Difference between Cosmic-Ray Equator and the Geomagnetic Dip Equator

After several recent measurements on the latitude effects of cosmic-ray intensities[1-3] it has been suggested that the cosmic-ray equator coincides well with the geomagnetic dip equator rather than the geomagnetic dipole equator. Even if this is so, however, there is still a considerable discrepancy between the cosmic-ray and dip equators. One explanation of this discrepancy may be an inaccuracy of the position of the dip equator itself, because the dip equator is a curve obtained by interpolations among the observation points.

During the voyage of the *Soya* on the second Japanese Antarctic Research Expedition, measurements of geomagnetic total intensities were carried out crossing the geomagnetic equator in the South China Sea. The daily range of total intensity (F) was found for each day around the geomagnetic equator and compared with that at the magnetic observatory at Muntinlupa, in the Philippines. Although the ratio of the range on the ship to that of Muntinlupa varied considerably from day to day, a smoothed curve shows a remarkable feature of F against geomagnetic dip angle, as shown in Fig. 1. It is clear that the region of maximum range in F is about 4° south of the geomagnetic dip equator.

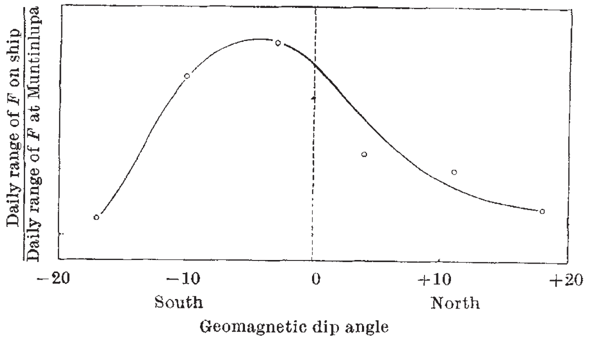

Fig. 1

On the other hand, cosmic-ray intensities measured on the same course during the first Japanese Antarctic Expedition show that the position of minimum cosmic-ray intensity was found at 6° north geographical latitude, which is situated at about 3° south of the geomagnetic dip equator[4]. Consequently, the cosmic-ray equator coincides with the geomagnetic dip equator deduced from the daily ranges of geomagnetic total intensities in the South China Sea, or along about 110° east geographical longitude.

These conclusions are valid on the assumption that the position of the geomagnetic dip equator is not necessarily accurately defined. Next, let us assume that the geomagnetic dip equator is accurate. In this case similar results are obtained around the geomagnetic dip equator in Africa[5], South America and India[6], except for a slight difference between the position of the maximum daily range in F and the geomagnetic dip equator. Since it has been suggested that an explanation can be found in the superposition of the effect of a narrow equatorial jet-current due to the Hall effect in the ionosphere[7], the area of maximum range in F is situated in the area of zero dip angle in the ionosphere. Therefore, it is suggested that the geomagnetic field is more effective in cosmic-ray intensities existing in the vicinity of 100 km. above sea-level than the geomagnetic surface anomalies, which decrease with height from the Earth's surface to the lower boundary of the ionosphere.

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Takashi Oguchi
Geophysical Institute,
University of Tokyo.
Masahiro Kodama
Institute of Physical and Chemical Research,
Tokyo.

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Infra-red Dispersion Wave-lengths for Solid Lithium Fluoride containing Varying Proportions of Lithium Isotopes

In a programme utilizing isotopic mass as a probe for the solid state, the infra-red dispersion wave-lengths of $^{6}\text{Li}^{19}\text{F}$ and $^{7}\text{Li}^{19}\text{F}$ were recently obtained[1]. Since then, improved apparatus and techniques have allowed a somewhat better estimate of these wave-lengths. Moreover, the study has been extended to lithium fluoride containing varying proportions of the lithium isotopes. Lithium fluoride was prepared by the action of hydrofluoric acid on metallic lithium and its oxide, nitride, etc., resulting from exposure to the atmosphere. The enrichment of the lithium-6 sample was specified as 99·3 ± 0·2 per cent, and that of the lithium-7 as 99·8 ± 0·1 per cent. Powdered samples of the appropriate composition were evaporated from a platinum boat on to $\frac{3}{4}$-mil polyethylene sheet. The thickness of the film of lithium fluoride as measured by the a.c. conductivity of a known volume of distilled water in which a fiduciary portion of the film plus sheet had been steeped, was about 0·2μ. Infra-red spectra were obtained by use of a Perkin–Elmer 'Model 21' double-beam spectrophotometer with a cæsium bromide prism.

Fig. 1 shows the results for the wave-length of the transmission minimum as a function of isotopic composition. Each circle represents a separate sample. The straight line is drawn through 32·6μ, the accepted value[2] for the fluoride of natural lithium (92·5 per cent lithium-7, 7·5 per cent lithium-6), with a slope such that the ordinates of the end-points are inversely proportional to the square root of the reduced masses of $^{6}\text{Li}^{19}\text{F}$ and $^{7}\text{Li}^{19}\text{F}$, that is, 1·059. The best straight line fitting the results is a trifle steeper. Our estimate of the infra-red dispersion wave-lengths for 100 per cent enrichment is the following: $^{6}\text{Li}^{19}\text{F}$, 30·8 ± 0·2μ; $^{7}\text{Li}^{19}\text{F}$, 32·6 ± 0·2μ; ratio of wave-lengths, 1·058 ± 0·013. These values are in excellent agreement with those predicted recently by Stevenson and Nettley[3], namely, somewhat less than 30·9μ for $^{6}\text{L}^{19}\text{F}$ and somewhat exceeding 32·5μ for $^{7}\text{Li}^{19}\text{F}$. Their values were deduced from measurements on the infra-red reflectivity of single crystals grown from fluorides made from enriched lithium.

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