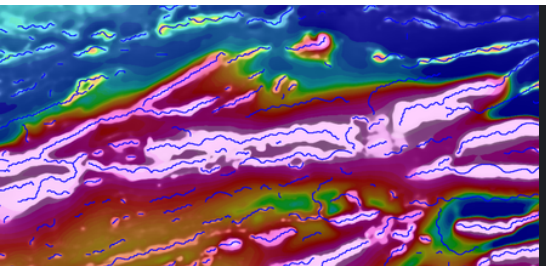
MASTERY Series

Oasis montaj

From 2D Grids to 3D Models: Advanced Structural Analysis

QUICK REFERENCE GUIDE

To complement the learnings from session three of the Oasis montaj Mastery Series, this document can be used to help you build a starting model for forward modelling in VOXI.



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Join the discussion

Before you begin you will need a master voxel to serve as your foundation.

Option 1:

i. Setup your inversion in your VOXI project.

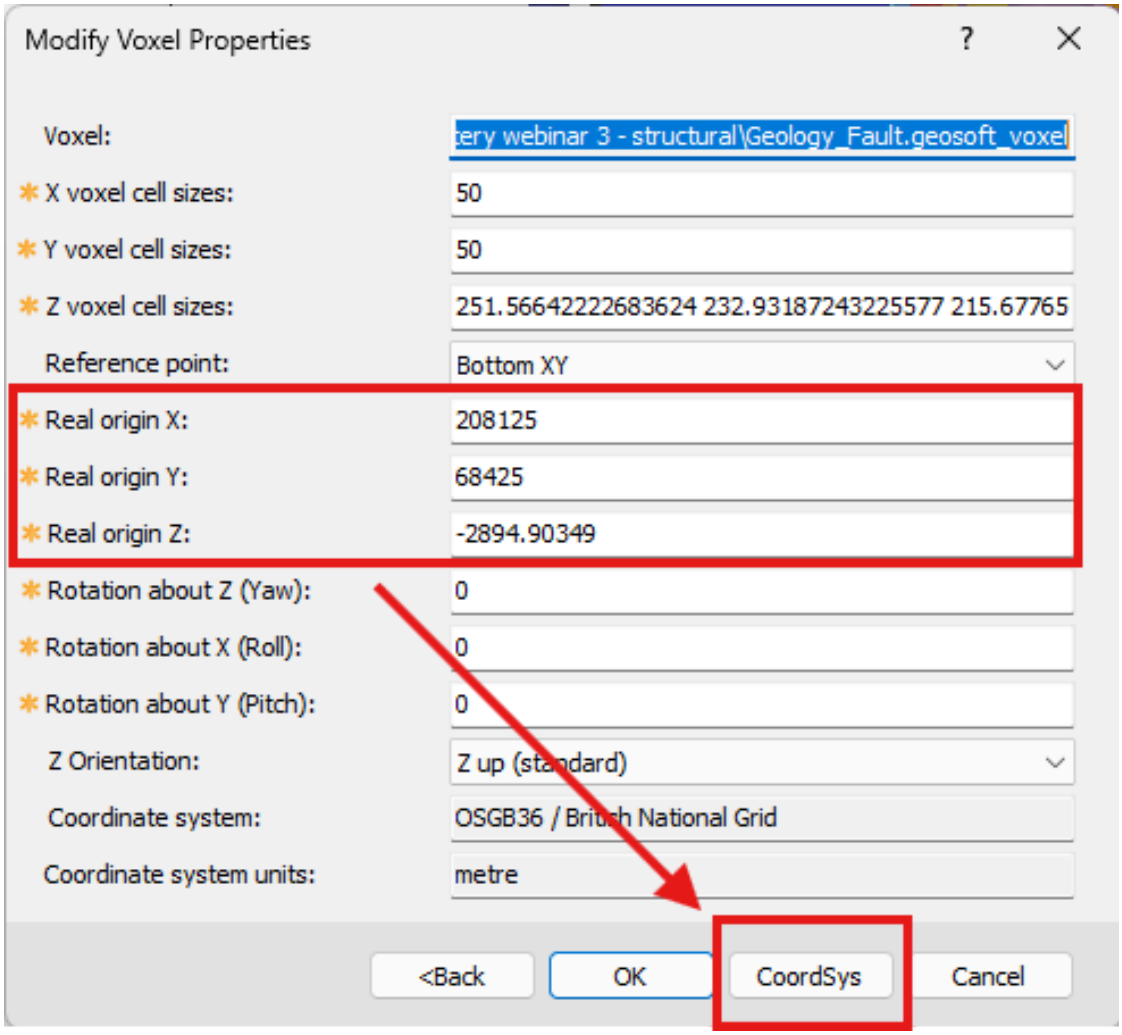
ii. Save the Mesh as your master voxel. (It will automatically inherit the same dimensions and coordinate system.)

