

Plate Dynamics of No Net Rotation Model as a window on Asthenosphere

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No Net Rotation Model was proposed by Solomon & Sleep (1974) as the simplest method to calculate absolute Plate motion. ITRF (International Terrestrial Reference Frame), which is used in space geodesy recently, is also based on NNR Model of NNR-NUVEL 1 (Argus & Gordon, 1991). Solomon & Sleep (1974) assumed that lithosphere rotates as a whole against base of mantle to be zero total of torque along the base of lithosphere.

Net Rotations (NR) of lithosphere as a whole were calculated for last 85 m.y., based on NNR Model and plate motions to Hotspot (Niitsuma, 2007). The Net Rotations were changed in one order of magnitude from 0.4 cm/y. for 65-70 Ma to 4.2 cm/y. for 70-75 Ma, and present NR is second largest as 3.7cm/y. The NR were enough small compared with plate motion for Hotspot Model to use on analysis of plate motions.

NR should induce drag force with opposite direction of NR in NNR Model. Moment of force on plates can be calculated, based on differential rotation of plate motion (Niitsuma, 2007). The total of moment of force on plates is Net differential Rotation (difNR). Because the dynamic interactions with plates should be cancelled out in difNR, difNR represents dynamic interactions with asthenosphere, which include drag force of lithosphere.

The antipodal relations between the Euler poles of difNR for 40 and 70 Ma and the Euler poles of NR for 40-45 Ma and 70-75 Ma with distinguish NR, show clearly that lithosphere was affected by the drag force of asthenosphere and decelerated.

Lithosphere for 30-35 Ma with significant NR was affected by the drag force and decelerated, however, the drag forces calculated from difNR have same direction and lithosphere accelerated as a whole in some intervals later than 30 Ma. Something has happened to the dynamic interaction between lithosphere and asthenosphere in 30 Ma.

Farallon Plate and Pacific Plate are candidates to take the initiative in the happening at 30 Ma, based on NR and difNR for each plate. Intrusion of batholiths from 100 Ma occurred widely along Andes Cordillera and stopped at 30 Ma and volcanic activity reduced in Oligocene around 30Ma, which can be related with gap of Wadati-Benioff zone under Andes along convergent plate boundary of Farallon Plate and detachment of slab.

Lithosphere as a whole rotated around central Pacific in 25 Ma, which recorded as drastic rearrangement of magnetic lineation along East Pacific Rise of divergent plate boundary of Pacific Plate and Farallon Plate.

Tectonics of Japanese Island arcs with subduction of slab of Pacific Plate, are directly related with the happening, e.g., Japan Sea Opening at 15 Ma, detachment of slab, initiation of Philippine Sea Plate and its subduction.

Keywords: Plate Dynamics, No Net Rotation Model, International Terrestrial Reference Frame, drag force, Hotspot Model, No Net differential Rotation