RenderMan and OpenGL Shaders

CS557

Project # 3

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1. Source listings

```
##OpenGL GLIB
LookAt  0 0 3  0 0 0  0 1 0
Perspective 70

Vertex   chaozhang.vert
Fragment chaozhang.frag
Program  OvalNoise                                                  \
        Ad <.01 .05 .5>  Bd <.01 .02 .5>                          \
        NoiseAmp <0. 1. 10.>  NoiseFreq <0. 1. 10.>             \
        Alpha <0. 1. 1.>   mColor {1., .5, 0. }                                  \
        Tol <0. 0. 1.>                                  \
        UseChromaDepth <false> \
        ChromaRed <-10. -5. -1.>  ChromaBlue <-10. -3. -1.>     \


Color 1. 1. 1.
Sphere 1 60 60

MessageBox This implements the Alpha and the ChromaDepth extra credit
```

chaozhang.glib

This file include all the definition I need to use. The ChromaRed and ChromaBlue are both in the range of -10 to -1, and the default is -5. mColor is still the beaver orange. This time I didn't use the teal as background color because it is not clear to see the tol. So I use the write as background color.

```
#version 330 compatibility


out vec3  vMCposition;
out vec4  vColor;
out float vLightIntensity;
out vec2  vST;
out float z;

const vec3 LIGHTPOS = vec3( -2., 0., 10. );

void
main( )
{

    vec3 tnorm = normalize( gl_NormalMatrix * gl_Normal );
    vec3 ECposition = vec3( gl_ModelViewMatrix * gl_Vertex ).xyz;
    vLightIntensity  = abs( dot( normalize(LIGHTPOS - ECposition), tnorm )  );
    z = ECposition.z;
    vMCposition = gl_Vertex.xyz;
    vColor = gl_Color;
    vST = gl_MultiTexCoord0.st;
    gl_Position = gl_ModelViewProjectionMatrix * gl_Vertex;
}
```

chaozhang.vert

Z= ECposition.z is the vertex position in eye coordinates. The vLightIntensity is the computed ligthingin the vertex shader. tnorm for storing the transformed normal. The vMCposition, vcolor, cLightIntensity, VST and z will be trans to the .freq file.

```
#version 330 compatibility

in vec3  vMCposition;
in vec4  vColor;
in float vLightIntensity;
in vec2  vST;
in float z;

uniform bool  UseDiscard;
uniform float Ad;
uniform float Bd;
uniform vec4 mColor;
uniform float NoiseAmp;
uniform float NoiseFreq;
uniform sampler3D Noise3;
uniform float Tol;
uniform float Alpha;
uniform bool UseChromaDepth;
uniform float ChromaRed;
uniform float ChromaBlue;
```

Part1 chaozhang.freq

This is part of the .freq file. This part will get the data from the vertex shader and define the variable.

```
ChromaDepth( float t )
{
    t = clamp( t, 0., 1. );

    float r = 1.;
    float g = 0.0;
    float b = 1.  -  6. * ( t - (5./6.) );

        if( t <= (5./6.) )
        {
                r = 6. * ( t - (4./6.) );
                g = 0.;
                b = 1.;
        }

        if( t <= (4./6.) )
        {
                r = 0.;
                g = 1.  -  6. * ( t - (3./6.) );
                b = 1.;
        }

        if( t <= (3./6.) )
        {
                r = 0.;
                g = 1.;
                b = 6. * ( t - (2./6.) );
        }

        if( t <= (2./6.) )
        {
                r = 1.  -  6. * ( t - (1./6.) );
                g = 1.;
                b = 0.;
        }

        if( t <= (1./6.) )
        {
                r = 1.;
                g = 6. * t;
        }

    return vec3( r, g, b );
}
```

Part2 chanzhang.freq

This part is to implement the different color for the ChromaDepth. Use different color for different range of t. This can change the sphere into rainbow sphere.

```
void
main( )
{
    vec4 nv = texture3D( Noise3, NoiseFreq * vMCposition );
    float n = nv.r + nv.g + nv.b + nv.a;    // 1. -> 3.
    n = n - 2.;             // -1. -> 1.
    float delta = NoiseAmp * n;
    float s = vST.s;
    float t = vST.t;
    float up = 2. * s;
    float vp = t;
    up += delta;
    vp += delta;
    int numins = int( up / Ad);
    int numint = int( vp / Bd);
    float Ar = Ad/2;
    float Br = Bd/2;

    gl_FragColor = vColor;      // default color
```

Part3 chaozhang.freq

This part use the Noise3 to create the moise. There are four values in this, the r,g,b and a. The “noise vector” texture nv is a vec4 whose components have separate meanings.

float n = nv.r + nv.g + nv.b + nv.a;

n = n – 2;