Option 2:

i. Go to Voxel > Utilities > Create Master Voxel.

ii. Define your desired voxel dimensions.

iii. Edit the voxel properties to assign real-world coordinates to the origin.



Add a fault

The equation of a slanting 1st order 3D plane is:

A (X-X0) + B (Y-Y0) + C (Z -Z0) +D=0

Let's meet the following conditions for the fault plane:

- Plane should pass though the origin of the voxel model so set: X0 = Y0 = Z0 = 0.0

→ AX + BY + CZ + D = 0

- Be independent of Y coordinate: B=0

→ AX+CZ+D=0

- Place D on the surface and make the dip direction 3 times faster in Z than in X -->

A=3, C=1, D=0

→ 3X + Z =0

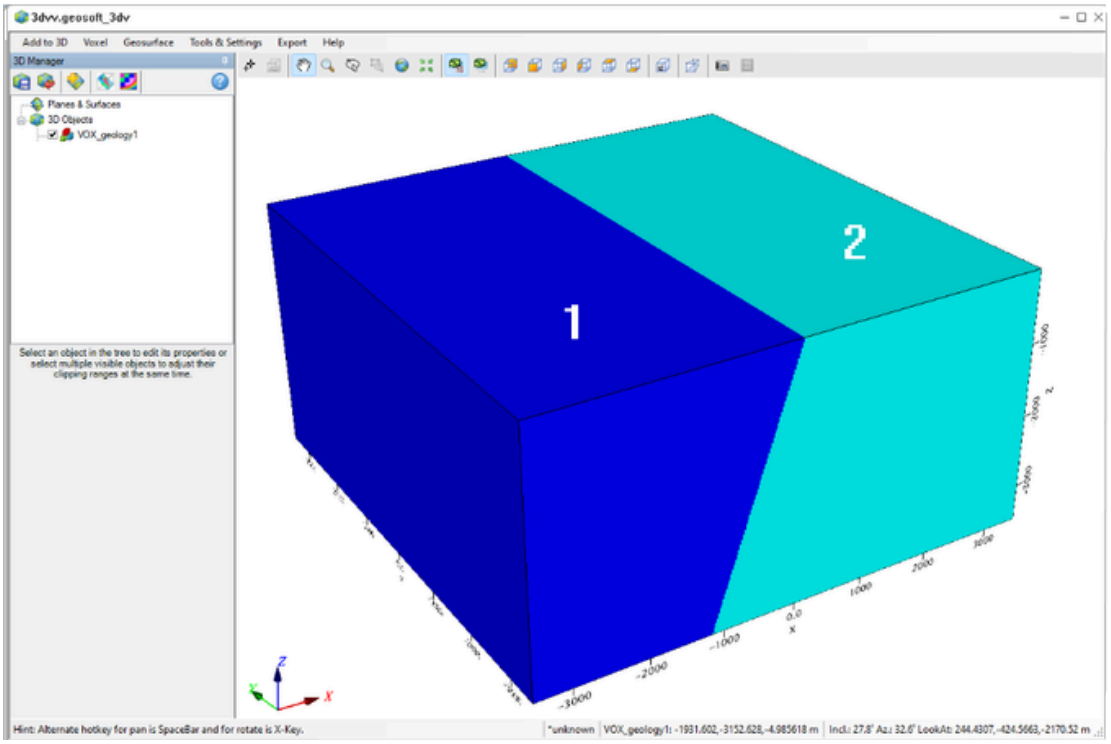
- Set all cell to the left of this plane equation (3X-Z <=0.0) to 1 and to the right of the plane (3X-Z >0.0) to 2

The corresponding Voxel Math expression is:

//V0=.\geology1.geosoft_voxel

//V1=.\master.geosoft_voxel

V0 = (3*X-Z>0.0)?2:1;



Add a basin on footwall

The basin can be mimicked with a partial ellipsoid. This basin chronologically occurs before the fault so it will be offset on the right and left of the fault. Start with the basin on the footwall.

