Crack the strike of minelayer and the attitude of fault on non-oriented oblique drill hole core

Because the attitudes of minelayer and fault on non-oriented oblique drill hole core are difficult to interpret[1], in the current, the mapping method for solid mineral exploration can only be two-dimensional approximation graphical method[1-3]. By virtually constructing rotary cores to analysis the spatial relationships of the attitudes of minelayer, stratum and fault of non-oriented oblique drill hole core, this article established the mathematical model groups of solving the strike of minelayer and the attitude of fault on non-oriented oblique drill hole cores, the results have laid a theoretical foundation for three-dimensional digital mapping directly of solid mineral exploration achievement, at the same time, have made the changes possible, which are the dynamic layout of holes, the flexible controlling of faults, and the improving of accuracy of achievement of solid mineral exploration.

Drilling is one of the most important and expensive, of all mineral exploration procedures, it provides the ultimate test and achievement for all the ideas, theories and predictions, at least 40% of exploration costs should be spent on drilling[1]. Because oriented drilling is expensive, non-oriented drilling is most commonly used in the field of solid mineral exploration[1]. Since the spatial relationships between the attitudes of minelayer, stratum and fault on non-oriented oblique drill hole core and their true attitudes in underground are complex and difficult to interpret, so that we can' t dig out the true information, and the information is crucial for the accuracy of exploration achievement. On the basis of incomplete information, the mapping methods for solid mineral exploration can only be two-dimensional approximation graphical methods[1-3]. The problem has been rarely cares for more than one hundred years, has become a daunting problem.

Mathematical models included in Fig.1, Fig.2 and Fig.3 are,

$$sinFOM=sinrcosAOB_m \quad (1)$$

$$FH=OFcosAOB_m tanr \quad (2)$$

$$BC^2=2R^2(1-cos(90-\angle AOB_m)) \quad (3)$$

$$tanFHK=BC/FH \quad (4)$$

$$tanDBC=(1-sinAOB_m)/cosAOB_m \quad (5)$$

$$tanCBI=tan\alpha'_m cos(90-\angle DBC-\angle AOB_m) \quad (6)$$

$$\angle HFK=90-\angle CBI \quad (7)$$

$$FK=FHsinFHK/sin(180-\angle FHK-\angle HFK) \quad (8)$$

$$tanCOI=tan\alpha'_m cosAOB_m \quad (9)$$

$$sinBOI=sinCOI / sin\alpha'_m \quad (10)$$

$$CI=BCtanCBI \quad (11)$$

$$OI^2=R^2+CI^2 \quad (12)$$

$$BI^2=BC^2+CI^2 \quad (13)$$

$$sinOBI=OIsinBOI/BI \quad (14)$$

$$\angle OFK=\angle OBI \quad (15)$$

$$OK^2=R^2+FK^2-2RFKcosOFK \quad (16)$$

$$sinFOK=FKsinOFK/OK \quad (17)$$

$$sin\alpha_m=sinFOM/sinFOK \quad (18)$$

$$cosPMO=tanFOM/tan\alpha_m \quad (19)$$

$$\angle MOK=90-\angle PMO \quad (20)$$

$$sinFKM=RsinFOM/FK \quad (21)$$

$$cosPMK=tanFKM/tan\alpha_m \quad (22)$$

To solve the problem , firstly, we virtually constructed rotary cores. See Fig.1, let the inclined cylinder 1 as oblique core 1[1], let the upright cylinder 2 as upright core 2, inclined cylinder 1 is formed from upright cylinder 2 by rotating angle r (the inclination of core ,that is the zenith of core) along line UOC, let line OA be the direction of the azimuth of core, let the azimuth be v ,let OBI and OFJ be respectively the structure in the upright core and in the oblique core, let the true dip angle of OFJ along the direction which is perpendicular to OB be α'_m, let the true dip angle of the OFJ along the direction which is perpendicular to OK be α_m, OA⊥OC, OA⊥OU, OA=OC=OU, OC⊥CI, BS∥DO, points E, X, F and J is respectively the corresponding points of point A, V, B and I, OK is the intersection line of OFJ and the top surface of upright cylinder 2, FM⊥OM, UGC is the intersection line of the outer surface of oblique cylinder 1 and the plane extended by plane UACV, point H is the intersection point of the straight line passed through point F and whose direction is parallel to EG with arc UGC, point R is on line FH, FH∥CJ, FR=CJ, FQ∥DO, FP⊥OK, four points D, M, B, and H are contained on a straight line, point L is the intersection point of line OK with arc UGHC, point W is the intersection point of line OB with arc UGHC, five points O, P, N, K and L are contained on a straight line, point T is the intersection point of line BO or the line extended by BO with the line which passes through point C and perpendicular to the line BO, six points C, F, J, K, R and H are contained in a incline plane. This type is called type A, it's conditions are that OK and OB are in the same side of OA, v <∠AOB <∠AOK, and the dip direction of the structure are toward the direction of C. Another two types B and C are shown in Figures 2 and 3.