Those two lines made the range of the four-octave function from 0 to 1. The rest of the code is like the project1 and 2. It is for the eclipse.

```
if( ( (numins+numint) % 1 ) == 0. )
{
    float uc = numins*2. * Ar + Ar;
    float vc = numint*2. * Br + Br;
    up = (up - uc)/Ar;
    vp = (vp - vc)/Br;
    float d = up * up + vp * vp;
    if( abs(d - 1) <= Tol )
    {
        float m = smoothstep( 1 - Tol, 1 + Tol, d);
        gl_FragColor = mix( mColor, vColor, m);
    }
    if( d <= 1.-Tol )
    {
        if( UseChromaDepth )       //MessageBox "This implements the ChromaDepth extra credit";
        {
            float t = (2./3.) * ( z - ChromaRed ) / ( ChromaBlue - ChromaRed );
            t = clamp( t, 0., 2./3. );
            gl_FragColor = vec4( ChromaDepth( t ) , 1. );
        }
        else
        {
            gl_FragColor = mColor;
        }
    }
    if( d >= 1.+Tol )
    {
        if( UseDiscard )    //MessageBox "This implements the Alpha extra credit";
        {
            discard;
        }
        else
        {
            gl_FragColor = vec4( 1, 1, 1, Alpha);
        }
    }
}

gl_FragColor.rgb *= vLightIntensity;    // apply lighting model
```

part4 chaozhang.freq

This part is the most important part of this project.

```
if( abs(d - 1) <= Tol )
{
        float m = smoothstep( 1 - Tol, 1 + Tol, d);
        gl_FragColor = mix( mColor, vColor, m);
}
```

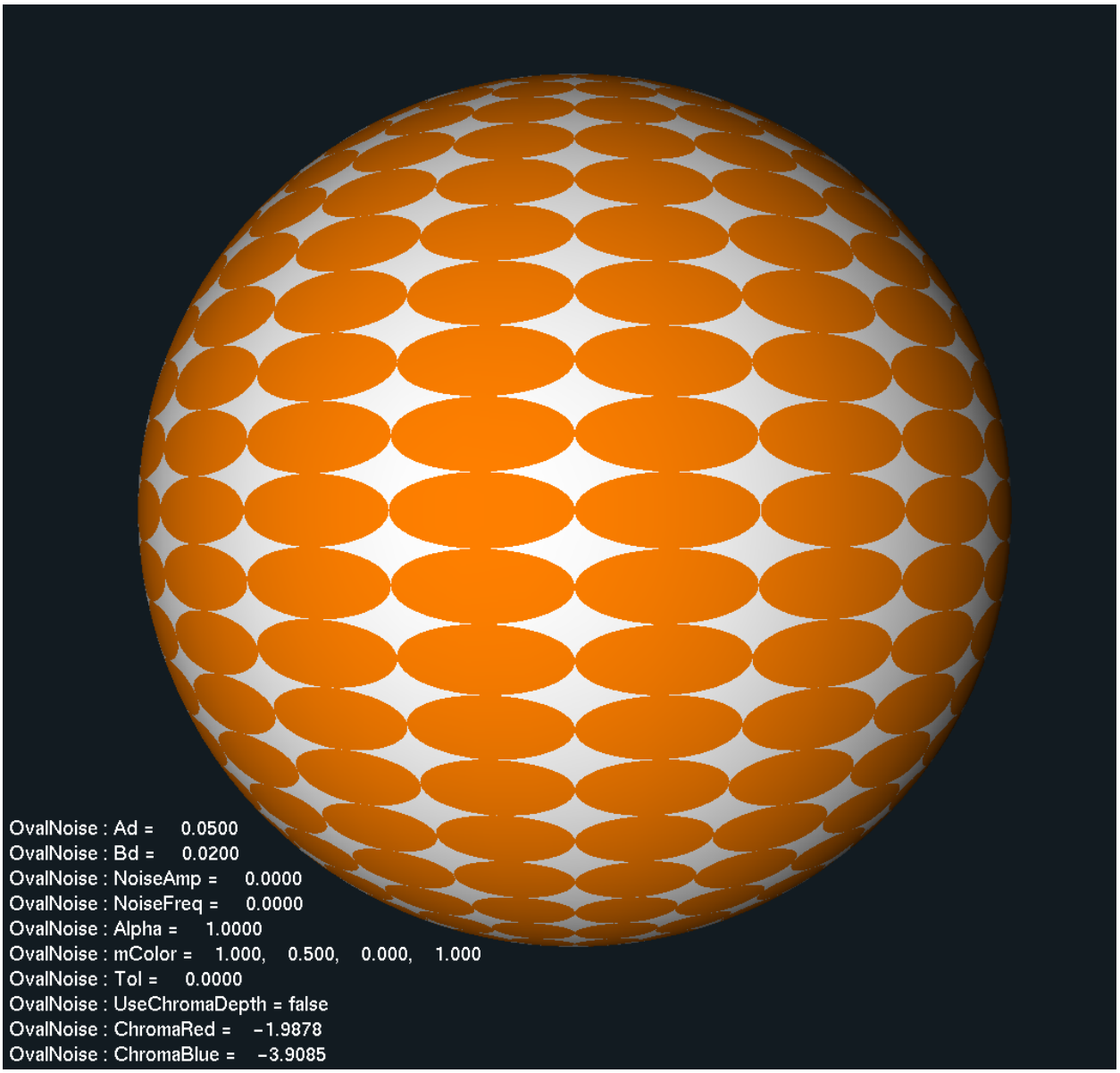
Those lines for the Tol function. With the increase of tol, the edge of the eclipse smooth. I mix the color to achieve the smooth goal.

