Divergent Hemisphere and Convergent Hemisphere based on Geometry around Plate Triple Junction

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The consistency of the observed plate motions based on space geodesy with those estimated from spreading along mid-oceanic ridges give us rigid images of plate motions. Time series finite rotations of relative plate motion are available along global mid-oceanic ridge system and therefore we can determine the time series stage rotations of plates so as to establish the new system on global tectonics.

Avoiding confusion on spherical plate motion with flat plane motion, we use Euler rotational vector. Analysis on the triple junction should be modified to investigate the global plate motions from the existing classic analyses.

We can calculate Euler rotational vector of another relative motion with addition and reduction of Euler rotational vectors of two relative motions under an assumption of no rotation on the triple junction. The two Euler vectors locate on a plane through the origin, and the derived Euler vector with addition and reduction of the two Euler vectors should also locate on the plane. Because a flat plane through origin corresponds to a great circle on a sphere, the three Euler poles of relative motions are arranged on calculated great circle.

We name a triple junction with three divergent plate boundaries, as pure divergent triple junction, and with three convergent plate boundaries, as pure convergent triple junction. Because divergent plate boundary is formed along a great circle of the Euler pole of the relative motion, the divergent boundary passes through the Euler pole. If the divergent boundary passes through the Euler pole, the boundary should change into convergent boundary. In a case of pure divergent triple junction, three divergent boundaries pass through the Euler poles of the relative motion at the calculated great circle and change into convergent boundaries. We name the hemispheres divided by the calculated great circle, as divergent hemisphere and convergent hemisphere, because of the relative motions along the boundaries. We can apply similar usage for pure convergent triple junction.

Triple junctions around the world have been examined using plate motion models NUVEL1 and REVEL2000. The hemisphere boundary great circle passes along the southwest of Java Trench for the pure divergent triple junction in Indian Ocean. The boundary great circles pass through Caribbean Sea and Scotia Sea for the pure divergent triple junctions on central and south mid-Atlantic Ridge, which is consistent with the existence of the convergent plate boundaries in West Atlantic. The boundary great circle locates at the west of Red Sea for pure divergent Afar Triangle Triple junction, which is consistent with Arabian Peninsula not rifting away from Africa. The boundary great circle passes through north and south ends of Mariana Trench for pure convergent Boso Triple Junction, which is consistent with spreading of Mariana Trough. The boundary great circle pass off European coast to Sakhalin for pure divergent triple junction on north mid-Atlantic ridge, which is consistent with the convergence in Japan Sea and Mediterranean. The boundary great circle locates along East Pacific Rise for pure divergent triple junction on East Pacific Rise, which indicates that the spreading of East Pacific Rise is affected by the subduction along Peru-Chile Trench.

Time series great circles of hemisphere boundary were examined for pure divergent triple junction of Indian Ocean. The hemisphere boundaries locate in the south of Himalaya from 46 Ma onward, and in the north of Himalaya around 46 Ma, which is consistent with the collision along the Himalaya in 46 Ma and subduction of Tethys Sea along north of Himalaya before 46 Ma like as given by the geologic record.