$$\angle OMK=\angle PMO+\angle PMK \quad (23)$$

$$OM=OFcosFOM \quad (24)$$

$$sinOKM=OMsinOMK/OK \quad (25)$$

$$cosAOM=tanFOM/tanr \quad (26)$$

$$\angle AOK_m=\angle AOM+\angle MOK \quad (27)$$

$$\angle MOK=180-\angle OMK-\angle OKM \quad (28)$$

$$FM=OFsinFOM \quad (29)$$

$$MK^2=FK^2-FM^2 \quad (30)$$

$$sinMOK=MKsinOMK/OK \quad (31)$$

$$BC2=2R2(1-cos(90+\angle AOBm)) \quad (32)$$

$$tanDBC=(1+sin\angle AOB_m)/cosAOB_m \quad (33)$$

$$tanCBI=tan\alpha'_m cos(90-\angle DBC+\angle AOB_m) \quad (34)$$

$$BOI=180-arc(sinCOI/sin\alpha'_m)$$

（35）

$$\angle OMK = \angle PMO - \angle PMK \quad (36)$$

$$\angle AOK_m = \angle MOK - \angle AOM \quad (37)$$

$$\angle AOK_m = \angle AOM - \angle MOK \quad (38)$$

take planes OBI and OFJ of Fig.1, Fig.2 and Fig.3 as minelayer or stratum, so that in above formulas, $\angle AOB_m$ is the angle between line OA with the intersection line of minelayer or stratum OBI and the top surface of upright cylinder 2, $\angle AOK_m$ is the angle between line OA with the intersection line of OFJ of oblique core 1 and the top surface of upright cylinder 2.

The mathematical models included in tape A（Fig.1）are（1）～（27）; included in tape B（ Fig.2）are（1）,（2）,（32）,（4）,（33）,（34）,（7）～（9）,（35）,（11）～（22）,（36）,（24）～（26）and（3-37）;and included in tape C（ Fig.3）are（1）,（2）,（32）,（4）,（33）,（34）,（7）～（9）,（35）,（11）～（22）,（36）,（24）～（26） and（38）.

Let the dip angle determined from struct contour map of floor of the minelayer or stratum as α_m，let the dip angle of the minelayer stratum determined from the upright cylinder 2 as α'_m, if the azimuth v and inclination r of core have been determined by the down-hole survey for that hole depth, we can obtain the strike of minelayer or stratum（$\angle AOB_m$） of the upright cylinder 2 using the front 18 formulas and formulas （28）～（31） of the formula group selected depending on the type（A, or B, or C）, and can obtain the strike of minelayer or stratum（$\angle AOK_m$） of the oblique core 1 using the all formulas of the formula group selected depending on the type（A, or B, or C）.

Once we have been $\angle AOB_m$ of a minelayer or stratum, it is easy to determine the attitude1 of fault of the seam core piece or the adjacent core piece which can be well pieced together with the core piece in which there is the minelayer or stratum. The specific method is, firstly, take planes OBI and OFJ of Fig.1, Fig.2 and Fig.3 as fault; secondly, change subscript m as f in mathematical models, subscript f indicates that the parameter is that of fault; thirdly, if the minelayer or stratum and fault are in a core, we determine the angle between the strike of fault and the azimuth of core （$\angle AOB_f$） on the upright core 2 according to $\angle AOB_m$, the angle between the strike of minelayer or stratum and fault on the upright core 2, and the relative positional relationship between the strike of minelayer or stratum and fault on the upright core 2; if the minelayer or stratum and fault are not in a core, but in the adjacent core piece which can be well pieced together with, we slide virtually the minelayer or stratum into the core in which there is fault under the condition of keeping its occurrence, then, we determine $\angle AOB_f$ using the seam method; fourthly, measure the dip angle of fault（α'_f）of the upright core 2; fifthly, take $\angle AOB_f$, α'_f ,v and r as known conditions, we can determine angle $\angle AOK_f$ between the strike of fault of the oblique core 1and the azimuth of core （when $\angle AOK_f$ is known, we can determined the strike and dip direction of fault according to the relative positional relationship between the strike of fault of the oblique core 1 and the azimuth of core）, and the true dip angle α_f of fault according to the all formulas of the formula group selected depending on the type（A, or B, or C）.