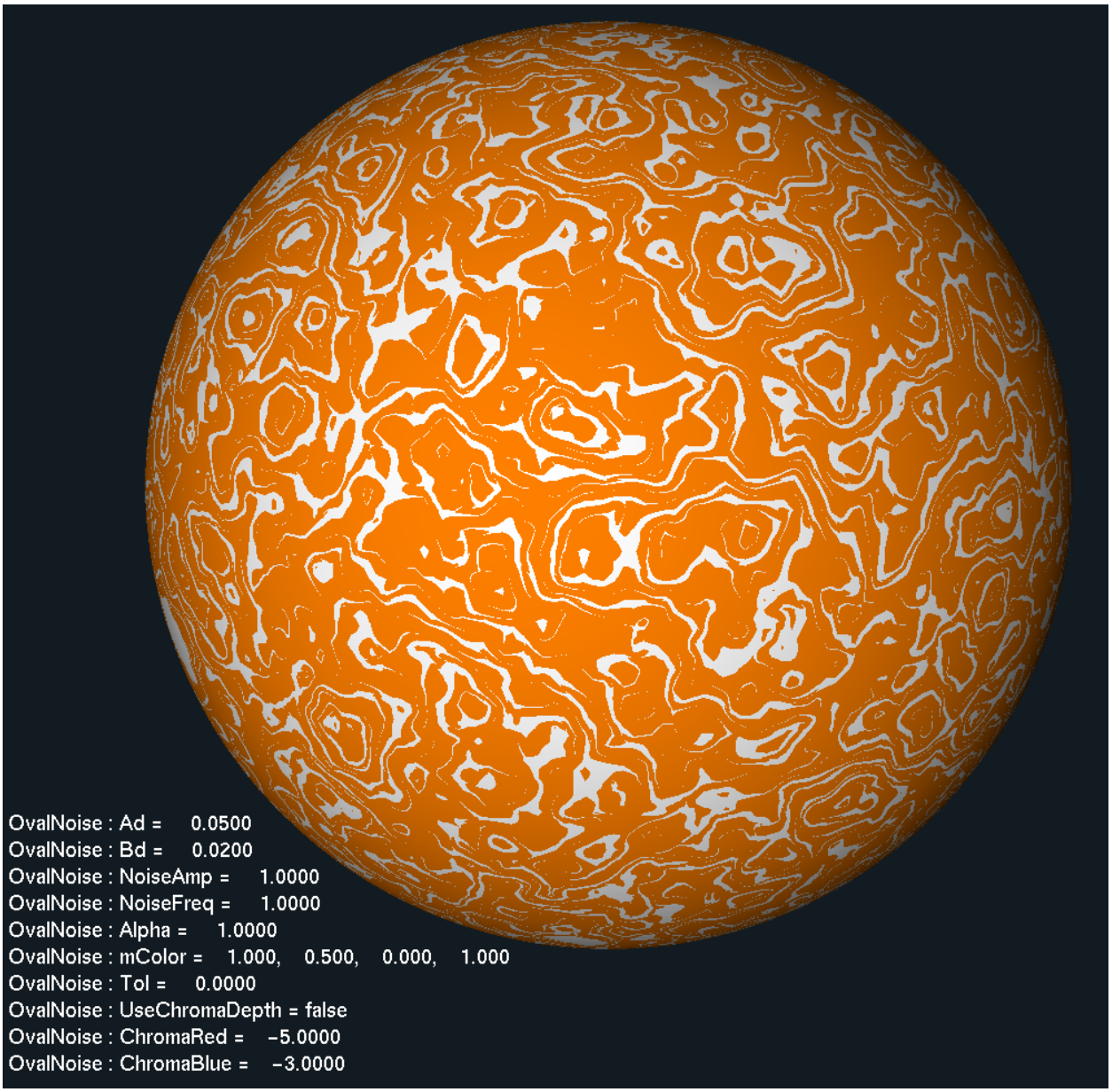
```
if( d <= 1.-Tol )
{
        if( UseChromaDepth )      //MessageBox "This implements the ChromaDepth extra credit";
```

