In recent years, precise data on travel times for P and S waves, the spatial derivatives of these travel times, the equally accurate eigenperiods of the Earth, as well as surface wave dispersion, have become available (see, for example, Archambeau, Flinn & Lambert (1969), Whitcomb & D. L. Anderson (1970), and Kanamori (1970). The usefulness of these geophysical data has initiated numerous data inversions to obtain the unique elastic wave velocity and density distribution in the Earth. Among the more successful methods are the Monte Carlo techniques to develop families of possible solutions for the entire Earth. Press (1968, 1969, 1970a, b) presented a systematic development of these Monte Carlo solutions and established workable contraints for the earth models. Press (1970b) recently derived successful models for density and elastic wave velocity distributions in the Earth, using oceanic data.

The Monte Carlo solutions for the bulk sound velocity-density relation of the Earth's mantle, presented by Press (1970b), is reproduced in Fig. 9. Fig. 9 compares the density and bulk sound velocities found in this work with Press's solutions. In terms of Press's division of the mantle into three zones, we find for the second zone that the slopes of olivine and olive-transformed spinel with Fe/(Mg + Fe) ratios of about 0·05 to 0·15 are quite similar to large numbers of the Monte Carlo successful solutions in the region 150–870 km. These Fe/(Mg + Fe) ratios correspond to the mean atomic weight $\overline{m}$ of about 20·1 to 21·5 agreeing with the $\overline{m}$ limit set by Press. The olivine-spinel phase change at about 350 km is indicated in the velocity-density plot; the laboratory data on the bulk sound velocity-density plot are in accordance with the result of the Monte Carlo solutions.

If one accepts the present elasticity data as representative of olivine, one must then conclude, within the framework of a peridotitic model, that the olivine has the necessary equation-of-state properties to qualify as a likely candidate for mantle constituents.

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