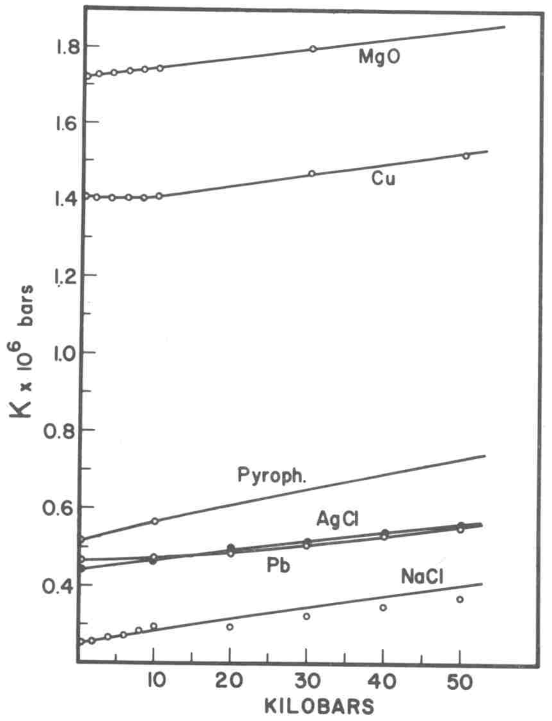

Fig. 6 High-pressure values of respective moduli of compression of materials shown. Points shown represent data taken from literature. References are given in text

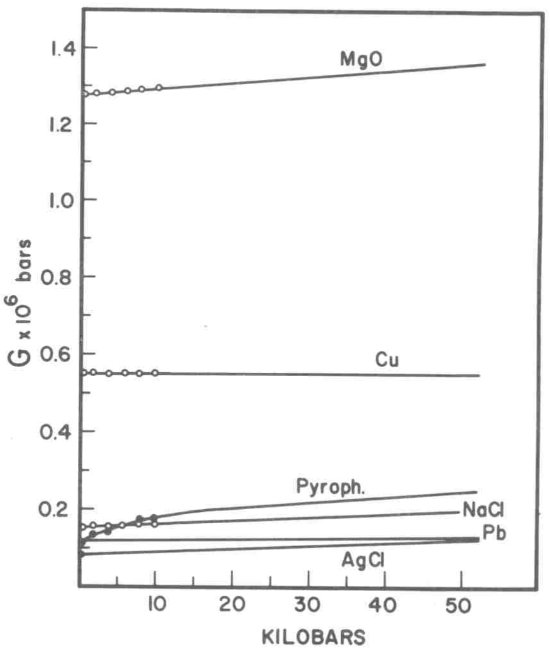

Fig. 7 Respective values of moduli of rigidity to approximately 50 kilobars for the materials shown. Points indicate experimental data taken from literature. References are given in text. Slopes for AgCl and Pb have been constructed by comparisons to those of NaCl and Cu, respectively

and lengths great compared to diameters and wall thicknesses in order for end effects to be negligible.

2 The materials are elastically isotropic.

3 The external stress is hydrostatic.

An approximate verification of the first assumption has been given by Love (8). The second assumption can be approximately satisfied with randomly oriented polycrystalline materials or single crystals with low mechanical anisotropy. The third assumption can be met by high-pressure fluid apparatus, and closely approximated by some solid devices such as the cubic multianvil press.

Numerical values of the pressure-difference ratio, P_e/P_i, have been calculated to 50 kilobars for a series of real systems composed of combinations of pyrophyllite ($H_2Al_2\,(SiO_3)_4$), halite ($NaCl$), periclase (MgO), and silver chloride ($AgCl$); solids commonly used in high-pressure work. Elastic data necessary for the calculations were obtained from the literature. In most cases, data to 50 kilobars were developed by linear extrapolation. Justification is based on the approximate linearity of respective moduli as established by the experiments of Bridgman (9), and the analyses of Murnaghan (10) and Birch (11) based on the finite strain theory of Murnaghan (12).

Values for the elastic constants of NaCl are those of Lazarus (13) to 10 kb. Elastic data for MgO (experimental to 4 kb and pressure derivatives beyond) are those of Anderson (14). The necessary constants for pyrophyllite have been approximated by taking the longitudinal wave velocities of Birch (15) and the tripled averaged linear compressibility reported by Bridgman (16). In view of the high anisotropy and inconsistency observed by Bridgman, the data for pyrophyllite are of very questionable validity. It has been included in the analysis only because of its almost universal use in high-pressure work. Hopefully, the results may at least serve to provide some idea of its behavior with respect to internal pressure differences.

The only elastic data available for silver chloride are the compressibility measurements of Bridgman (17), and the 1 bar constants of Hearmon (18). Here again, because of the widespread use of silver chloride, crude data have been used. The slope of the compressibility curve of AgCl has been used as a corrective guide to extract extrapolations of required elastic data from that available for NaCl. No rigorous justification exists, but the resulting data probably are sufficiently accurate for the purposes at hand.