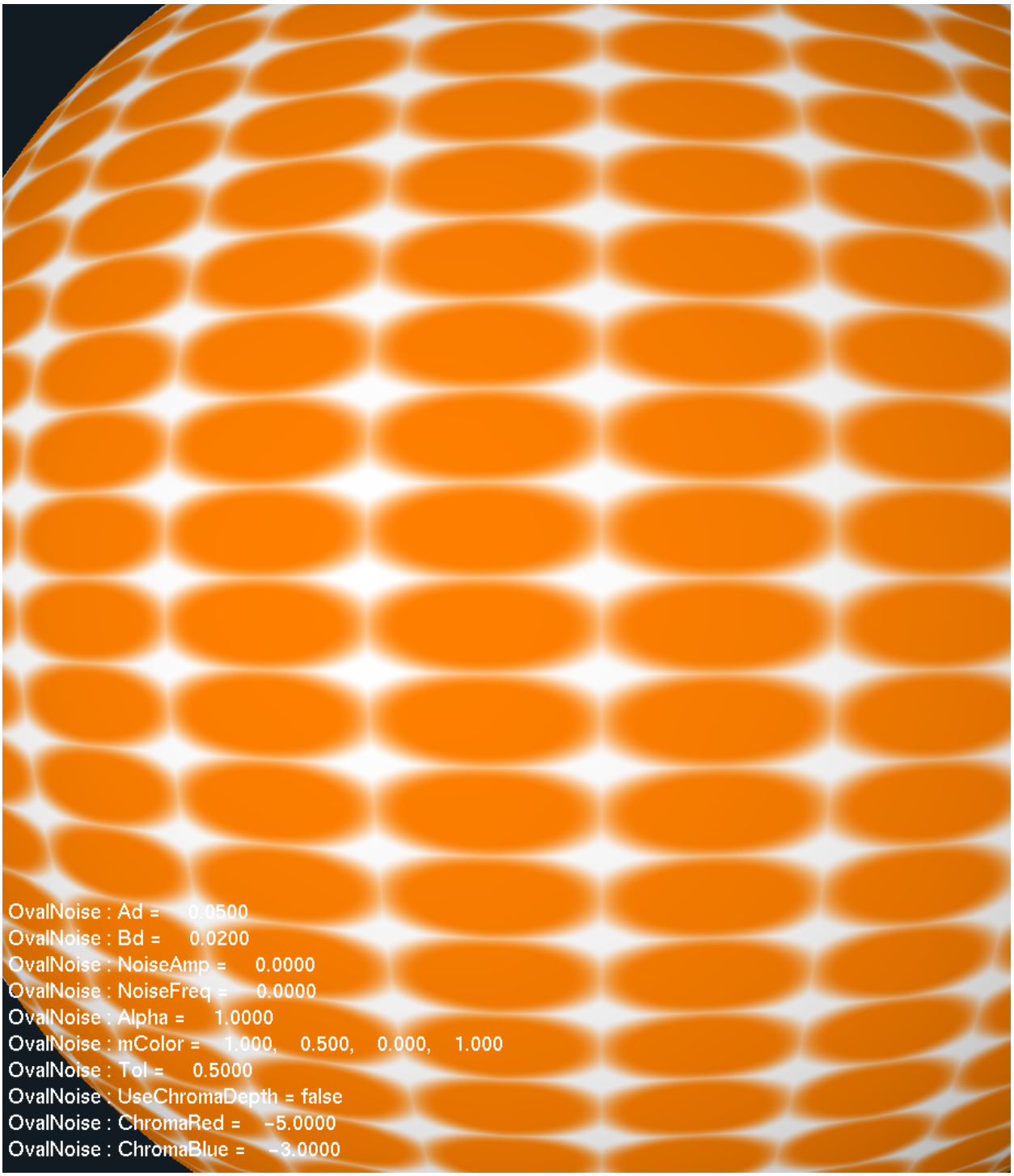
```
{
        float t = (2./3.) * ( z - ChromaRed ) / ( ChromaBlue - ChromaRed );
        t = clamp( t, 0., 2./3. );
        gl_FragColor = vec4( ChromaDepth( t ) , 1. );
}
else
{
        gl_FragColor = mColor;
}
}
```