The equation of a 3D ellipsoid is:

$((X-X0)/A)^2 + ((Y-Y0)/B)^2 + ((Z -Z0)/C)^2 =1$

The basin will meet these conditions:

- Set the origin of the ellipsoid is at X0=Y0=0, and the Z origin up Z0=400 to generate a partial ellipsoidal volume

→ $(X/A)^2 + (Y/B)^2 + ((Z -400)/C)^2 =1$

- Shape the ellipsoid with the corresponding coefficients to be flattened in the Z direction and more oblong in the Y direction A, B, C= 1200,1600,1000

→ $(X/1200)^2 + (Y/1600)^2 + ((Z -400)/1000)^2 =1$

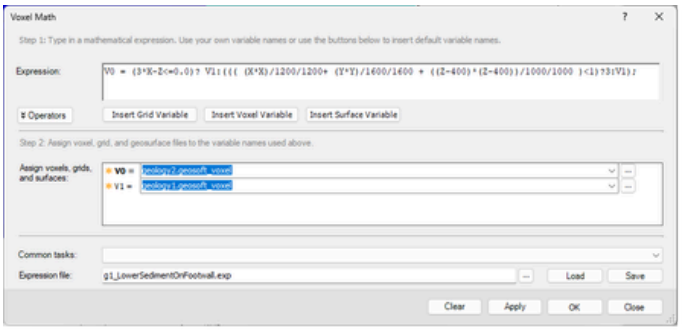
- Only apply the math on the footwall (right) and leave the hanging wall as is with the following conditional statement (V1==1)? V1: <apply math to this other side only>

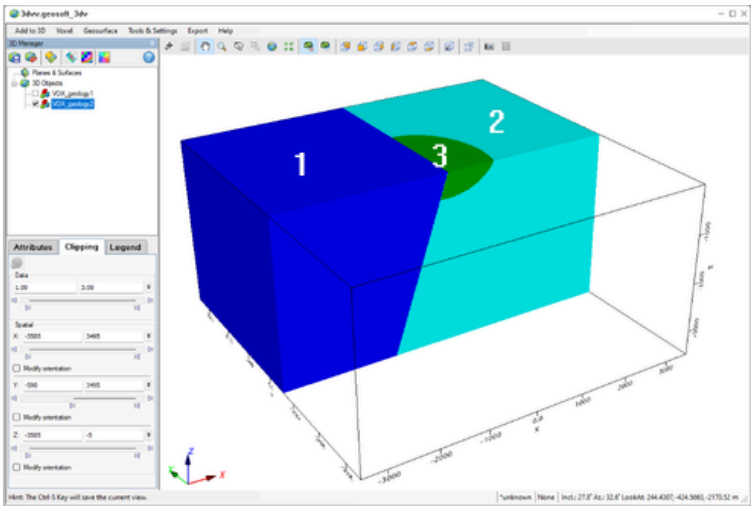
The corresponding Voxel Math expression is:

//V0=.\geology2.geosoft_voxel

//V1=.\geology1.geosoft_voxel

V0 = ((3*X-Z)<=0.0)? V1: ((((X*X)/1200/1200+ (Y*Y)/1600/1600 + ((Z-400)*(Z-400))/1000/1000)<1)?3:V1);





Add a basin on hanging wall

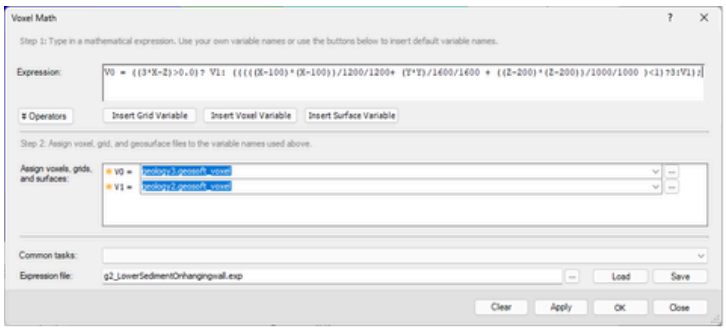
Introduce the rest of the basin on the hanging wall and slightly shifted in the X direction. It will be the same equation introduce on the left side (above), with an offset in X0=100, Z0=200