The results calculated by instances of formula groups of three sets A, B and C are exactly match with the results of computer simulation.

Other cases can be summarized as the above three types A , B and C.

To sum up, these studies have established mathematical models of spatial relationships of the attitude of structure on non-oriented oblique drill hole core, the results have laid a theoretical foundation for three-dimensional digital mapping directly of solid mineral exploration achievement, at the seam time, have made the changes possible, which are the dynamic layout of holes，the flexible controlling of faults, and the improving of accuracy of achievement of solid mineral exploration.

Methods

Virtually construct rotary cores. This article proposed and applied the methods of by virtually constructing rotating cores to analysis the spatial relationships of the attitudes of structure of non-oriented oblique drill hole core.

Establish the mathematical models. This article established the mathematical model groups of solving the strike of minelayer and the attitudes of fault on non-oriented oblique drill hole core.

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Statement

. I am sincerely stating that all mainbi contents of this article were completed independently by author, and none of the material has been published in academic journals or is under consideration elsewhere, including the Internet.

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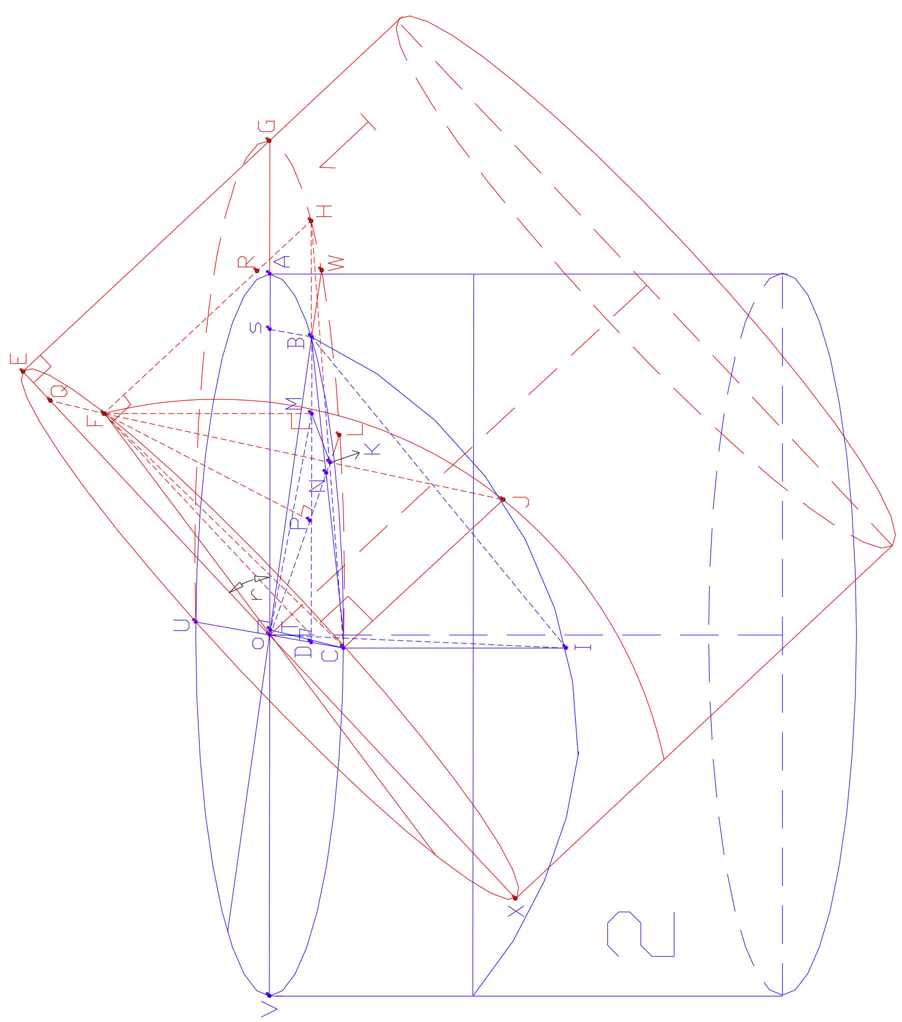


Figure 1 shows the spatial relations of the structure in inclined core1 and upright core 2 of type A. it's condition is that OK and OB are in the same side of OA, v＜∠AOB ＜∠AOK，and the dip direction of the minelayer （or stratum）or fault are toward a direction of C.

