Calculation of shear displacement using strain analysis, in Qaleh-Zari mine, (south of Birjand)

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Abstract

Mineralization in Qaleh-Zari mine is in the dextral shear zone with N135 trend. In this paper, shear displacement has determined by Mohr circle method and using available formula. Calculation of shear strain and volume change in studied area, indicate dilatation for this zone. With regard to shear strain and volume change values at different distances for 4300m lengths of shear zone, the measured shear displacement is about 2021m.

Key words: *Qaleh-Zari mine shear zone, shear displacement, volume change, shear strain value.*

1. Introduction

Qaleh-Zari mine is located in longitude between 58º 58'-59º 1' east and latitude between 31º 46'-31º 49' north, almost 180km south of birjand. This area is in east of lut block and so follows of structural treatment of it. Mineralization in this mine is as vein in the fractures of shear zone.

The determination of shear displacement is a basic object of structural geology. The Qaleh-Zari mine shear zone is dextral with N135 trend. The shear zone is 4.5km in length and 50m in width. Trend of shortening is N and stretching is W. Statistical amounts of longitudinal strain and shear strain and descriptive components of strain ellipsoid (supposed that primary sphere has unit radius) for various points in the area have gotten, then shear displacement in studied area has determined.

2. Construction of Mohr circle method for calculation of strain and volume change value

For 3-D finite strain analysis in the area can be used Mohr circle diagram because that fractures have crossed each others. So location, trend and dip.direction of cross vein planes are needed. Strain ratio ($\frac{\lambda'_2}{\lambda'_1}$) has been measured for 30 instances of fracture cross (Fig1,2).

For determination of volume strain values, it's necessary calculating strain ratio (R) according to equation 1, at principal strain planes.

$R_{yz} = R.\cos\alpha$
$R_{xz} = R.\cos\beta$ equation (1)
$R_{xy} = R.\cos\gamma$

α, β, γ are polar angle of plane and x, y, z axis respectively.

Application of shear strain is for introduction of angle variations on two perpendicular directions and it is:

$$\gamma=tg\psi \qquad \text{equation (2)}$$

Follow equation has been used for measurement of maximum finite shear strain:

$$\gamma = \sqrt{R_{xz}} - \frac{1}{\sqrt{R_{xz}}} \qquad \text{equation (3)}$$

Maximum strain ratio (R_{xz}) can be written as follow:

$$\frac{S_X}{S_Z} = \frac{1+e_X}{1+e_Z} \qquad \text{equation (4)}$$

3. Calculation of shear strain and volume change determining shear displacement of Qaleh-Zari mine shear zone

The spectrum of Δ and γ can be obtained repeating the above process at different distances (X) and X-γ curve chart may be drown. The area between the curve and X-axis is shear displacement.

The detailed values of Δ and γ are shown in table 1. Fig3 is X-γ curve chart. It shows that in the distance of 4300m of the zone, the total shear displacement is about 2021m.

4. Summary

On determining the shear displacement of Qaleh-Zari mine shear zone with volume change (dilatation), the shear strain and volume change in plane have been calculated using Mohr circle diagram, and measurement of strain ratio for different points of fracture (vein) crosses along the shear zone.

The area between the curve and X-axis, in *the* X-γ curve chart shows shear displacement that in the distance of 4300m of the zone, is about 2021m.

References

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Table1. calculated data of the Qaleh-Zari mine shear Zone by Mohr circle diagram.

