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Observing Skills of Secondary and Backscatter SEM Method of Shale

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1 Introduction

There are two ways to prepare SEM samples of shale, one is fresh fracture secondary electron method, the other is Ion-Milled Backscatter Method. Secondary electron SEM is 3-D image, can provide the original morphology, fossil and mineral ID is easier; Backscatter SEM (Ar-ion milled) have very flat surface and is 2-D image, the grayscale is proportional to density, and visible pores have well-defined outlines.

2 Mineral and OM identify

In Secondary electron SEM we identify mineral by crystal morphology, e.g. quartz is hexagonal prisms, pyrite monomer is usually cube or pyritohedron, crystalline aggregate is usual take the shape of strawberry, and so on. In Secondary electron SEM, it isn't so easy to identify organic matters(OM), OM has such characteristics in SEM, (1) OM is amorphous, and haven't certain shape; (2) OM is soft and it is easy to impress on it; (3) by means of the form of occurrence of OM, the occurrence of OM are common in bands , film, particles, and remnant of biology (such as sclerotinite, alginate, fusinite), at last we can identify OM by EDS, if the content of C is more than 30%, then the OM was affirmed. In Backscatter SEM we can density mineral by grayscale, clay and quartz are a similar medium gray color; pyrite and other heavy minerals are white, organic matters are dark, open pores are darkest. In both method, we can identify mineral and OM with the help of EDS.

3 observation of pores

Both Secondary electron SEM and Backscatter SEM can see pores in shale, but they have their own advantages and disadvantages. Secondary electron SEM fit to observe large pores (more than 5μm), such as intergranular pores, corrosion pores. The surface of fresh fracture is rough, and it is difficult to define the outlines, so this method don't fit to observe small pores. Backscatter SEM fit to observe small pores, because pores have well-defined outlines, but to large pores, because the fragment of shale tend to blocking the large pores during sample preparing, so it is difficult to see the whole actual pores. Backscatter SEM fit to observe OM pores,

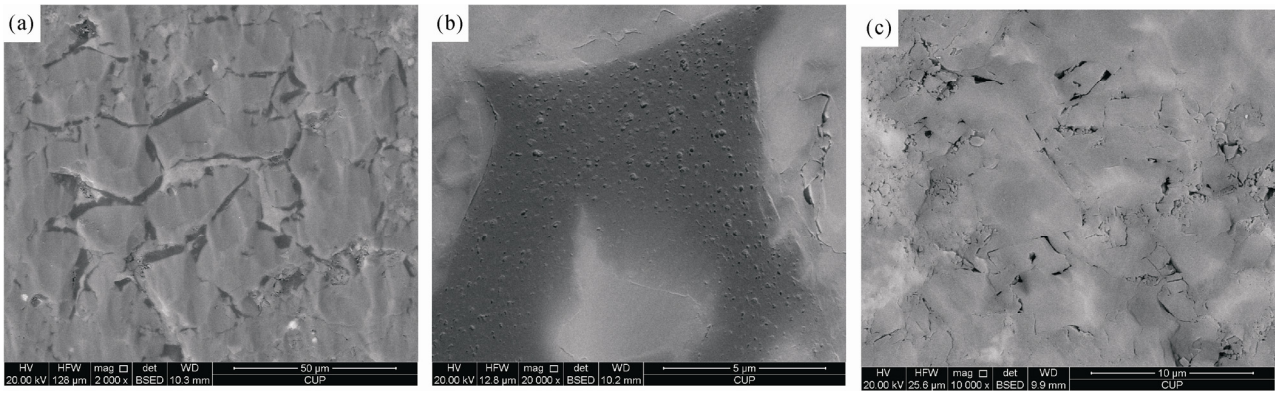

Fig.1 Image of Ion-Milled Backscatter SEM of shale
Al OM dispersing around quartz; B pores in OM; C corrosion pores in carbonate

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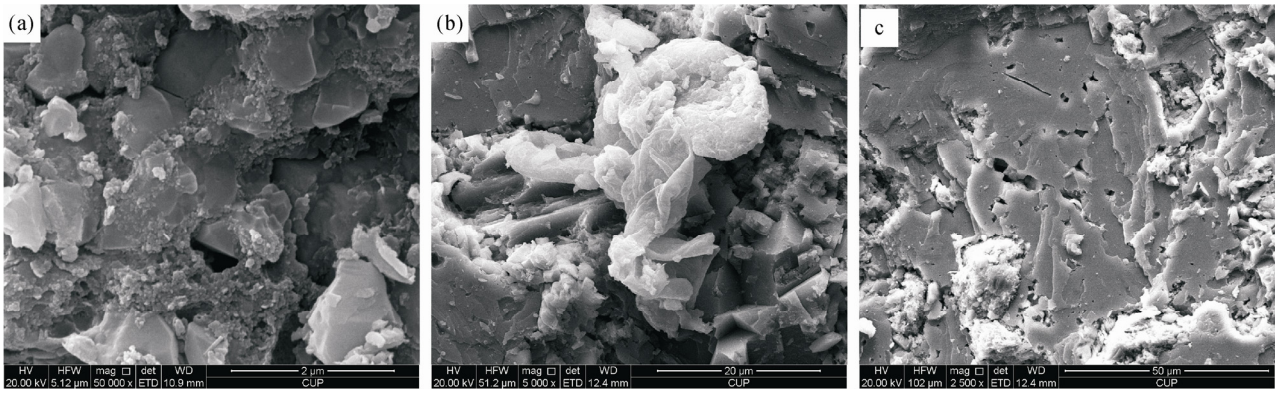

