanic rocks, coal and enhanced oil recovery etc. ,were obtained good application effect and the level of research and development has been in a leading position in the world, with great popularization and application value.