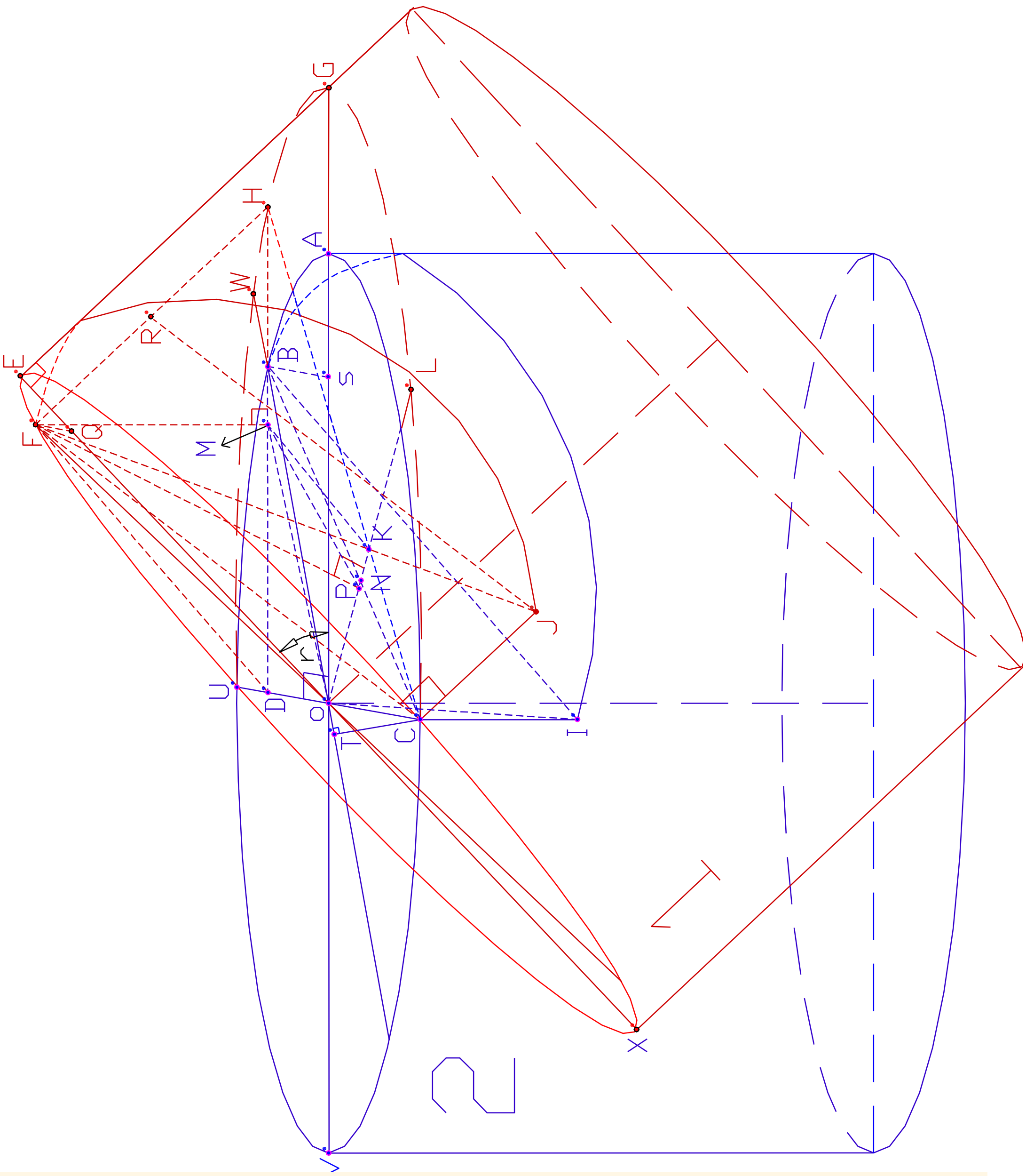


Figure 2 shows the spatial relations of the structure in inclined core1 and upright core 2 of type B. it's condition is that OK and OB are in the two side of OA, v＜UOK、 UOB＜v、UOK-v＜90o， v-UOB＜90，and the dip direction of the minelayer （or stratum）or fault are toward a direction of C.

