Microplate Deformation of the Western U.S. Interior

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This study of western U.S. deformation examines the intraplate extension of the Basin-Range (BR) province and the Yellowstone-Snake River Plain volcanic region [Puskas and Smith, 2007]. Microplate motions were modeled using GPS data compiled from multiple studies (many supported by UNAVCO and including the PBO network), Late Quaternary fault-slip rates, and earthquake slip directions from moderate to large earthquakes. The western U.S. was divided into blocks of uniform deformation based on tectonic and volcanic history and the location of active fault zones. The model examined the effects of rotation, internal strain, and block-binding faults on these microplates. Our results show that western interior is characterized by a clockwise rotation and increase of velocities from east to west. The Yellowstone-Snake River Plain moves southwest at 1.4 ± 0.2 mm/yr. This motion rotates into a westward direction at 2.3 ± 0.1 mm/yr in the eastern Basin-Range. Velocities then rotate to the northwest in the western Basin-Range, accompanied by a velocity increase to 4.6 ± 0.1 mm/yr and the introduction of internal shear-deformation in the western Basin-Range. The total east-west extension across the entire Basin-Range is 12.9 ± 0.1 mm/yr, and velocities in the northwestern region decrease in magnitude and rotate farther to the north.

The pattern of deformation is considered to be the result of multiple factors. Gravitational potential energy from buoyancy forces associated with the Yellowstone hotspot and Rocky Mountains contributes to southwest motion of the Yellowstone-Snake River Plain microplate [Puskas et al., 2004].

The northwest-moving Sierra Nevada microplate blocks westward extension of the Basin-Range and deflects motion to the northwest. Additional extension of the BR extends north of the Sierra Nevada in Nevada and Oregon.

References

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Figure 1 (a) GPS-measured velocities of microplate motions in the western U.S. interior. (b) overview of microplate velocities and strain rates in the western U.S. interior.