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Research on the Method of Measuring Mineral Percentage under the Microscope

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Abstract: The determination of mineral percentage has great significance for the rock identification and the analysis of geological environment. However, In the process of practical application, the traditional estimation is easy to make an error and difficult to be mastered. This paper introduces a kind of method which grids the watching horizon by the assistant measuring glass. In that way, you can change irregular shape and uneven distribution rock constituents into multiple squares, which is convenient for its percentage content and grain diameter in statistic. Because of convenient operation and high accuracy, this method has high practical significance.

Key words: *Mineral percentage; Rock identification; Gridding the watching horizon; Under the microscope*

I. INTRODUCTION

The determination of all kinds of mineral percentage in the rocks has great significance for the naming and analysis of geological conditions of the rock. [1,2].For example, the heavy minerals content can reflect the characteristics of parent rocks, the distances from the provenance and the hydro-dynamic conditions in sedimentary rocks. In magmatic rocks, accessory mineral content can be used for the time correlation of magmatic rocks and the analysis of magma evolution. The methods that determine the mineral percentage under the microscope including paint estimation, eyepiece micrometer linear measurements, etc. [3].These estimating methods are easy to make errors, especially for the accurate evaluation of the content of less heavy minerals and accessory minerals that distributing unevenly and hard to be mastered expect some practiced observers. [4]. Many scholars put forward some advanced methods to calculate the mineral content quantitatively by rock chemical methods [5] and the use of texture and spectral characteristics of rock image [8], but these methods have higher requirements for the research equipments and not be conducive to popularity.

II. ESTIMATION STUDY

In order to estimate the mineral percentage accurately and simplify the operation as far as possible in the process of rock identification, the author attempts to put forward a method that meshing the observing area using auxiliary measuring glass to calculate the percentage of all kinds of mineral content in thin section, and solve the above problems.

The thin section is made of thin hard transparent material (figure 1) and divided into two zero, low power area and middle power area. The low power area is 2 cm *2 cm, the grid spacing of 0.05 mm, for the calculation of large diameter minerals in the thin section, and applied to the observation and measurement of objective lens at low magnification; Times in the area is 1 cm * 1 cm, the grid spacing of 0.01 mm, for the calculation of the content of smaller diameter minerals, and applied to the observation and measurement of objective lens at middle magnification. The grid lines are marked by solid and dotted lines (or two colors) alternately to facilitate ours count of the mineral diameter or calculation of the percentage of the mineral. We just cover it on the thin section or ore-ray when doing it. The characteristic of this method is that it gridding

the observation field and transform the irregularly shaped mineral grains into several regularly squares. Due to the total number of squares in horizon is known, so it is easy to calculate the percentage of each mineral as long as count the number of the square of each mineral.

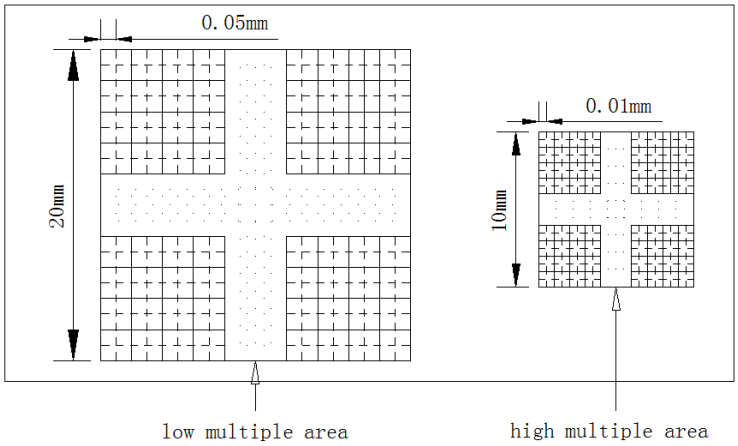


Figure1 The sketch of auxiliary measuring
debris of mineral content under microscope

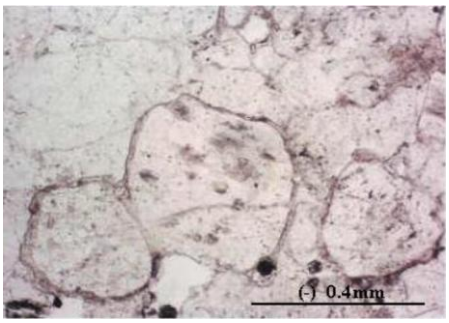
III. EXAMPLE ANALYSIS

1. The application of horizon gridding method in naming of rocks

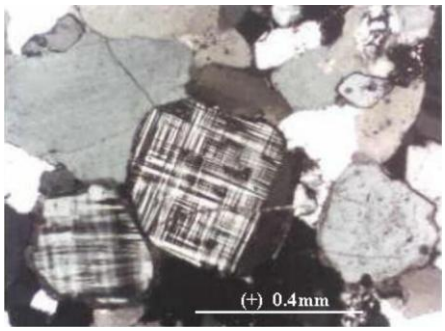
We take the rock thin section sample as an example in figure 2, it consists of quartz, feldspar (microcline), and cuttings. Under the plane-polarized light, the quartz manifest as xenomorphic texture, smooth surface, colorless and transparent, the feldspar shows as hypidiomorphic crystal, kaolinization in surface and edge colorless and transparent. However, the debris is xenomorphic and opaque with a color of brown. Under the cross-polarized light, the quartz showed with a interference color of Ⅰgray level without cleavage, the feldspar also show showed with a interference color of Ⅰgray level but developed cross hatched twin, and the debris is close to complete extinction.