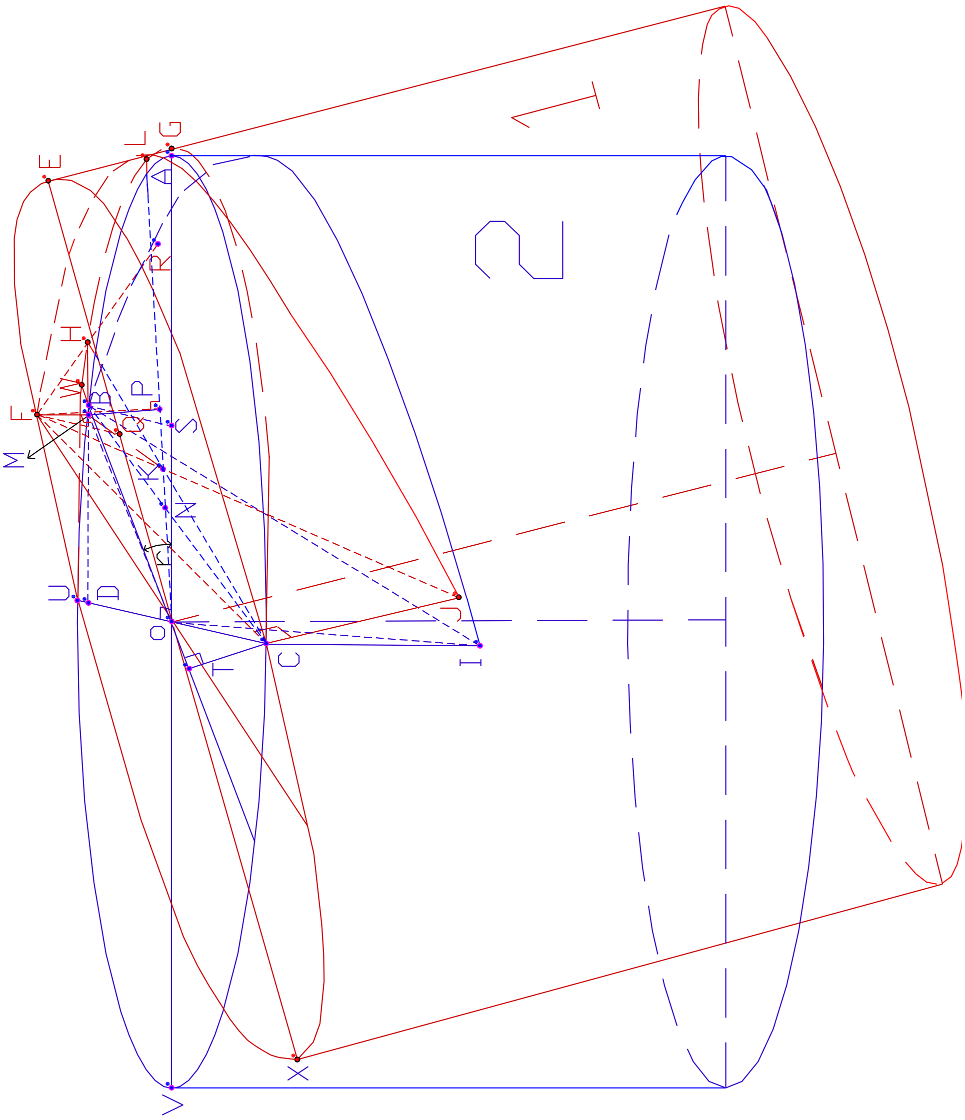


Figure 3 shows the spatial relations of the structure in inclined core1 and upright core 2 of type C. it's condition is that OK and OB are in the same side of OA, UOB＜v, UOK＜V, UOK -UOB＜90º,， and the dip direction of the minelayer （or stratum）or fault are toward a direction of C.