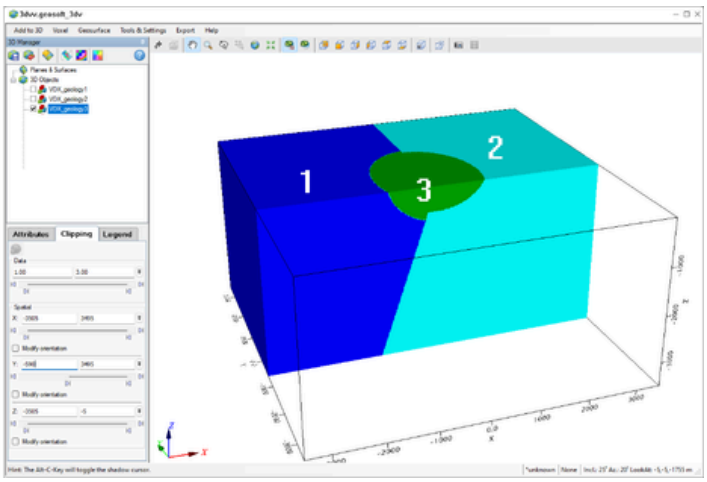
The corresponding Voxel Math expression is:

//V0=.\geology3.geosoft_voxel

//V1=.\geology2.geosoft_voxel

V0 = ((3*X-Z)>0.0)? V1: (((((X-100)*(X-100))/1200/1200+ (Y*Y)/1600/1600 + ((Z-200)*(Z-200))/1000/1000)<1)?3:V1);





Create an alteration rim

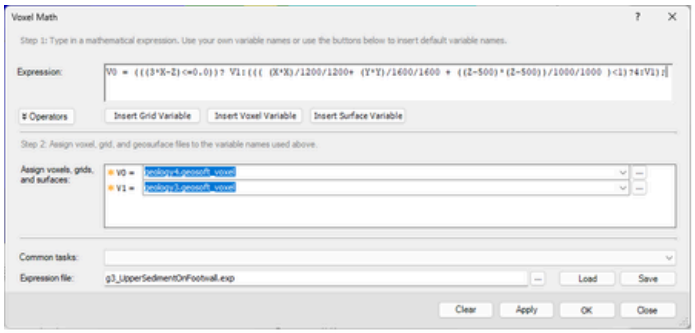
Add alteration rim between the basin and the host rock by adding the same 2 ellipsoids but with the Z origin higher by 100 units. Shift Z by 100, and apply the basin equation to both foot and hanging walls.

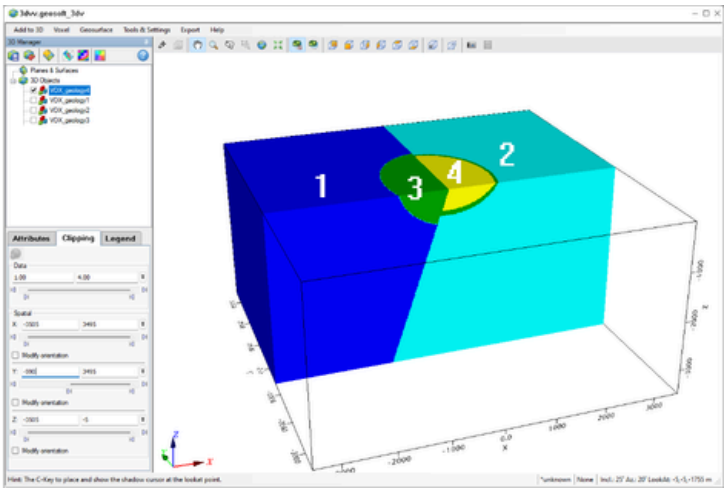
The corresponding Voxel Math expression is:

//V0=.\geology4.geosoft_voxel

//V1=.\geology3.geosoft_voxel

V0 = (((3*X-Z)<=0.0))? V1:((((X*X)/1200/1200+ (Y*Y)/1600/1600 + ((Z-500)*(Z-500))/1000/1000)<1)?4:V1);





Add a dipping dyke

Adding a slab is similar to adding 2 fault planes.

- Add 2 planes a fix distance d appart
- Set the inside of the slab to a new unit and leave the outside as is.

