GEOSOFT

Northwest Geophysical Associates, Inc.

Case Study

3D Gravity Interpretation Lower Klamath Lake Basin, Oregon

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GMSYS-3D, the new 3D gravity and magnetic modeling software from Northwest Geophysical Associates, Inc. (NGA) and Geosoft, Inc., was used to model the depth to basement in the Klamath Basin. Gravity data collected in the Spring of 2002 for the Klamath Drainage District (KDD) was reinterpreted using the 3D gravity inversion code and displayed using the Geosoft 3D display module which has been incorporated into the ***GMSYS-3D*** package. A 3D view of the model is shown below as Figure 1.

GMSYS-3D

GMSYS-3D is a *surfaced based, frequency-domain* gravity and magnetic forward and inverse modeling program which runs under Oasis montaj™. By *surface based* we mean that the model is defined by a number of surfaces, or geologic horizons, which define the model. Each surface is defined by a Geosoft grid (or any grid format compatible with Oasis montaj. Each layer is either assigned a constant density, assigned a series of sub-layers defining a density-depth function, or assigned a laterally changing density grid.

By *frequency-domain* we mean that the calculations are done in the spatial wave-number domain using an algorithm developed by Parker (1972). The grid preparation and Fourier transforms are all carried out seamlessly with as little, or as much user input as the operator desires.

The ***GMSYS-3D*** program runs under Geosoft's Oasis montaj and utilizes the Geosoft grid handling, 2D-FFT functions, and the 3D display module.

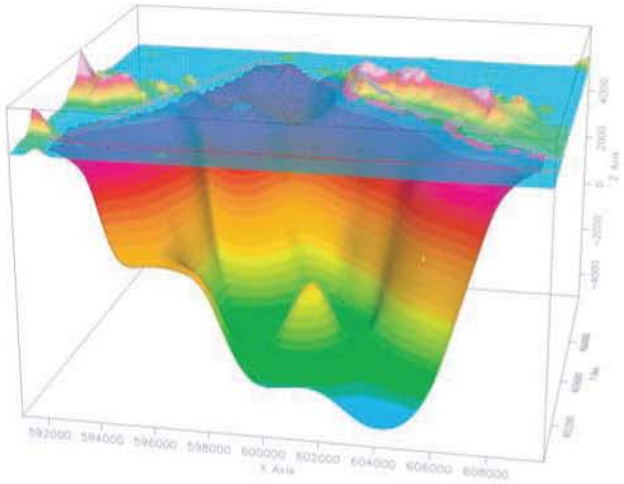

Figure 1: 3D View of Model

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Gravity Data

Gravity data were acquired by NGA in March 2002. Nominal station spacing over the basin was 500 meters. Details of the data acquisition program and interpretation are reported by French, Jenks, and Connard (2003). Publicly available regional gravity data were also incorporated in that data set. The original interpretation included

- Two-dimensional GM-SYS cross section models incorporating seismic reflection data where available,
- a fault analysis using the USGS "boundary" analysis (Blakely & Simpson, 1986), as implemented by Geosoft, and
- a simple two layer 3D inversion using the USGS "GI3" software (Cordell et al., 1992).

Lower Klamath Lake Gravity Model

The Lower Klamath Lake Basin is a classic graben structure, the northwest limit of the Basin and Range province of the western United States. Tertiary basalts and continental sedimentary "basement" rocks outcrop on the northeast and on the west sides of the basin.

The gravity model is a simple two layer model with lower density basin sediments overlying volcanic basement rocks. We have assumed a density of 2.2 gm/cm^2 for the basin sediments and a density of 2.69 gm/cm^2 for the basement. Gravity data were upward continued to a reference plane (1490 m MSL) just above the highest topography in the area.

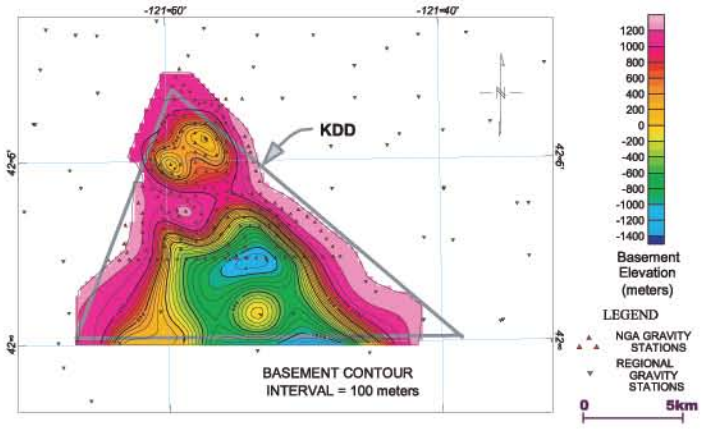

Figure 2:
PLAN VIEW OF BASEMENT STRUCTURE

Figure 1 is a 3D display of the same model. Using the Geosoft 3D viewer built into GMSYS-3D the model can easily be rotated on the screen to any viewing angle. Figure 2 is a map view, color contour map of the basement surface, showing basin sediments up to 2 km thick.

The depth to basement interpretation has constrained prospective targets to the northern end of the basin, where drilling costs are considerable lower. It has also identified several "sub-graben" features. The fracture zones within the bounding faults are more permeable targets for irrigation water production.

References

Blakely, R. J. and **Simpson, R. W.**, 1986, Approximating edges of source bodies from magnetic or gravity anomalies (short note): Geophysics, v.51:1494-1498.

Cordell, L., Phillips, J.D., and **Godson, R.H.**, 1992, U.S. Geological Survey potentialfield geophysics software, Version 2.0: USGS Open File Report 92-18.

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Parker, R.L., 1972, The rapid calculation of potential anomalies: Geophysical Journal of the Royal Astronomical Society, v.42:315-334.