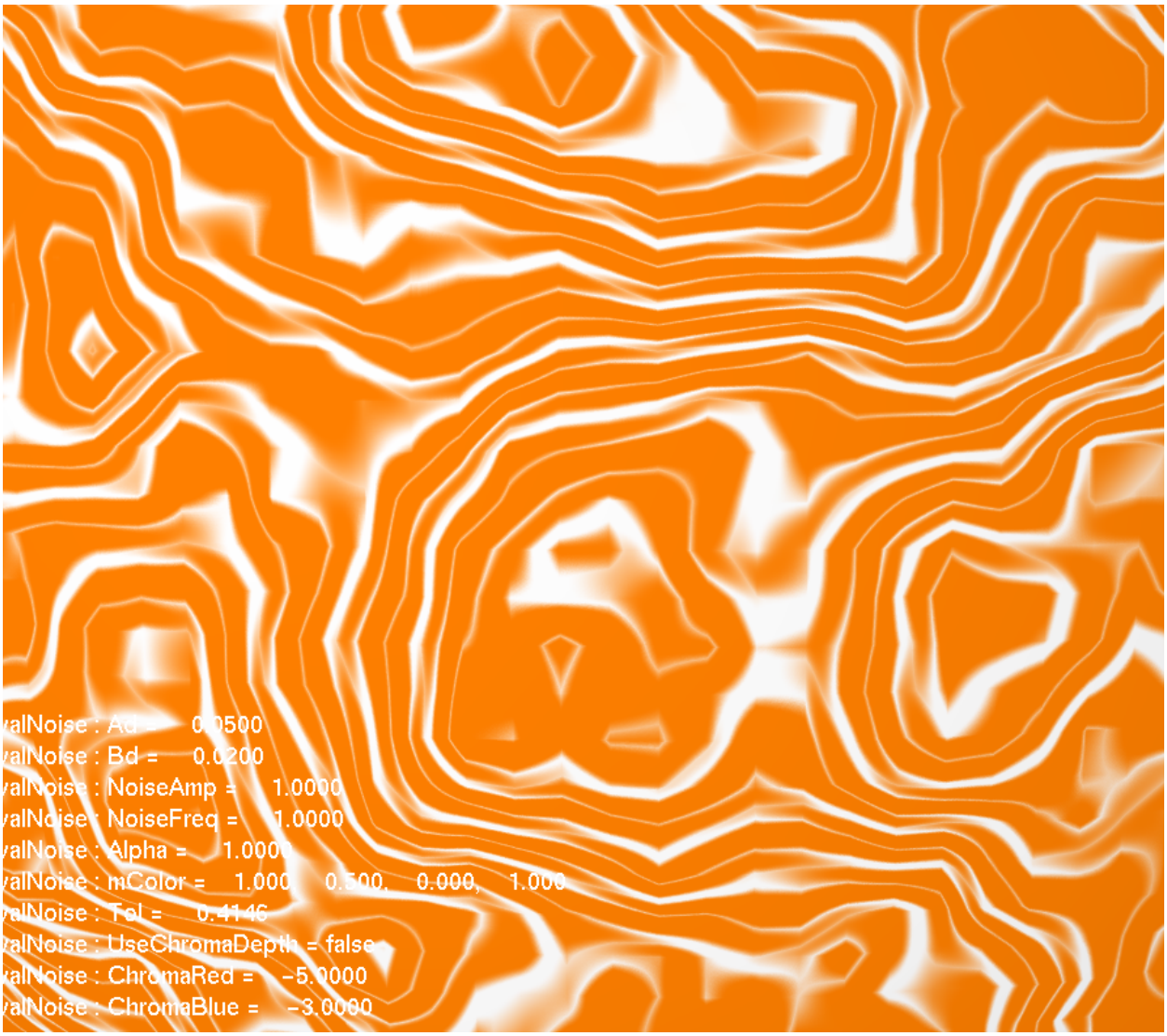
the inside loop is for the chromadepth. The reason it is a inside loop is because I only turn the eclipse color to rainbow not include the background color. The range of t is from 0 to 2/3 is because we want the red and blue.