→ Condition (V > (A (X-X0) + B (Y-Y0)+ C (Z -Z0) +D) && V < (A (X-X0) + B (Y-Y0)+ C (Z -Z0) +D+d))

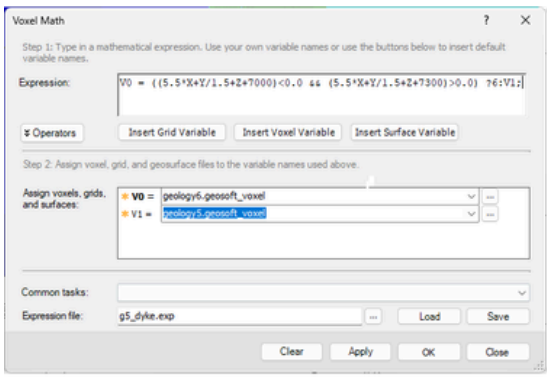
- Slab will pass through the origin X0=Y0=0 & z=-7000
- Set d=300
- Give a slant to X & Y directions relative to Z

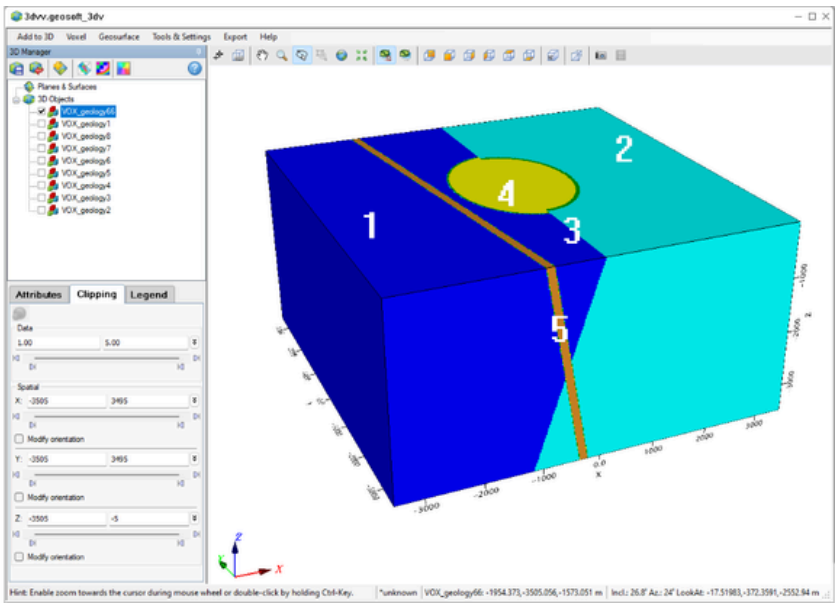
The corresponding Voxel Math expression is:

//V0=.\geology6.geosoft_voxel

//V1=.\geology5.geosoft_voxel

V0 = ((5.5*X+Y/1.5+Z+7000)<0.0 && (5.5*X+Y/1.5+Z+7300)>0.0) ?5:V1;





Add a deep intrusion

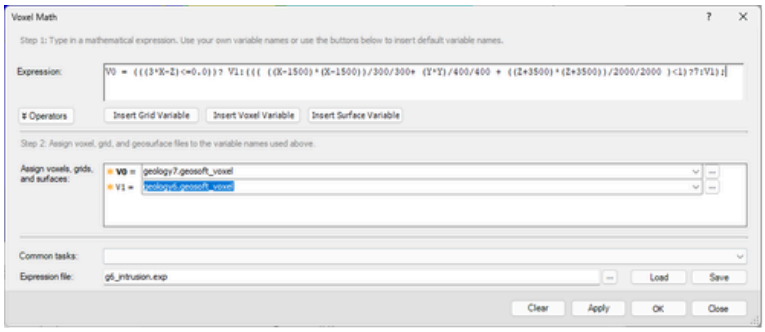
This is similar to adding a basin. The radius will be smaller and the unit will be below surface.

