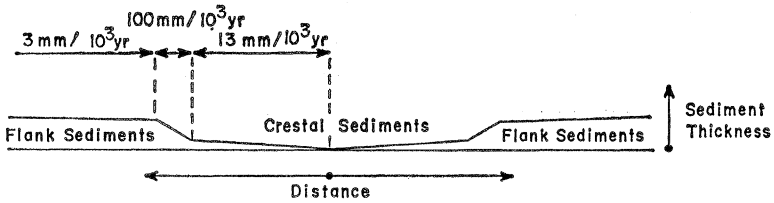

Fig. 4. Generalized sketch of crestal and flank sediment thickness based on data from the equatorial Pacific. The slopes give accumulation rates as indicated if spreading is assumed constant at 4.5 cm/yr.

50°S in the South Pacific, the flank sediments are no more than twice as thick as the crestal sediments, which indicates either a shorter quiescent period or a substantial increase in sedimentation rates during the Late Tertiary. There is evidence that in some areas, such as the equatorial Pacific, the Early Tertiary accumulation rate was lower than that in Late Tertiary and Quaternary [for example, see Arrhenius (*7*)], so it is possible that the quiescent period began as early as, or even before, Upper Cretaceous time. Sediments of the Atlantic basins, dated by studies of horizon A (*1*) as extending at least into the Mesozoic, indicate deposition during a quiescent period.

This hypothesis will be disproved if drilling fails to recover old sediments on the flanks of the ridge near the sediment discontinuity. In that event we will apparently have to accept extreme changes in sedimentation rates about 10 million years ago, that is, in Late Miocene.

The intermittent character of the convection suggested by the sediment distribution is consistent with the idea [see, for example, Vening Meinesz (*8*)] that the rate of generation of heat seems inadequate to maintain continuous convective motion. Bearing in mind the limited accuracy of our estimates of the convective phases of the last two cycles, it seems worthwhile to point out that these times agree reasonably well with the Late Cretaceous and Miocene orogenies.

The fact that high values of heat flow are concentrated within 100 km of the ridge axis in the Atlantic (*9*) and that the value is almost constant for a considerable distance beyond is consistent with a long period of quiescence followed by spreading, as specified above. The broader belt of high values of heat flow on the East Pacific rise is consistent with the higher spreading rates and wider sediment gaps found there.

Geological data around the Gulf of Aden summarized by Laughton (*10*) indicate that rifting may have commenced as early as Eocene but that major movement probably occurred in Miocene time. Seismic profiler traverses show sediments up to 800 m thick in the gulf except for a central strip 60 to 80 km wide where the thickness is only 0 to 100 m. This evidence also supports intermittent spreading.

Oliver and Isaacs (*11*) have interpreted seismological studies in the Tonga–Fiji region to indicate that the intermediate and deep earthquake foci occur in a section of the lithosphere that has been thrust 600 to 700 km into the mantle. Although the depth range of the foci may represent the limit to which the lithosphere remains unmelted it might correspond instead to the total amount of thrusting (spreading) during the present cycle.

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12. Supported by the U.S. Office of Naval Research and Bureau of Ships, and by the National Science Foundation. We also thank the British Hydrographic Service for their assistance in obtaining data abroad H.M.S. *Vidal.* Many members of the Lamont staff have assisted in obtaining the other data, in particular, J. L. Worzel, M. Langseth, C. Windisch, G. Bryan, R. Leyden, X. Le Pichon, and R. Zaunere. Lamont Geological Observatory contribution No. 1063.

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Long Base Line Interferometry: A New Technique

Abstract. *The technique of using magnetic-tape recorders and atomic frequency standards to operate two widely separated radio telescopes as a phase-coherent interferometer when the stations have no radio-frequency connecting link has been successfully tested at the National Research Council of Canada's Algonquin Radio Observatory.*

In extending conventional radio interferometry to very long base lines two major problems are encountered. The most obvious is the requirement for a phase-stable radio link, but perhaps even more important is the difficulty of compensating for the large and varying difference in arrival time of the signals at the two sites. A flexible technique which overcomes both these difficulties has been developed; it uses video tape recorders and atomic frequency standards.

For radio astronomical applications each tape recorder must have a large signal bandwidth and corresponding time-base stability. If the bandwidth is in excess of 1 Mhz the width of the cross correlation function is less than 1 μsec when the two tapes are correlated on playback. Thus the recorders must be capable of being aligned and of remaining in alignment during playback to within a fraction of a microsecond. To meet these requirements video tape recorders of the type used successfully for many years in television were chosen for the present experiment.

Each station has its own rubidium frequency standard which, during the observing period, is used to derive the frequency of the receiver's local oscillator (since no frequency synchronization between stations is provided) and to provide a time reference. The frequency spectrum of the incoming signal is shifted by the local oscillator to a band centered at zero, so that the receiver output is an undetected, low-pass waveform having a bandwidth of about 1 Mhz. Synchronizing and blanking pulses are then added (so that the composite waveform resembles a television signal without "vertical" pulses) and a recording is made.