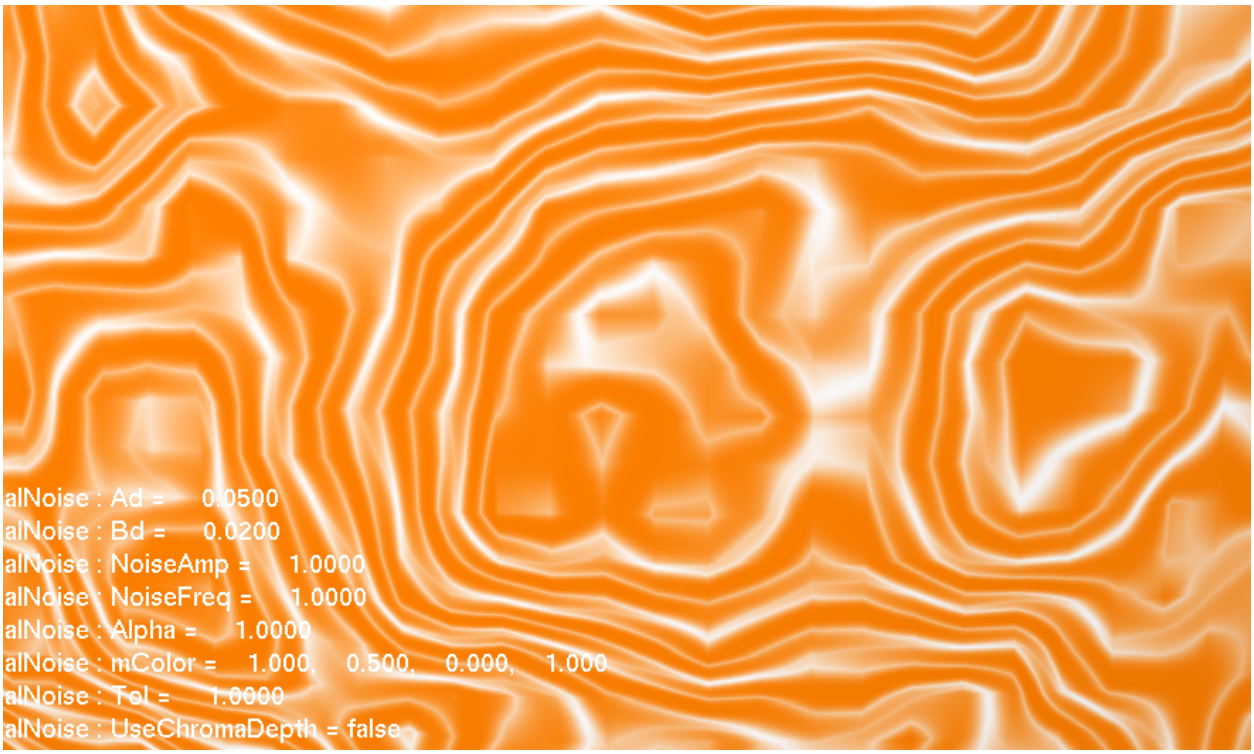
2. Results

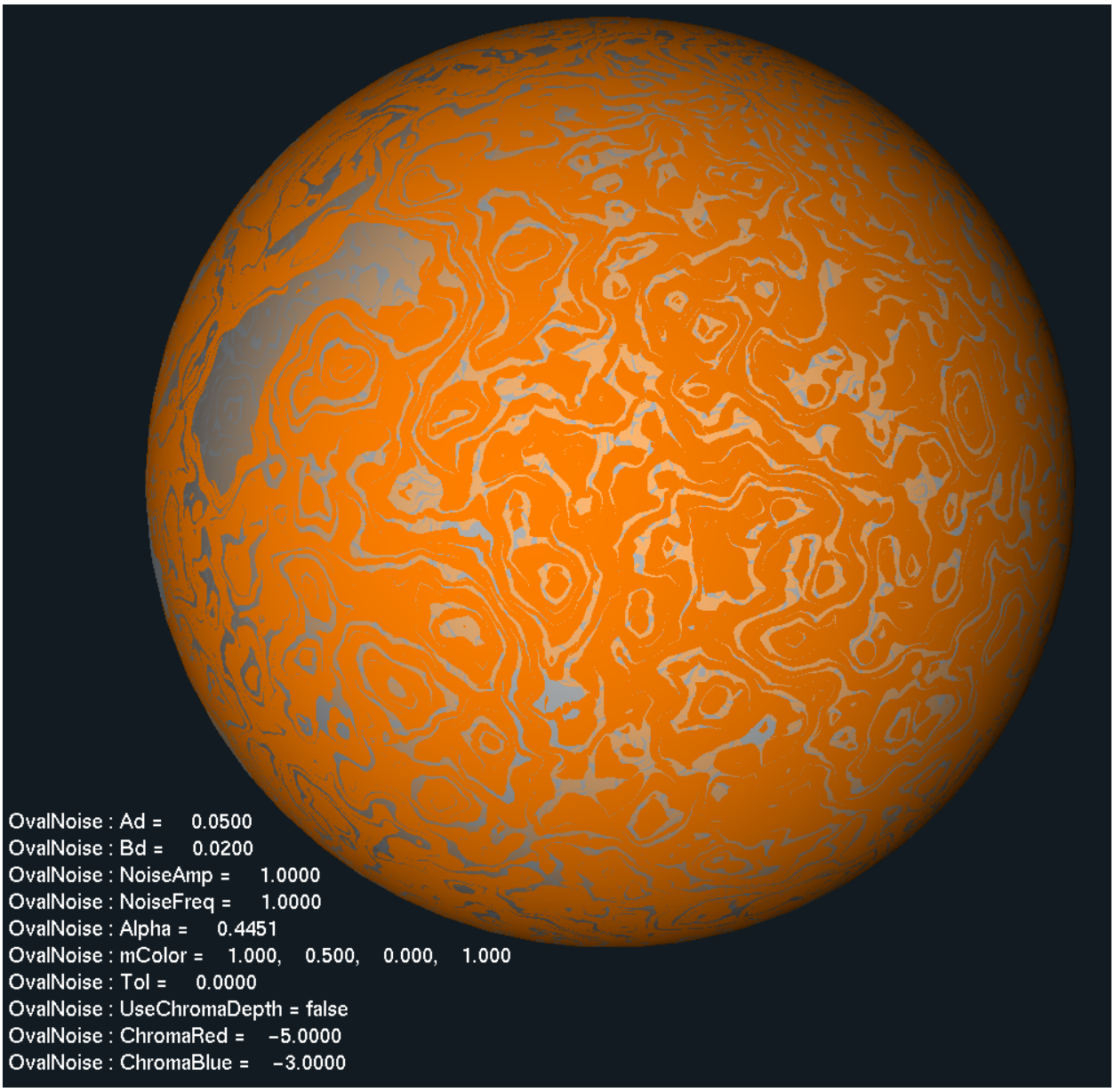

OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 0.0000
OvalNoise : NoiseFreq = 0.0000
OvalNoise : Alpha = 1.0000
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.0000
OvalNoise : UseChromaDepth = false
OvalNoise : ChromaRed = -1.9878
OvalNoise : ChromaBlue = -3.9085

