Analysis of core casting thin section under different etching time

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Abstract. The Missan oil field is located in southeastern Iraq and is an important part of Iraq's oil economy. Carbonate reservoirs in the Missan Oilfield have the characteristics of multiple mineral types, large changes in reservoir physical properties, and strong heterogeneity. It is difficult to develop reservoirs reasonably and effectively. Therefore, subsequent acidification and acid fracturing of the reservoir Reconstruction is necessary. To provide a basis for the selection of input parameters of the subsequent productivity prediction model and improve the effectiveness of acidified acid fracturing reservoir reconstruction, this paper prepares cast thin sections and uses an electron microscope to observe the microscopic pore structure of the thin sections before and after acid etching. The research results show that acid etching will significantly increase the storage space, and the dissolution rate and dissolved pore morphology of different types and shapes of minerals after exposure to acid have obvious differences. The accuracy has certain guiding significance.

1. Preface

The Middle East is rich in oil resources, 43% of the world's proven oil and gas resources are located in the Middle East, and carbonate reservoirs account for 65% of the world's total crude oil reserves. Misan oilfield is located in the southeast of Iraq and is a large carbonate reservoir [1]. However, due to low porosity and permeability, diverse mineral types, and strong reservoir heterogeneity, the recovery degree is only about 6%, so it is necessary to carry out reservoir reconstruction of carbonate reservoir by acidizing and acid-fracturing.

In order to improve the effectiveness of acid fracturing reservoir acidification transformation, improve the accuracy of the subsequent acidification acid fracturing measures productivity prediction, in this paper, the preparation before and after the acid corrosion of the casting thin sections, through electronic microscope core acid corrosion in different time after the change of microscopic pore structure and mineral composition, research Maysan oilfield microscopic pore characteristics of carbonate reservoir, research has shown that hydrochloric acid is preferred to dissolve calcite. Calcite with large crystals is more easily dissolved than calcite with small crystals. The dolomite with a small crystal is more easily dissolved than the dolomite with a large crystal. The acid etching is selective for composition and crystal only; Pure limestone or dolomite will form large karst caves, the mixture of...
gray and dolomite will form continuous dissolved pores, and sandy dolomite will form dissolved pores between quartz particles. This study is of great significance to improve the accuracy of the productivity prediction of acidizing and acid-pressing measures in carbonate reservoirs.

2. Experiment cores and equipment

2.1. The experiment of core
Comparison experiments were designed for changes in mineral composition and pore structure of the same core at different times of acid etching. Table 1 shows the basic core data used in the experiment.

2.2. Laboratory equipment
a) Cut a thin sheet from the end face of the core, then use a diamond sheet and grind it from 80 to 1000 mesh, with plate glass placed underneath.

b) Paste the polished sheet onto the slide.

c) In the use of alizarin red-S solution for dyeing treatment (alizarin red-S solution preparation: 2mL concentrated hydrochloric acid was taken and diluted with 998mL distilled water to make 0.2% dilute hydrochloric acid (volume fraction), and 1g alizarin-red-S was dissolved in 1000mL dilute hydrochloric acid) [2]. The dyeing range was 1/3 of the whole sheet, and then the prepared sheet was dissolved in 5% hydrochloric acid for different times to observe the phenomenon.

d) The treated sheet is put on the copper sheet of the microscope, and after drying, the copper sheet containing the sample is glued to the conductive tape on the sample holder [3].

e) Adjust the brightness of the microscope aperture, and adjust the Angle of reflection. Aim at the light hole through the low-power objective lens, and adjust the lens barrel from top to bottom using the coarse focus spiral. The eyes observe and observe on the side.

f) Press "LowMag" and "QuickView" on the keyboard to minimize the magnification, click "Stagemap" to mark the samples, and proceed in sequence.

g) Cancel "LowMag" to see if the image is clear. If it is not clear, adjust the focus knob until the image is clear, then rotate the magnification knob to focus the image until the image is clear, and then zoom in until the desired image is enlarged.

h) Press the "Fineview" key for slow scanning, and press the "Freeze" key to lock the scanned image [4].

i) After scanning the image, open the "Save" window on the software, press the "Save" button, fill

| Serial number | Well number | Sample number | Horizon | Sample depth | Sampling depth |
|---------------|-------------|---------------|---------|--------------|----------------|
| 1             | FQCS-28     | C1T11         | A1      | 2994.56      | 0.06           |
| 2             | FQCS-28     | C1T11-1       | A1      | 2994.56      | 0.06           |
| 3             | FQCS-28     | C2T12         | Asmari  | 3004.15      | 0.65           |
| 4             | FQCS-28     | C2T12-1       | Asmari  | 3004.15      | 0.65           |
| 5             | FQCS-28     | C5T12         | Asmari  | 3027.86      | 0.36           |
| 6             | FQCS-28     | C5T12         | Asmari  | 3027.86      | 0.36           |
| 7             | FQCS-28     | C3T93         | Asmari  | 3030.01      |                |
| 8             | FQCS-28     | C3T93-1       | Asmari  | 3030.01      | \              |
| 9             | FQCS-28     | C6T62         | Asmari  | 3080.81      | 0.42           |
| 10            | FQCS-28     | C6T62-1       | Asmari  | 3080.81      | 0.42           |
| 11            | FQCS-28     | C9T52         | MB21    | 4023.03      | 0.25           |
| 12            | FQCS-28     | C9T52-1       | MB21    | 4023.03      | 0.25           |
| 13            | FQCS-28     | C9T82         | MB21    | 4025.87      | 0.29           |
| 14            | FQCS-28     | C9T82-2       | MB21    | 4025.87      | 0.29           |
| 15            | FQCS-28     | C9T82-1       | MB21    | 4025.87      | 0.29           |
| 16            | FQCS-28     | C9T18         | MB21    | 4035.41      | 0.41           |
in the image name, select the image Save format, and then OK, Save the image. Avoid the objective lens hitting the slide and damaging the lens and breaking the slide.

