

NORSAR

ROYAL NORWEGIAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

Scientific Report No. 3-76/77

FINAL TECHNICAL SUMMARY

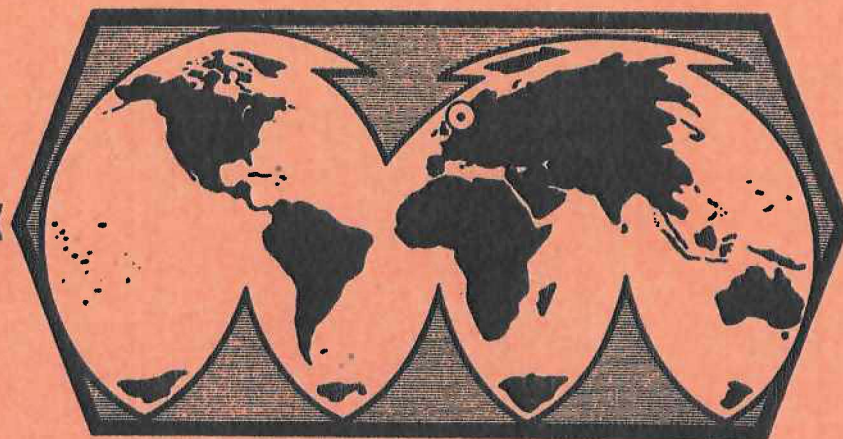
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VI.4 Lateral P-velocity Distribution in the Upper Mantle Derived from
NORSAR Data

An integral part of problems associated with discrimination between earthquakes and underground nuclear explosions is the composition of the upper mantle, in particular its P-velocity distribution. There are several approaches used for studying these kinds of problems, that is, inversion of surface wave data, seismic refraction profiling (very costly), various types of analyzing techniques in conjunction with seismic network data and so-called tau-inversion (Bessanova et al, 1974; Kennett, 1976) of gross P-wave travel time data. The latter two methods have been popular with NORSAR scientists in analysis of P-wave recordings at NORSAR from explosions in Western Russia and earthquakes in southeastern Europe (for references, see King and Calcagnile, 1976; and England, Worthington and King, 1977). More recently, England, Kennett and Worthington (1977) have undertaken a comprehensive analysis of NORSAR recordings from the North Atlantic, and the essence of their findings is to be reported here. We note in passing that NORSAR has a rather unique location being situated within 30 degrees from 3 major tectonic zones: the old shield of Western Russian platform, the young collision zone of SE Europe and the Alpine-Carpathian chain and the active spreading ridge of the North Atlantic Ocean.

A travel time curve for P seismic waves recorded at NORSAR from earthquakes in the North Atlantic is of significantly different character from those for rays bottoming under Western Russia and southeast and central Europe (for details, see Figs. VI.4.1, VI.4.2 and VI.4.3). The differences arise principally from variations in the outer 2-300 km of the three regions and from the apparently anomalous nature of the velocity distribution between 300 and 500 km beneath southern and central Europe. Extremal 'Tau'-inversion is extended to the calculation of bounds on vertical transit time for different depth ranges beneath the three regions. A maximum difference of 3 s is permitted in the two-way vertical transit times of P waves between 50 and 800 km below western Russia and the North Atlantic. The bounds obtained on transit times between 300 and 800 km demand no difference between the two regions and permit a maximum difference of 1.5 s in two-way transit time. This is consistent with the observation

that the North Atlantic travel time curve may be fitted to within error by a model which is substantially the same as that for western Russia below 300 km.