Comparative summaries of experimental and

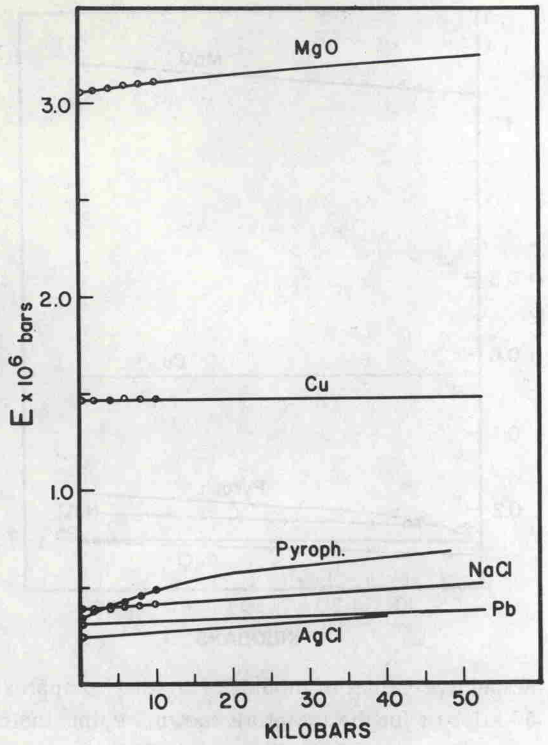

Fig. 8 Values for the respective Young's moduli of the materials shown to approximately 50 kilobars. Experimental data are indicated by points. References are given in text. Slopes for AgCl and Pb have been constructed by comparison to those of NaCl and Cu, respectively

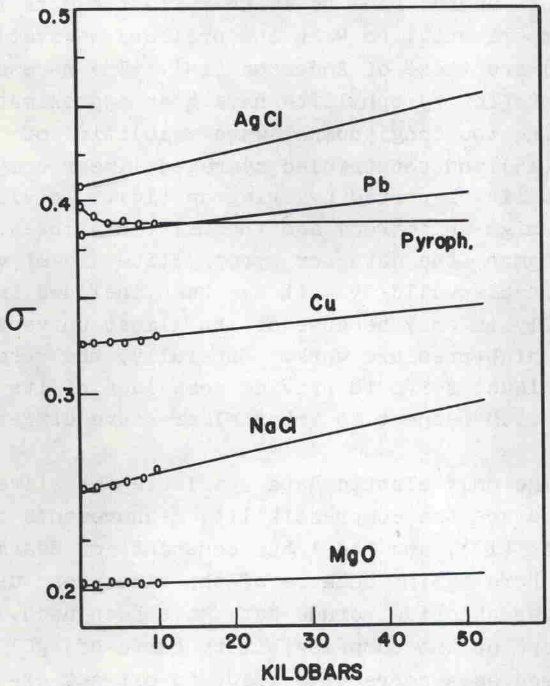

Fig. 9 Values of Poisson's ratios to approximately 50 kilobars for materials shown. Experimental data are indicated by points. References are given in text. Slopes for AgCl and Pb have been constructed by comparisons to those of NaCl and Cu, respectively

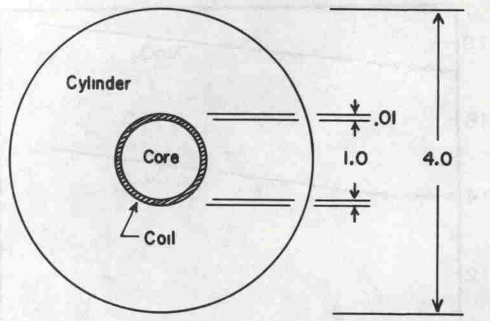

Fig. 10 A cross-sectional schematic of inductance-coil model used in alalysis of internal pressure differences which result from use of different materials in assembly

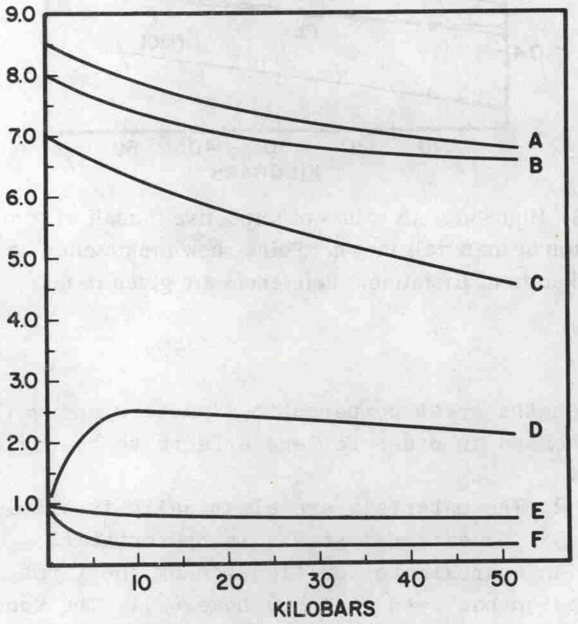

Fig. 11 The labeled curves represent following comparative ratios for equivalent cylinders of MgO and NaCl: Curve A = moduli of rigidity according to MgO/NaCl. Curve B = Young's moduli according to MgO/NaCl. Curve C = moduli of compression according to MgO/NaCl. Curve D = radial displacement, U_R, according to NaCl/MgO. Curve E = Poisson's ratios according to MgO/NaCl. Curve F = ratio P_i/P_e for the case of a solid cylinder core of NaCl enclosed by a cylindrical shell of MgO which in turn is subjected to an external hydrostatic pressure, P_e

extrapolated values of moduli of compression, K, rigidity, G, Young's moduli, E, and the Poisson ratio, σ, for the materials considered are given in Figs.6, 7, 8 and 9, respectively. A cross section of the inductive-coil assembly model is shown in Fig.10. Graphical summaries of elastic, displacement, and pressure-ratio data for representative compositional models are given in Figs.11,