![Electron Microscope Image](image.jpg)

**Figure 1.** OLYMPUS electron microscope

### 3. Comparative experiment before and after acid etching of calcite

According to the electron microscope observation of the cast section before dissolution, the core C6T62 is mainly composed of calcite, dolomite, chlorite, and Terri-origin quartz, and the calcite and dolomite are the main components. It mainly has a grain structure and residual sand structure. There are three crystal sizes of dolomite: 0.01-0.05mm fine grain, 0.05-0.1mm coarse grain and 0.1-0.25mm fine grain, and mainly coarse grain and fine grain. The fine grains and some coarse-grained dolomites are idiomorphic grains, while some coarse-grained dolomites and some coarse-grained dolomites are anastomose-hypidiomorphic grains. The silt-crystal dolomite aggregate constitutes the residual sand (possibly). Terrestrial quartz is distributed from powder to medium grain, with different sizes, sub-angular shapes, and poor sorting. The main component of argillaceous is chlorite, which is distributed among dolomite crystals.

After the dissolution of 5% hydrochloric acid for 10 seconds, the wafer surface foamed more intensely, and no gas was released, nor did the odor overflow. The changes were observed under an electron microscope, and it was found that the changes were not obvious. After dissolution for 15 seconds, the surface of the thin section was blistered with no gas release and no taste. Under the microscope, there was no obvious change in the mud and dolomite crystals. Calcite has been completely dissolved, only the shape remains, under the orthogonally polarized light completely extinction, face rate increased by nearly 30%.

**Table 2.** Before and after core C6T62 calcite etching

| Acid soluble before | After the first acid etch | After the second acid etch |
|--------------------|--------------------------|---------------------------|
| Coarse-fine grained marl dolomite | After 10 seconds of dissolution of 5% dilute hydrochloric acid | After 15 seconds of dissolution of 5% dilute hydrochloric acid |
4. The comparative experiment of dolomite before and after acid etching

The rock mineral composition is mainly dolomite, a small amount of gypsum, and anhydrite. It mainly has a grain structure. The dolomite crystals are about 0.008mm in size and develop two sutures along which are rich in muddy iron. Multiple nearly parallel microfractures are developed, filled with gypsum and anhydrite [5]. The dissolution pore is developed, and the facial rate is about 5%.

First 5% acid solution for 30 seconds: no reaction on the sheet, no change under the microscope. The second time 5% acid solution for 2 minutes: macroscopically, slightly foaming, no significant change under the microscope. The third time 5% acid solution 6 points: slight foaming, with a filar white gas. The dolomite dissolves about a third. Anhydrite and gypsum showed no dissolution. Porosity increases by about 30%.

Table 3. Core C9T93 dolomite before and after acid etching

| Acid soluble before | After the first acid dissolves | After the second acid dissolves | After the third acid dissolution |
|---------------------|--------------------------------|--------------------------------|---------------------------------|
| Micrite contains anhydrite dolomite | Dissolve with 5% acid for 30 seconds | Dissolve it a second time with 5% acid for 2 minutes | The third time 5% acid solution 6 points |

Table 4. Core C1T11 dolomite before and after acid etching

| Acid soluble before | After the first acid dissolves | After the second acid dissolves | After the third acid dissolution |
|---------------------|--------------------------------|--------------------------------|---------------------------------|
| Silty grains containing silty argillaceous dolomite | Dissolve with 5% acid for 30 seconds | Dissolve it a second time with 5% acid for 2 minutes | The third time 5% acid solution 6 points |

5. Conclusion

Hydrochloric acid is preferred to dissolve calcite, and only pure dolomite will be completely dissolved by hydrochloric acid. However, when both exist, calcite will be completely dissolved, while dolomite will only be broken. The calcite with a large crystal size is more likely to be dissolved than the calcite
with a small crystal size, and the cementation of fine-grained coarse-grained calcite or sparry calcite is more likely to be dissolved than the micrite calcite. The dolomite with a small crystal size is more easily dissolved than the dolomite with a large crystal size, and the micrite dolomite is more easily dissolved than the fine-grained and coarse-grained dolomite. The acid etching is only selective to the composition and crystal, not to the matrix or pores, and does not select the intergranular pores or cracks for corrosion first. Pure limestone or dolomite will form large caves, the mixture of gray and dolomite will form continuous solution pores, and sandy dolomite will form intergranular solution pores of quartz. In short, acid etching will significantly increase the reservoir space.

References
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