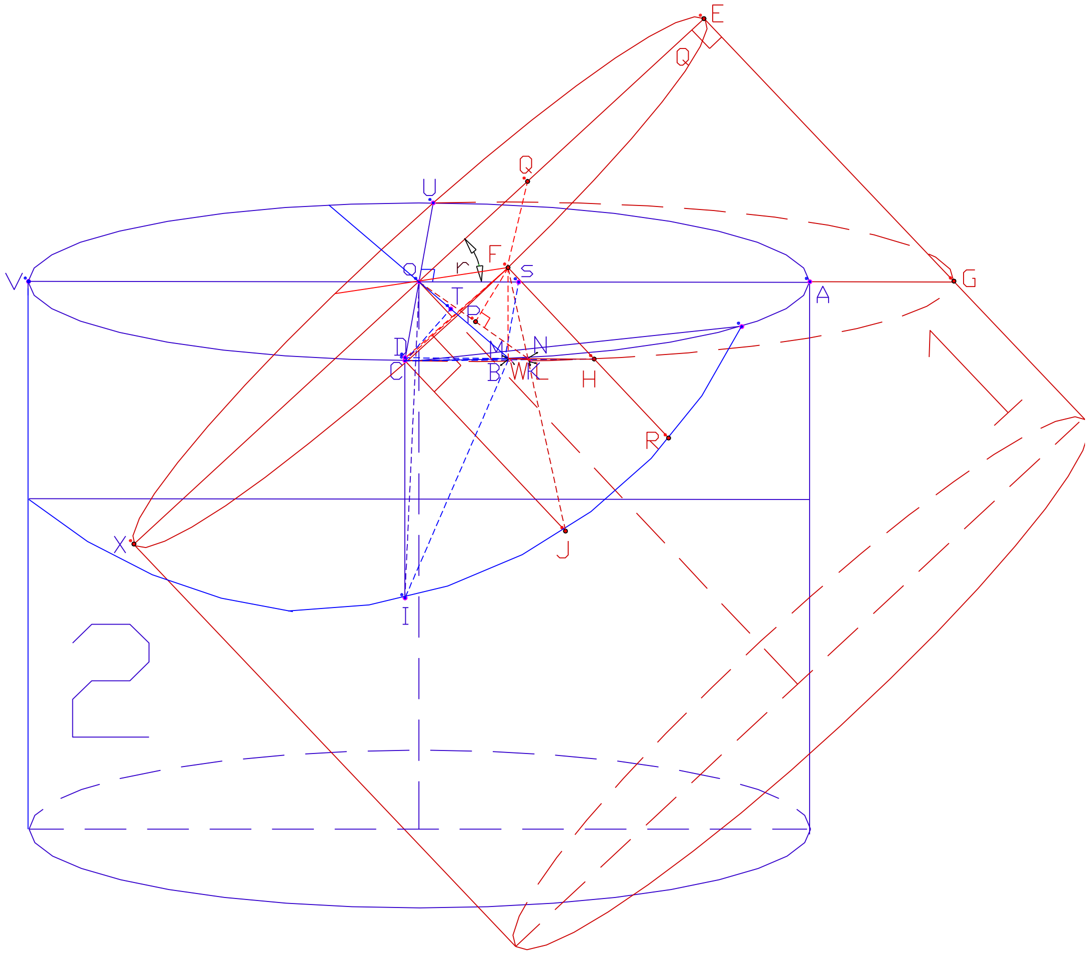
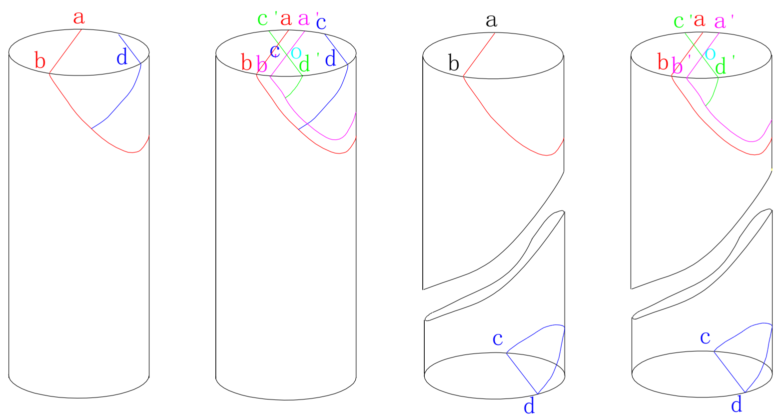
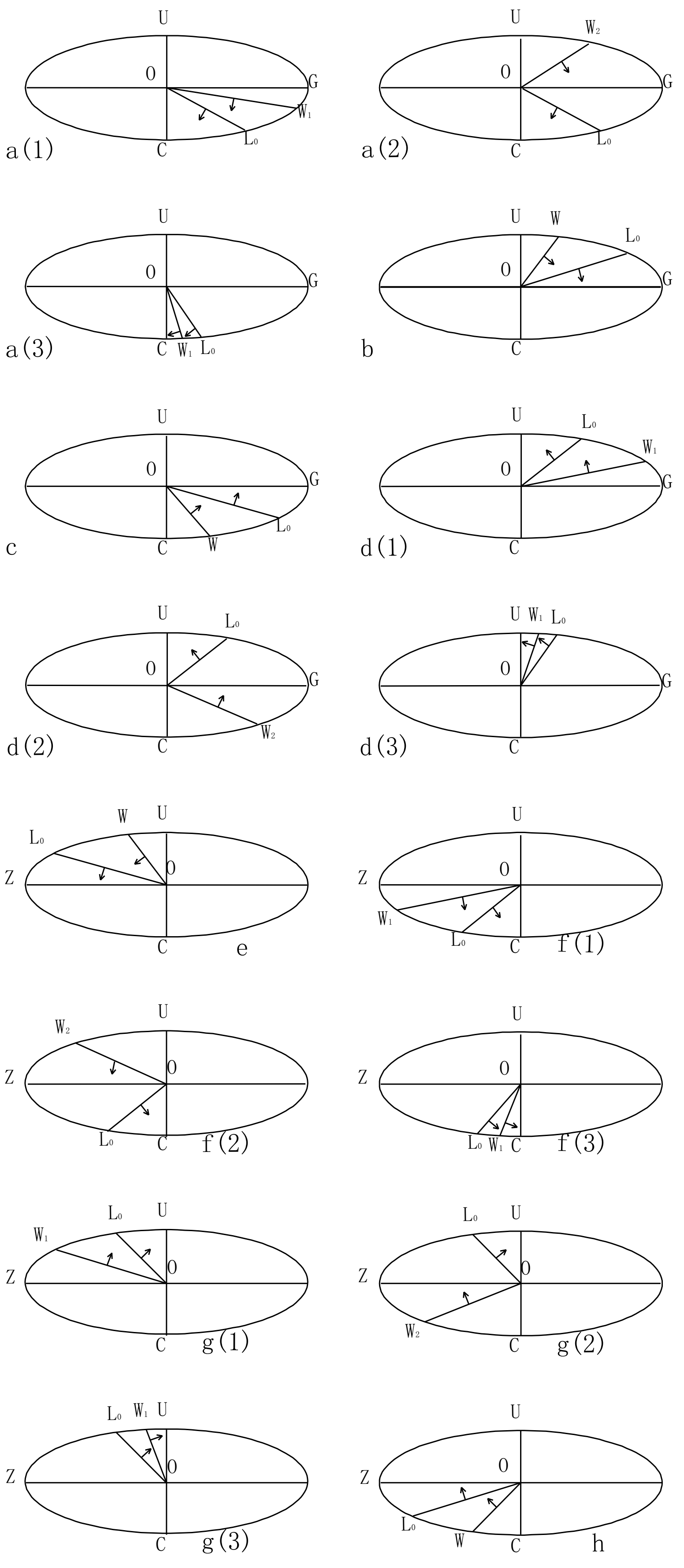


图 3-3-c　V<NOL、v<NOW、 NOW-NOL<90°，矿层（或断层）倾向与 OG 相背直立岩芯 2 和倾斜岩芯 1 上岩层（或矿层）与断层间的空间关系示意图





a(1) U 0 G W_1 L_0 C
a(2) U W_2 0 G L_0 C
a(3) U 0 G C W_1 L_0
b U W L_0 0 G C
c U 0 G L_0 W C
d(1) U L_0 W_1 0 G C
d(2) U L_0 0 G W_2 C
d(3) U W_1 L_0 0 G C
e W U L_0 Z 0 C
f(1) U Z 0 W_1 L_0 C
f(2) U W_2 Z 0 L_0 C
f(3) U Z 0 L_0 W_1 C
g(1) L_0 U W_1 Z 0 C
g(2) L_0 U Z 0 W_2 C
g(3) L_0 W_1 U 0 Z C
h U 0 Z L_0 W C

Golden section method