CRUSTAL STRESS ACROSS THE NORTHERN ARABIAN PLATE AND THE RELATIONSHIP WITH THE PLATE BOUNDARY FORCES

Rayan Yassminh

Dr.Eric Sandvol, Thesis Supervisor

ABSTRACT

The region encompassing the collision of northern Arabia with Eurasia is a tectonically heterogeneous region of distributed deformation. The northern Arabia plate is bounded to the west by the subducting Sinai plate and the left-lateral Dead Sea transform. This complexity suggests that there are multiple competing processes that may influence regional tectonics in northern Arabia and adjacent areas. Earthquake mechanisms provide insight into crustal kinematics and stress; however, reliable determination of earthquake source parameters can be challenging in a complex geological region, such as the continental collision zone between the Arabian and Eurasian plates. The goal of this study is to investigate spatial patterns of the crustal stress in the northern Arabian plate and surrounding area. The focal mechanisms used in this study are based on (1) first-motion polarities for earthquakes recorded by Syrian earthquake center during 2000-2011, and (2) regional moment tensors from broadband seismic data, from Turkey and Iraq. First motion focal mechanisms were assigned quality classifications based on the variation of both nodal planes. Regional moment tensor analysis can be significantly influenced by seismic velocity structure; thus, we have divided the study area into regions based on tectonic units. For each region, the velocity model is described using a waveform-modeling technique prior to the regional moment tensor inversion. The resulting focal mechanisms, combined with other previously published focal mechanisms for the study area, provide a basis for stress inversion analysis. The resulting deviatoric stress tensors show the spatial distribution of the maximum horizontal stress varies from NW-SE along the Dead Sea Fault to the N-S toward the east. We interpret this to reflect the eastward change from the transform to collision processes in northern Arabia. Along the Dead Sea Fault, transposition of the sigma-1 and sigma-2 to vertical and horizontal, respectively, may relate to influences from the subducted part of the Sinai plate. This change in regional stress is also consistent with extensional strains observed from GPS velocities.