

VLBI 測地技術の開発とプレート運動の実証

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Development of Geodetic VLBI System and Direct Measurements of Plate Motion

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Abstract

A very long baseline interferometry (VLBI) technique was originally developed to study radio source size and structure with high angle resolution by utilizing atomic clocks and magnetic recording systems. In the late 1970's VLBI came to be used for precise geodetic measurements by the development of technique called bandwidth synthesis to measure group delays with sub-nanosecond accuracy. In the United States, VLBI system named Mark-III was developed for precise geodetic measurements and started operation. In the same period, satellite laser ranging (SLR) demonstrated its high-accuracy capability for geodetic measurements. NASA started the Crustal Dynamics Project (CDP) in 1979 to study the dynamic motion of the surface of the earth by using these space techniques. Since the accuracy of VLBI and SLR at that time was about 3 cm, a series of measurements spanning several years was expected to reveal actual plate motions with the formal velocity uncertainty less than 1 cm/year.

In Japan, the Radio Research Laboratory (RRL) (presently NICT: National Institute of Information and Communications Technology) initiated VLBI and has led the technology developments from the beginning. NICT started the developments of the first VLBI system (K-1) in 1974, and carried out the first VLBI experiment in Japan successfully in 1977. This success led to the developments of precise VLBI system (K-3) for geodetic use, which is designed to be compatible with the Mark-III system. In 1983, NICT succeeded in the first Japan-US VLBI experiment using the K-3 system. NICT then joined regular CDP experiments with the K-3 system from 1984 to directly measure the motion of the Pacific plate. The motion of the Pacific plate was detected as early as in the next year. NICT then started to develop a new VLBI system named K-4 in 1987, which realized easy operation and transportation. K-4 was operated at Minamitorishima (Marcus Island), which is the only island in the Japanese territory located on the Pacific plate, and contributed to the direct measurements of the motion of the Pacific plate in Japan. Thereafter NICT has led the developments of VLBI in the world, such as real-time VLBI systems, gigabit recording VLBI systems, internet VLBI (e-VLBI) systems, and the standardization of the interfaces and software protocols.

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