Approximately 15 of the 90 minutes of available recording time are allowed to align the machines during playback to within 1 μsec by use of timing pulses

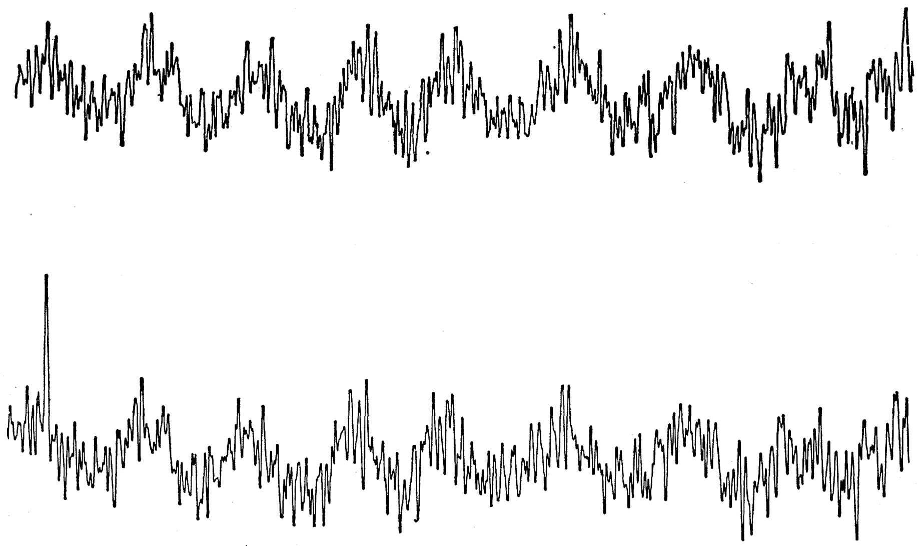

Fig. 1. (Top) An interferometer pattern from the source 3C-294 obtained directly while a recording was being made. (Bottom) An interferometer pattern from the source 3C-294 obtained on playback. The recorded signals were those correlated directly to produce the pattern in the top part of the figure.

recorded from the rubidium standard and a simple counting procedure on the sound track. The synchronizing pulses recorded during the observing period keep the machines locked together to within ±0.2 μsec. These pulses are then removed from the output of the recorders before further processing takes place. The resulting waveform has blank intervals which reduce the effective observing time by less than 30 percent but which create no other problem.

The first test was performed at a center frequency of 448 Mhz. The antenna system consisted of the 46-m radio telescope and a 10-m instrument located 200 m away. The two local oscillators were *not synchronized,* each being controlled by its own atomic frequency standard. There was no noticeable evidence of any short-term phase drift in the local oscillators.

Two methods of operation were employed during the experiment. In the first mode the local oscillator frequencies were the same and the natural fringe rate resulted. The effective integration time of the system was about 1 second. In this mode strong sources such as Taurus "A" (1200 flux units) produced almost noise-free sinusoidal fringes. The weakest source observed was 3C-294 (4.5 flux units), and the fringes obtained are shown in Fig. 1.

In the second mode of operation the fringe rate was increased to about 300 hertz. This was achieved by offsetting the frequency of one local oscillator with a frequency synthesizer. After the tape recorder outputs were correlated the resulting signal was passed through a narrow filter tuned to the fringe rate and the output of this filter was detected. This mode of operation is particularly useful when searching for a strong source when time at the two stations is not known accurately. We found that with a source such as 3C-273 we could "scan" the tapes for the correct time delay at rates of up to 1 μsec/sec by altering the speed of one machine. A plot of the square of the autocorrelation function of the recorder output, centered at the correct time delay, appeared clearly above the noise.

Since both receivers were at the same site it was possible to correlate the receiver outputs directly while a recording was being made and to compare the fringes thus obtained with the fringes obtained on playback. Figure 1 (top) shows such a record for the source 3C-294 (approximately 4.5 flux units). The signals in this case were passed through the electronics of the tape recorders, bypassing the recording heads but having the "sync." pulses added and subsequently removed. Figure 1 (bottom) shows the results of correlating the same signals after they were recorded on tape and played back at a later time. It is interesting to note that the noise on the two records is strongly correlated, which indicates that most of it is caused by the receiver and not by the tapes.

The use of video tape recorders and atomic frequency standards as a technique for operating two widely separated radio telescopes as a phase-coherent interferometer appears to be quite sound. Synchronizing the two tapes to within a fraction of a microsecond presents no problem. Using tape recorders and unsynchronized local oscillators does not produce a large degradation in the signal-to-noise ratio.

When the system is extended to very long base lines the initial time delay can be taken into account by delaying the recorded timing pulses at one station. Compensation for the variation in the time delay can be accomplished by the simple expendient of varying the speed of one machine. The accuracy required in the alignment of the tapes depends only on the system bandwidth and not on the length of the base line.

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Irradiation Effects in Glasses: Suppression by Synthesis under High-Pressure Hydrogen

Abstract. *Glasses synthesized under high pressure of hydrogen showed resistance to certain effects of irradiation. Paramagnetic and light-absorption effects associated with irradiated glasses were diminished by a factor as large as 20 in some glasses. Irradiation increases the concentration of hydroxyl ions, as evidenced by increased absorption in the 2.7-micron (3700 cm^{-1}) infrared region for hydrogen-silica glasses.*

We have shown previously that various gases may be forced into glasses and melts at high temperature by use of high-pressure techniques (*1*). In this study glasses containing up to 8 moles percent of H_2 were synthesized by the following process: The glass was heated to 800°C under hydrogen at pressures as high as 3 kb; then, when equilibrium