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Is the velocity of P_n an indicator of Q_α?

IN a recent paper Booth *et al.*[1] showed that short period teleseismic P waves are recorded with relatively small amplitudes at long range seismic measurement (LRSM) stations in the western United States compared with those in the eastern half of the country. This is in agreement with the results of Jordan *et al.*[2] and several more recent studies. Booth concluded that this might be because the upper mantle anelastic quality factor Q_α is higher in the east, and consequently waves passing through it suffer less absorption.

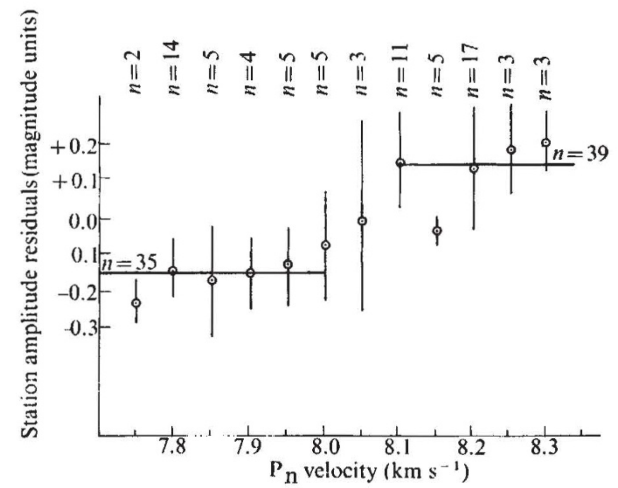
The hypothesis has important consequences for the measurement of magnitude (m_b) and the proposal made by the United States and the Soviet Union to limit the size of their nuclear weapon tests stimulated further investigations of the idea. There is not an obvious way of doing so because opportunities to make reciprocal station–source experiments (firing at one station and recording at another, then firing at the second and recording at the first) are few. Would other geophysical quantities provide an indicator of Q_α in the upper mantle?

The velocity of the Moho refracted wave, P_n, is an obvious candidate; Herrin and Taggart[3] have proposed that the variation in velocity of P_n might be due to fundamental differences between east and west in the upper mantle of North America, Evernden[4] used P_n velocities to improve the estimates of magnitudes of near and near-regional earthquakes, and Alsup[5] estimates Q_α in the uppermost mantle of the United States with the help of P_n waves.

The result of plotting Herrin and Taggart's observations[3] of P_n velocity against the average short period P-wave amplitude residuals for stations overlying a particular P_n velocity is illustrated in Fig. 1. The two horizontal lines are simple averages. Cleary's[6] data from the homogeneous (LRSM) network of stations are included with those of Booth *et al.* All five observations at 8.15 km s^{-1} are in Wisconsin and Minnesota where according to Herrin and Taggart, the P_n velocity is not well determined. (Note, however, that Smith *et al.*[7] give a P_n velocity of 8.07 km s^{-1} for this area and that this eliminates the anomalous value.)

The correlation illustrated in Fig. 1 establishes an empirical relationship between the velocity of P_n and amplitude residuals in North America. As it seems reasonable to suppose that the amplitude variations are caused by Q_α variation, we conclude that Q_α and the velocity of P_n are correlated. Archambeau *et al.*[9] have already implied a relation between upper mantle *P* velocities and Q_α. The work which is developing from these key observations reported in this note indicates that such a relationship does exist, and that useful estimates of effective Q_α of the upper mantle and of amplitude (magnitude) residuals can be made wherever there are reliable measurements of P_n velocity. Since P_n velocities are available from most parts of the world it is possible to improve the accuracy of estimates of seismic yields of underground explosions. The more fundamental investigations into the physical significance of the observations are being pursued.

Fig. 1 Relationship between average station amplitude residuals and P_n velocity. Horizontal bars are obtained by summing all individual station amplitude residuals values > 8.1 km s^{-1} and all < 8.0 km s^{-1} and dividing by *n* the total number of observations in each velocity range.



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Received September 10; accepted October 19, 1976.

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Use of phototransfer for the anomalous fading of thermoluminescence

THE occurence of anomalous fading of thermoluminescence (TL) in minerals typical of the inclusions found in archaeological pottery has been reported[1]. This effect leads to an erroneous evaluation of the archaeological age using conventional TL methods. Consequently it introduces serious problems in the dating of such materials. Here the phototransfer technique (re-excited glow)[2] was applied. The results indicate that in some materials anomalous fading may be circumvented, or at least substantially reduced. Of the materials of interest in TL dating that display anomalous fading (zircon, fluorapatite and plagioclase feldspars labradorite, andesine and bytownite), fluorapatite and zircon[3] were found to be the most promising for the application of the phototransfer technique.

The samples tested (from the same specimen as used by ref. 1) were in the form of loose, crushed, grains and their TL was observed with apparatus that has been described by Aitken and Fleming[4]. Before the experiments these materials were annealed for 15 min at 700 °C in an atmosphere of oxygen-free nitrogen. Ultraviolet illumination (usually 1-min exposure) of the samples was made at room temperature (RT) by means of a 300-W xenon lamp, the light from which was passed through a f/4.0 grating monochromator. A $^{90}Sr/^{90}Y$ β source was used for the irradiations.

The phototransferred TL (PTTL) was observed using the following procedure: first, irradiation at RT and subsequently erase TL to 500 °C; second, illumination with monochromatic light at RT and third the observation of re-excited TL by means of a glow curve of 500 °C. The re-excited glow curves arising from phototransfer, obtained for fluorapatite and zircon are shown in Fig. 1. They are compared with the glow curves obtained after a short β