Num.	γ	ψ	R_{XY}	R_{YZ}	Δ	X (m)
1	0.12	6.84	1.27	0.37	0.7	1567
2	0.07	4	1.13	1.12	1.15	2000
3	0.04	2.3	0.95	0.47	1.88	1367
4	0.09	5.14	1.07	0.58	1.1	933
5	0.09	5.14	0.97	0.6	0.4	1167
6	0.13	7.4	0.97	0.86	0.03	1900
7	0.1	5.7	1.18	0.3	1.15	2667
8	0.2	10.7	1.36	0.79	0.08	2300
9	0.08	4.57	0.95	0.7	0.056	2500
10	0.07	4	0.083	0.8	0.03	3233
11	0.04	2.3	0.94	0.67	0.15	833
12	0.07	3.75	0.85	0.63	0.12	1600
13	0.1	5.7	1.04	0.8	0.08	2200
14	0.1	6.3	1.1	0.65	0.12	3100
15	0.06	3.4	0.95	0.95	0.05	1233
16	0.05	2.86	۰.۷۴۵	0.81	0.063	367
17	0.09	5.14	0.98	0.7	0.1	1667
18	0.16	9	1.2	0.84	0.06	1967
19	0.09	5.14	1.1	0.46	0.5	1433
20	0.04	2.3	0.98	0.48	0.3	967
21	0.06	3.43	0.63	0.87	0.2	3667
22	0.03	1.7	0.95	0.55	0.19	3867
23	0.06	3.43	1.1	0.35	0.8	4067
24	0.01	0.57	1	0.2	1	4233
25	0.07	4	1.27	0.57	0.23	4300
26	0.05	2.86	0.9	0.48	2	3533
27	0.02	1.14	0.73	0.7	0.4	400
28	0.05	2.86	0.9	0.65	0.1	333
29	0.07	4	1.1	0.4	0.5	133
30	0.04	2.3	1	0.4	0.85	667

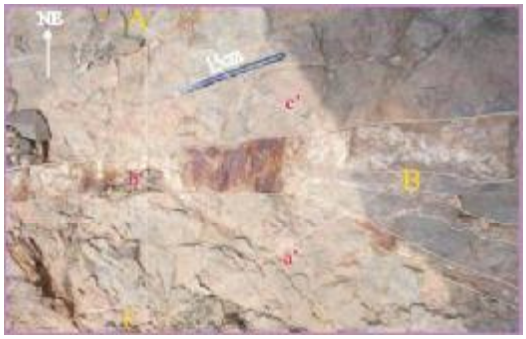

Fig1. vein cross and calculation of strain ratio, by Mohr circle diagram

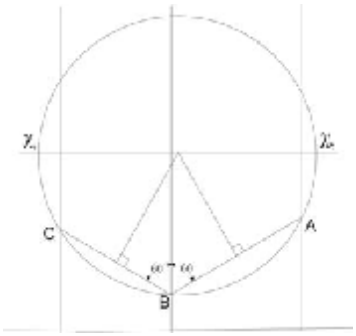

Fig2. determination of strain ratio (R) by Mohr circle method.

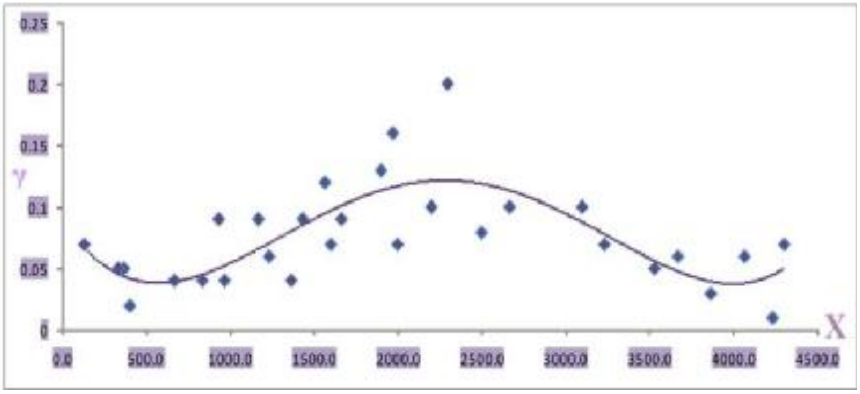

Fig3. *X-γ* curve chart on the Qaleh-Zari mine shear zone. The measured shear displacement is about 2 021m.