PLATE MOTION AND WESTERN U.S. DEFORMATION FROM VLBI DATA

ARGUS, Donald F., Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109; GORDON, Richard G., Dept. of Geological Sciences, Northwestern University, Evanston, IL 60208

We use VLBI results for 50 radio telescope sites from observations made from 1979 to 1990 to estimate (a) motion between the North American (NA), Pacific (PA), and Eurasian (EU) plates, (b) motion of the Sierra Nevada-Great Valley (SN) microplate, and (c) motion relative to these plates of 24 sites in the Pacific-North American plate boundary zone. The VLBI angular velocities (NA–PA: 50°N, 78°W, 0.80°/Myr; EU–NA: 67°N, 119°E, 0.22°/Myr; EU–PA: 62°N, 81°W, 0.93°/Myr) describing motion between the major plates nearly equal the corresponding angular velocities from geologic plate motion model NUVEL-1, which averages motion over 3 million years. Vector differences (0.03°/Myr for NA–PA; 0.03°/Myr for EU–NA; and 0.05°/Myr for EU–PA) are statistically insignificant for two of the three plate pairs, and is of marginal significance for EU–NA. Plate velocities differ between the two models by no more than 5±5 mm/yr.

Along the straight segment of the San Andreas fault at Parkfield, the SN–PA angular velocity (45°N, 103°W, 1.33°/Myr) predicts motion of 40±2 mm/yr toward N39±2W (1-σ errors). The predicted rate is 6 mm/yr faster than, but within error limits of, the fault slip rate estimated from offsets at Wallace Creek. The azimuth is 1° clockwise of the trend of the fault, and predicts that shortening taken up perpendicular to the fault is minor (−3 to +4 mm/yr, 95% c.l.). A small circle can be centered on the PA–SN pole with its radius chosen to coincide with the straight segment of the San Andreas fault. Such a small circle passes east of the San Andreas near San Francisco Bay, which implies there is a contractional component of slip across the San Andreas in the southern Bay area, or that significant slip is taken up on eastern Bay faults, or both. PA–SN motion is clockwise of the segments of the San Andreas broken by the great 1906 San Franciscan and 1857 Fort Tejon earthquakes, but it parallels the creeping and Parkfield segments of the fault.