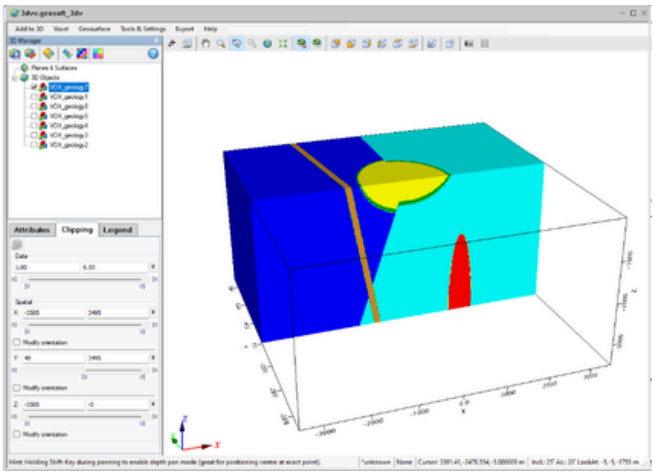
The corresponding Voxel Math expression is:

//V0=.\geology7.geosoft_voxel

//V1=.\geology6.geosoft_voxel

V0 = (((3*X-Z)<=0.0))? V1:(((((X-1400)*(X-1400))/300/300+ (Y*Y)/400/400 + ((Z+3500)*(Z+3500))/2000/2000)<1)?6:V1);





Add a horizontal spreading intrusion

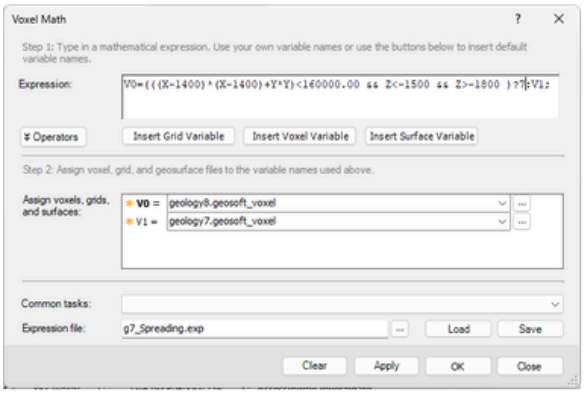
Add a flat cylinder on top of the intrusion to simulate spreading of the igneous rock in an area with less pressure of fissure.

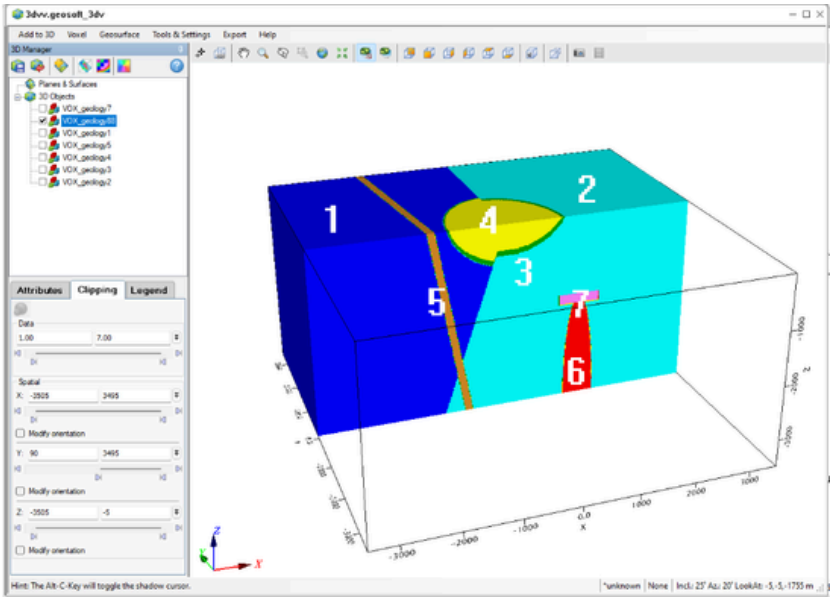
The equation of a cylinder is
$((X-X0)/A)^2 + ((Y-Y0)/A)^2 = 1$ & $B<(Z-Z0)<C$

- Place the cylinder between depths C=-1500 & B=-1800
- Offset in the X direction by X0=1400
    - Offset in the Y directionY0=0
- Set the radius to A=400

The corresponding Voxel Math expression is:

//V0=.\geology8.geosoft_voxel
//V1=.\geology7.geosoft_voxel
V0=(((X-1400)*(X-1400)+Y*Y)<160000.00 && Z<-1500 && Z>-1800)?7:V1;





Add a tunnel

Add a tunnel gently sloping (10 deg) down and also azimuthally in the north East (40 deg) direction. Use a horizontal cylinder (X & Y) that is sloped in the Y direction.