The total number of square in horizon is 300, including 8 debris squares, 77 feldspar squares, and the rest is quartz. So, the debris occupied 2.7%, feldspar occupied 25.7%, the percentage of quartz is 71.6%. Hence, in this case, it can be named as feldspar sandstone (in order to reduce the random error, we should observe a few more horizons in the process of actual operation until final conclusion).

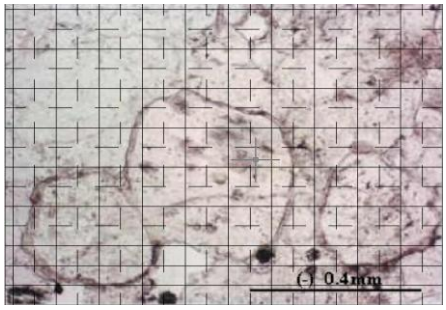
It is difficult to determine whether feldspar percentage is more than 25% within traditional estimation that based on the visual inspection or simple measurement with ocular lens that leads to unable to determine it belongs to feldspar sandstone or feldspathic quartz sandstone. So, this method is more credible compared with the traditional estimation for the naming of rocks. In the same way, the mineral content measured by this method has a higher reliability when analyzing the geological characteristics such as provenance and sedimentary environment.



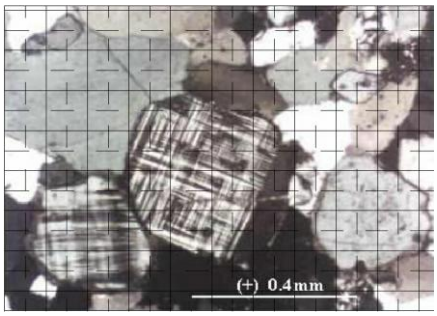
（a）observed under the plane-polarized light



（b）observed under the cross polarized light



（c）observed under the plane-polarized light plus auxiliary slides



（d）observed under the cross polarized light plus auxiliary slides

Figure2　The sketch of arkose under the microscope

2. The application of the Horizon grids method in provenance analysis

The Zizhou gas field located in the northeast of Yshan slope of the Ordos Basin, which adjacent to the Yulin gas field and Mizhi gas field. As main reservoir of Zizhou gas field , Permian Shan2 reservoir can be divided into three single layers —$Shan_2^3$,$Shan_2^2$,$Shan_2^1$ reservoirs from bottom to top. According to the results of thin section identification, the Shan23 single layer in Zizhou region is mainly quartz sandstone , next is lithic quartz sandstone times. $Shan_2^2$+$Shan_2^1$ single layers developed lithic sandstone mainly, next is lithic quartz sandstone. Each single layer's sandstone type and particle composition content in south Yulin region is closed to the Zizhou region. It indicates that there must be some continuity between the sedimentary layers of two regions in space. However, the quartz content in Zizhou region is more than south Yulin region slightly, and the feldspar and debris content is higher lightly (table 1). It suggests that the Zizhou region affected by other provenance apart from provenance from the south Yulin region. (provenance from Mizhi region),which consistent with the conclusion from the reservoir property analysis.

From this case, it can be seen that determining the percentage of the rock components has a great significance for geological environment analysis. However, the method which grids the watching horizon have a high accuracy in the process of calculating the percentage of rock components, and the conclusion also has a higher credibility.

Horizon	Rock composition percentage in Zizhou region % （Average value）			Rock composition percentage in south Yulin region % （Average value）		
	quartz	feldspar	debris	quartz	feldspar	debris
$Shan_2^2$+$Shan_2^1$	63.48	2.39	34.13	66.53	0.24	33.23
$Shan_2^3$	93.12	0.70	6.18	94.73	0.13	5.14
$Shan_2$	87.11	0.63	12.26	90.64	0.18	9.18

IV. RESEARCH SIGNIFICANCE

(1) Compared with traditional estimation like paint estimation, eyepiece micrometer linear measurements etc., this kind of method has a higher accuracy, more convenient. Then, this estimation has lower equipment requirements than petrochemistry methods, it needs only a piece of auxiliary slides.

(2) This method not only be applied to teaching and helping students determine the mineral percentage accurately, but also as a auxiliary means to validate the result of the ocular estimation in the process of training of ocular estimation ability.

(3) This method is applied to both polarizing microscope and metallographic microscope, which can satisfy the normal study such as the rock naming, analysis of the geological conditions that the rock formation, and it is convenient for popularization.

V. THE SUMMARY

This method gridding the observation horizon using the auxiliary measuring slide engraved with grid to measure the mineral diameter, calculate the percentage of mineral microscope accurately, and reduce the estimation error accordingly, especially applied to the calculation of mineral component percentage that with irregular shape, less content and heterogeneous distribution. Meanwhile, this method measurement accurate, easy to operate, does not rely on rich experience observation, novice can quickly grasp. It also can be applied to the teaching as an auxiliary method to facilitate students to master traditional paint estimation, eyepiece micrometer linear measurements. This method was applicable widely and has high practical significance.

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