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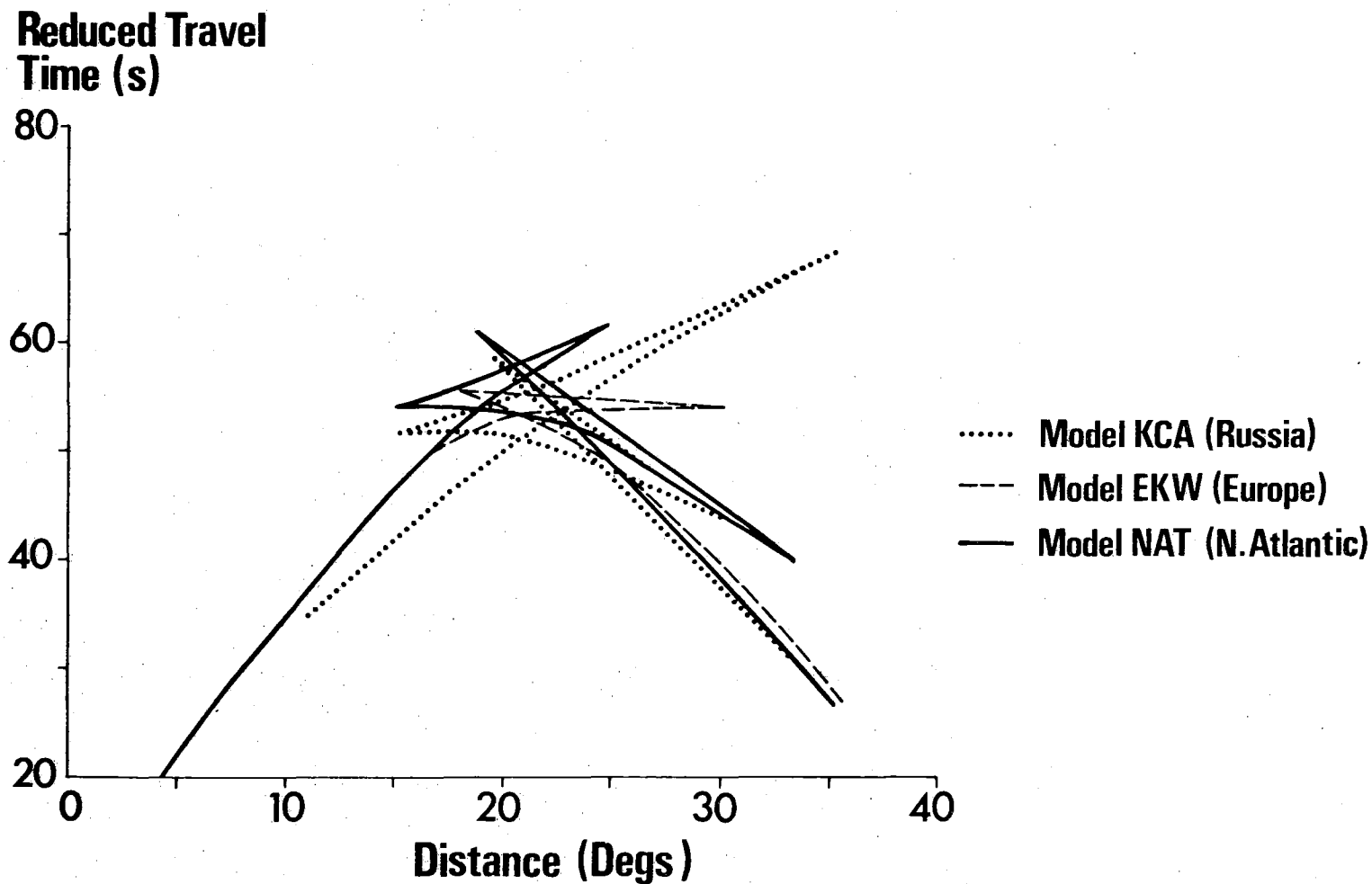


Fig. VI.4.1 Comparison of the reduced travel time curves generated from the three velocity models shown in Fig. VI.4.2. (Figure reproduced from England, Kennett and Worthington, 1977.)

