## Def3D, a three-dimensional FEM tool for modeling deformation near active faults and volcanic centers

## \*luyuan Huang<sup>1</sup>

1. institute of crustal dynamics, CEA

Calculation of the quasi-static crustal deformation and stress changes plays an important role in geodetic observation's interpretation and seismic hazards assessment after mega destructive earthquakes and volcanic intrusions. However, most calculation methods are based on simplified models, such as half space model, 1D flatten model, symmetric spherical Earth model, while the realistic earth is heterogeneous ellipsoid with topography. FEM codes allow for flexibility in distribution of material properties and geometry that is difficult to accommodate in analytical or semi-analytical codes.

In this paper, with high performance computing capacity, we present a Visco-elastic Lateral Heterogeneous model, which includes topography, lateral heterogeneity and curvature of the ellipsoid Earth. Our new model can efficiently calculate visco-elastic deformation and stress changes due to earthquakes and volcanic intrusions. Our new approach is verified by comparisons with Okada's analytical solutions and Mogi's analytical solution in various cases. At last, the performance of the software is shown by case study of 2008 Wenchuan Earthquake and Changbaishan volcanic area.

We calculate visco-elastic deformation, stress changes and the Coulomb Failure Stress changes ( $\Delta$ CFS) induced by Wenchuan earthquake. The preliminary results show that the coseismic  $\Delta$ CFS on the hypocenter of Jiuzhaigou earthquake caused by the Wenchuan earthquake is about 0.008 MPa, while the postseismic  $\Delta$ CFS is up to 0.012<sup>~</sup>0.016 MPa which means several years advance for Jiuzhaigou earthquake.

The inversion of volcano deformation based on equivalent body force method is first time to be adopted in Changbaishan volcanic area. The surface deformation caused by an ellipsoidal magma chamber fits well with the observed GPS and Leveling data. The Interaction between regional and magma-induced stresses can explain the present stress orientations around the volcano inferred form stress measurements. The Coulomb Failure Stress changes due to magmatic eruption may promote the earthquake swarms with NW fault planes clustering in two regions: in the northeastern part and the southwestern part of the caldera during 2002-2003.

Keywords: FEM, crustal deformation, active faults, volcanic centers