Fig.2 Image of second electron SEM of shale
A OM particles distributing around quartz; B agglomerated curly OM film ; C corrosion holes of carbonate

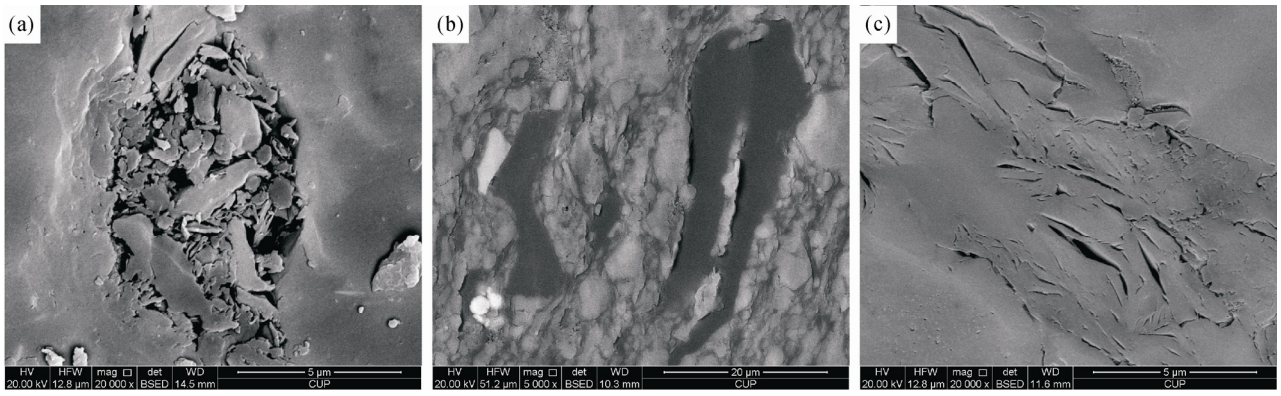

Fig.3 Image of Ion-Milled Backscatter SEM of shale
A big pore was filled with fragment; B strips of OM; C pores in clay

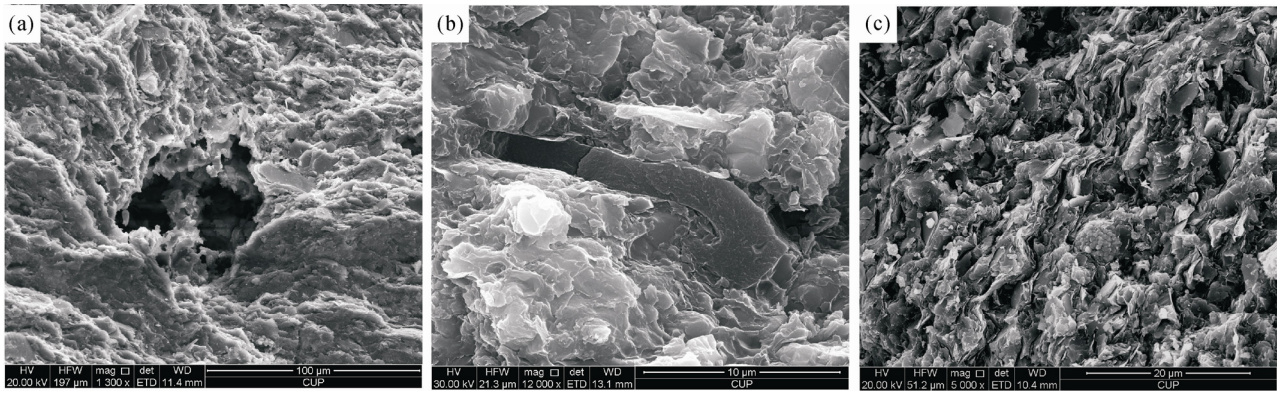

Fig.4 Image of second electron SEM of shale
A big pore of over 50μm width ; B OM strip; C pores in clay

intracrystalline pores in clay and corrosion pores. Usually the pores in shale are small, so Backscatter SEM was used more frequently.

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