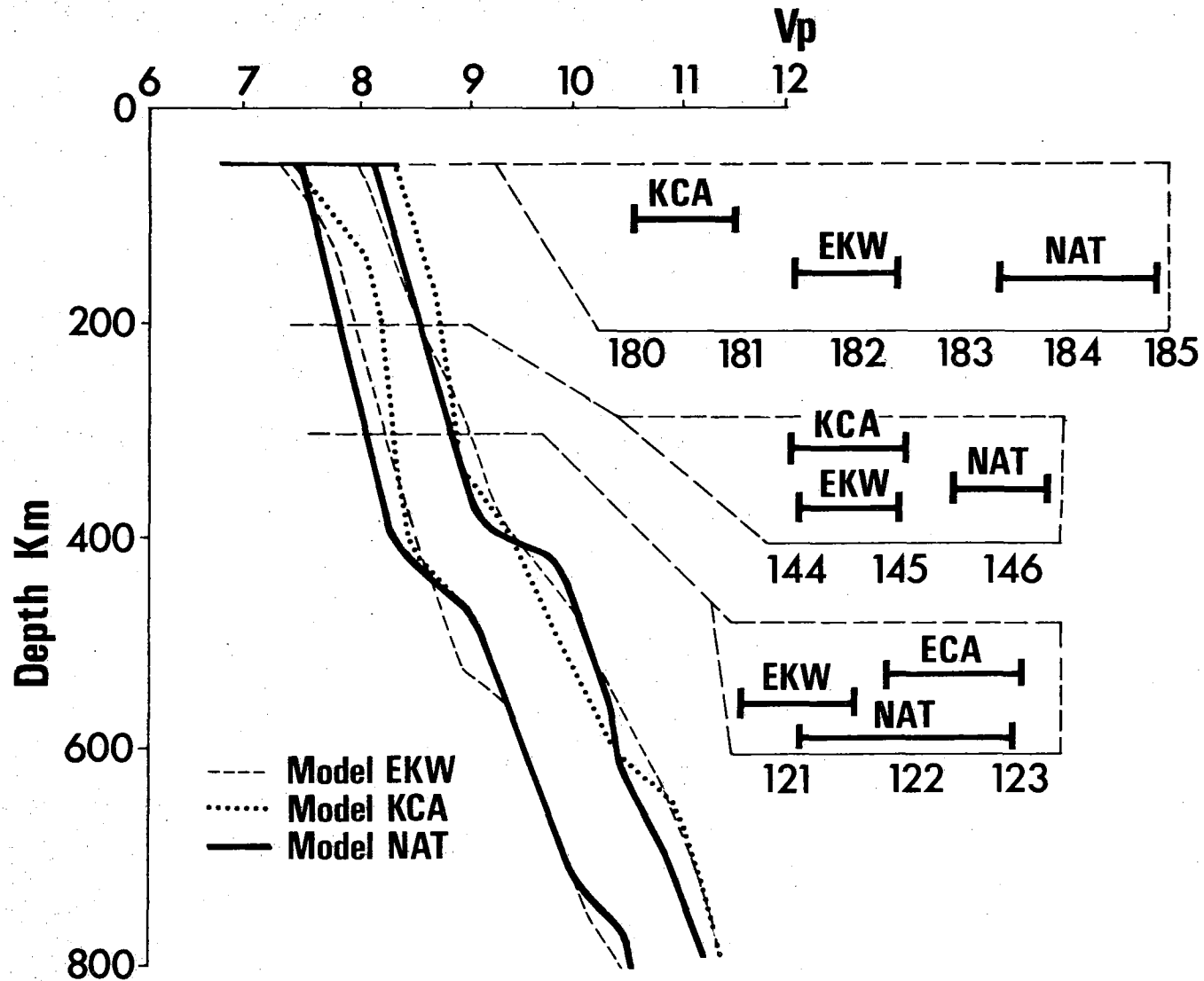


Fig. VI.4.2 Velocity depth models obtained by Wiechert-Herglotz inversion of the travel time curves for the regions of Western Russia, central and southern Europe and the North Atlantic. (Figure reproduced from England, Kennett and Worthington, 1977.)

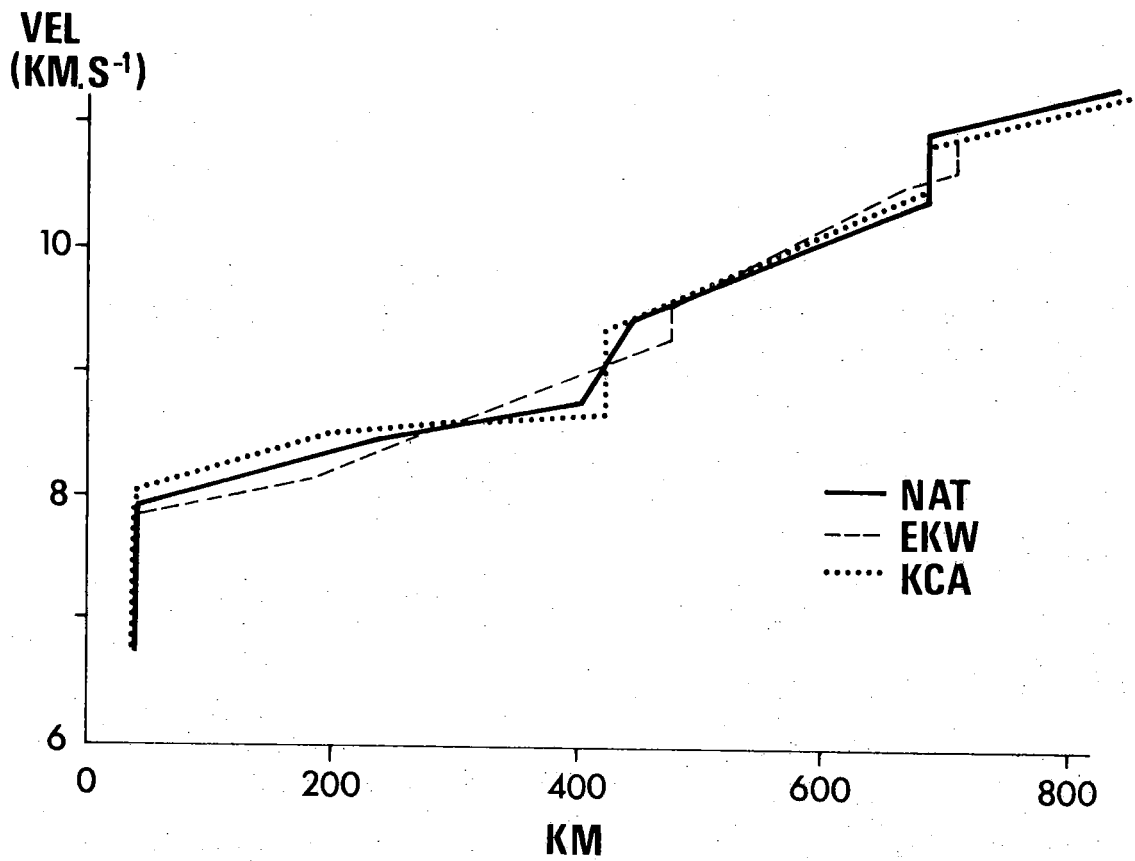


Fig. VI. 4.3 Velocity-depth bounds obtained by tau inversion of the three travel time curves represented in Fig. VI.4.1, and bounds on the two-way vertical transit times between 50 and 800 km, 200 and 800 km and 300 and 800 km for each pair of velocity-depth bounds. (Figure reproduced from England, Kennett and Worthington, 1977.)