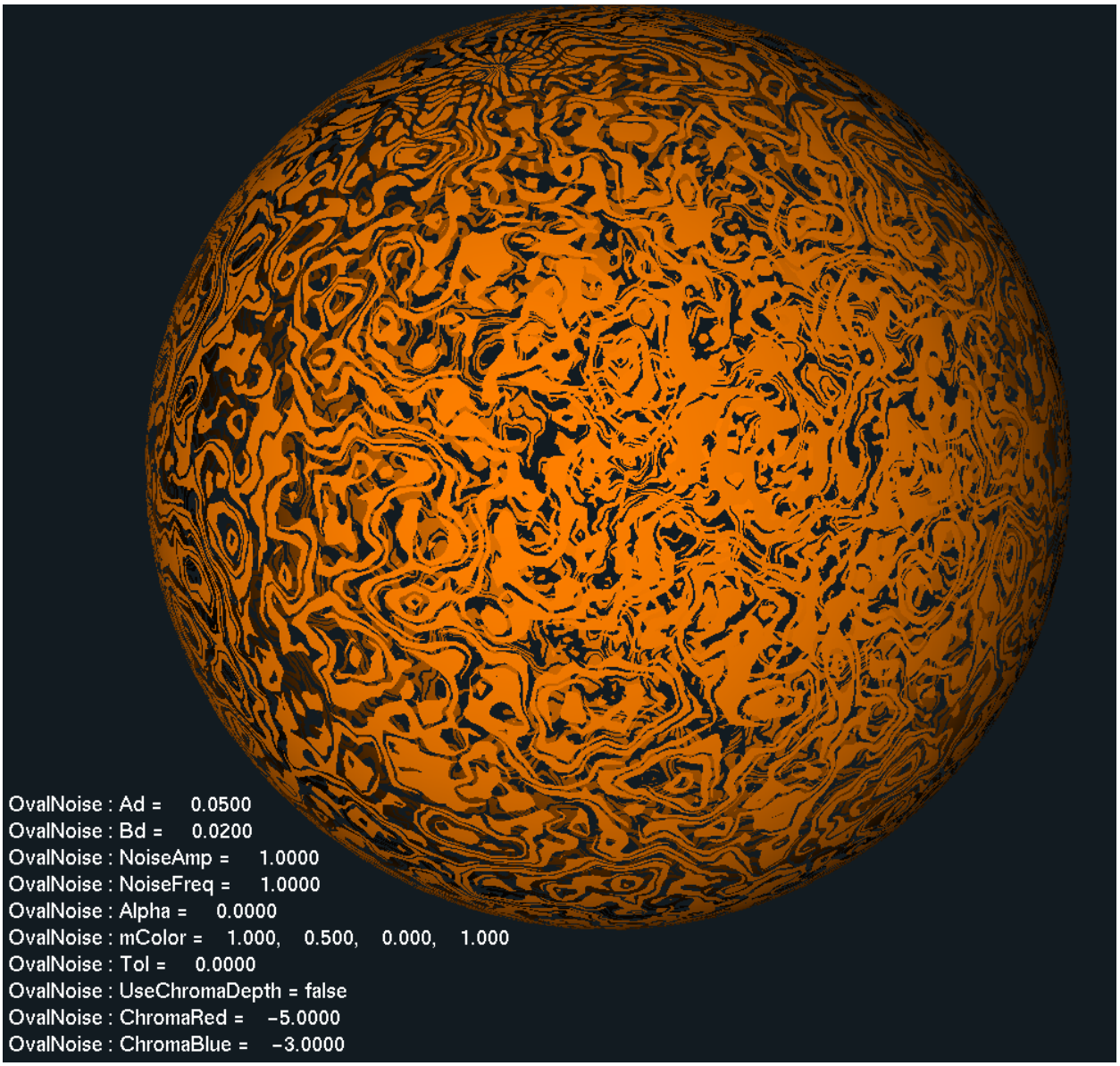

OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 1.0000
OvalNoise : NoiseFreq = 1.0000
OvalNoise : Alpha = 1.0000
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.0000
OvalNoise : UseChromaDepth = false
OvalNoise : ChromaRed = -5.0000
OvalNoise : ChromaBlue = -3.0000