$(X-X0+\sin(A)(Y-Y0))^2+ (Z-Z0+\sin(B)(Y-Y0))^2 =C^2$

Place the cylinder center at X0=-500, Y0=0, Z0=-500

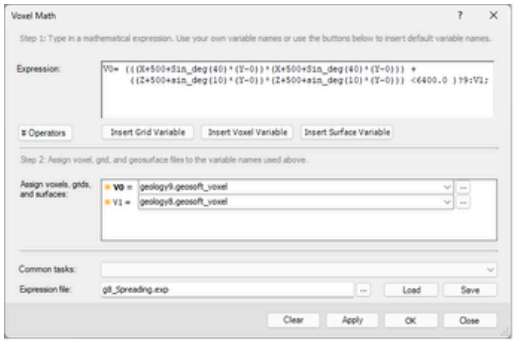
- Slope in down in the Y direction by degrees B=10 degrees
  - Turn it in the azimuth direction by A=40 degrees
- Set the radius to C=80

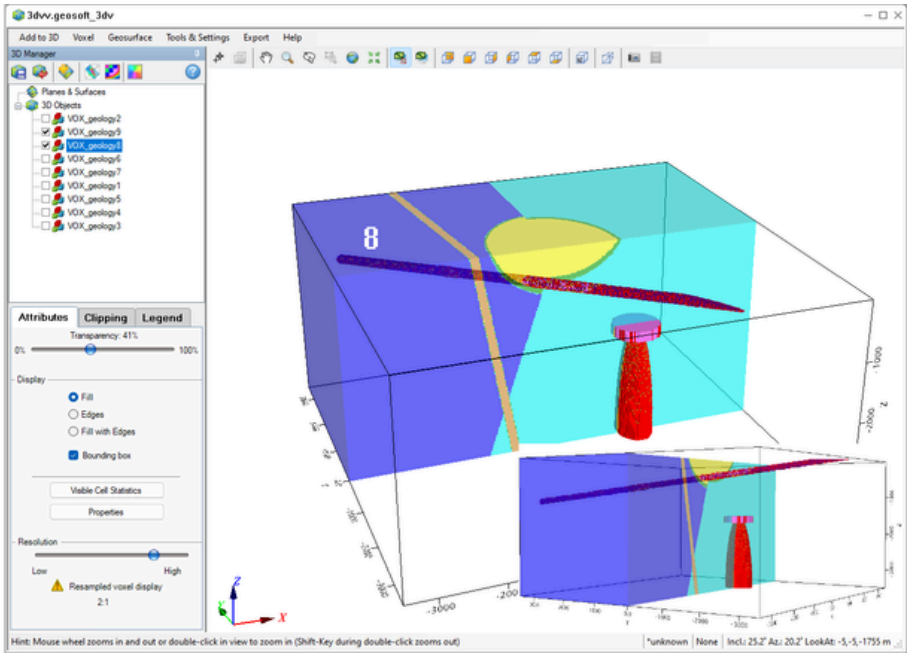
The corresponding Voxel Math expression is:

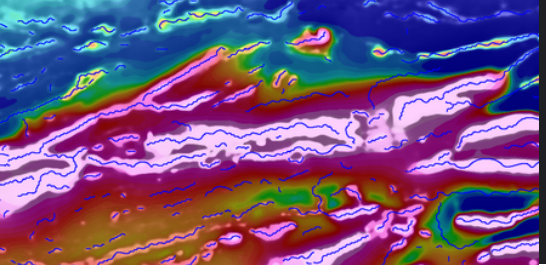
//V0=.\geology9sloping.geosoft_voxel

//V1=.\geology8.geosoft_voxel

V0= (((X+500+Sin_deg(40)(Y-0))(X+500+Sin_deg(40)(Y-0))) +((Z+500+sin_deg(10)(Y-0))(Z+500+sin_deg(10)(Y-0))) <6400.0)?8:V1







Assign susceptibilities to rock units

Unit	Susceptibility
1	0.0005
2	0.0004
3	0.0002
4	0.00015
5	0.0006
6	0.0008
7	0.0009
8	0.0000

The corresponding Voxel Math expression is:

```
//V0=.\Susceptibility.geosoft_voxel
//V1=.\geology8.geosoft_voxel
V0 = (V1==1)?0.0005:
((V1==2)?0.0004:((V1==3)?0.0002:((V1==4)?0.00015:((V1==5)?0.0006:(V1==6)?0.0008:
(V1==7)?0.0009:0.001))));
```

Assign projection

Right click on final Voxel in Project Explorer > Properties > Modify > CoordSys