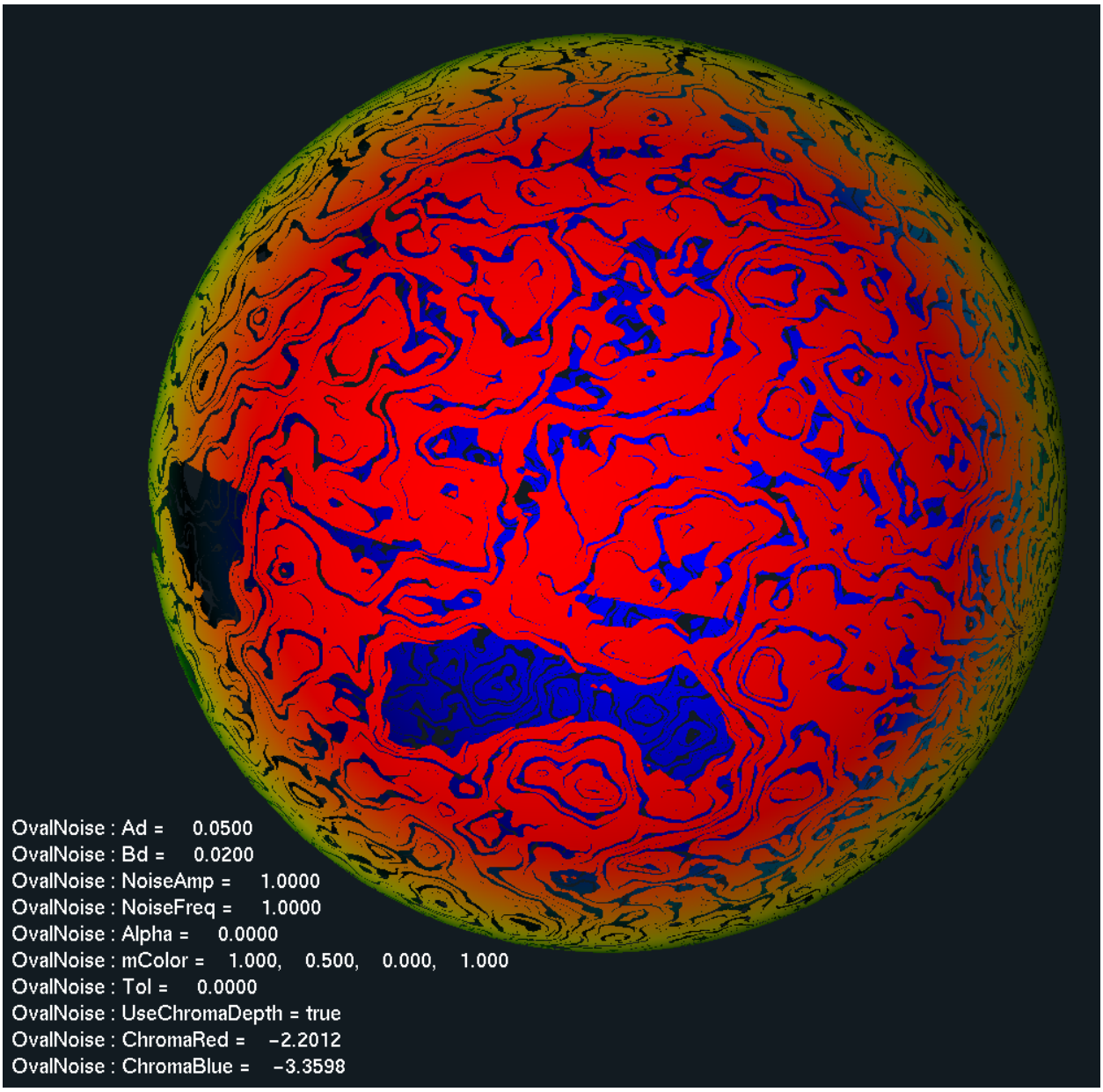

OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 0.0000
OvalNoise : NoiseFreq = 0.0000
OvalNoise : Alpha = 1.0000
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.5000
OvalNoise : UseChromaDepth = false
OvalNoise : ChromaRed = -5.0000
OvalNoise : ChromaBlue = -3.0000


valNoise : Ad = 0.0500
valNoise : Bd = 0.0200
valNoise : NoiseAmp = 1.0000
valNoise : NoiseFreq = 1.0000
valNoise : Alpha = 1.0000
valNoise : mColor = 1.000, 0.500, 0.000, 1.000
valNoise : Tol = 0.4146
valNoise : UseChromaDepth = false
valNoise : ChromaRed = -5.0000
valNoise : ChromaBlue = -3.0000


alNoise : Ad = 0.0500
alNoise : Bd = 0.0200
alNoise : NoiseAmp = 1.0000
alNoise : NoiseFreq = 1.0000
alNoise : Alpha = 1.0000
alNoise : mColor = 1.000, 0.500, 0.000, 1.000
alNoise : Tol = 1.0000
alNoise : UseChromaDepth = false


OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 1.0000
OvalNoise : NoiseFreq = 1.0000
OvalNoise : Alpha = 0.4451
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.0000
OvalNoise : UseChromaDepth = false
OvalNoise : ChromaRed = -5.0000
OvalNoise : ChromaBlue = -3.0000


OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 1.0000
OvalNoise : NoiseFreq = 1.0000
OvalNoise : Alpha = 0.0000
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.0000
OvalNoise : UseChromaDepth = false
OvalNoise : ChromaRed = -5.0000
OvalNoise : ChromaBlue = -3.0000


OvalNoise : Ad = 0.0500
OvalNoise : Bd = 0.0200
OvalNoise : NoiseAmp = 1.0000
OvalNoise : NoiseFreq = 1.0000
OvalNoise : Alpha = 0.0000
OvalNoise : mColor = 1.000, 0.500, 0.000, 1.000
OvalNoise : Tol = 0.0000
OvalNoise : UseChromaDepth = true
OvalNoise : ChromaRed = -2.2012
OvalNoise : ChromaBlue = -3.3598