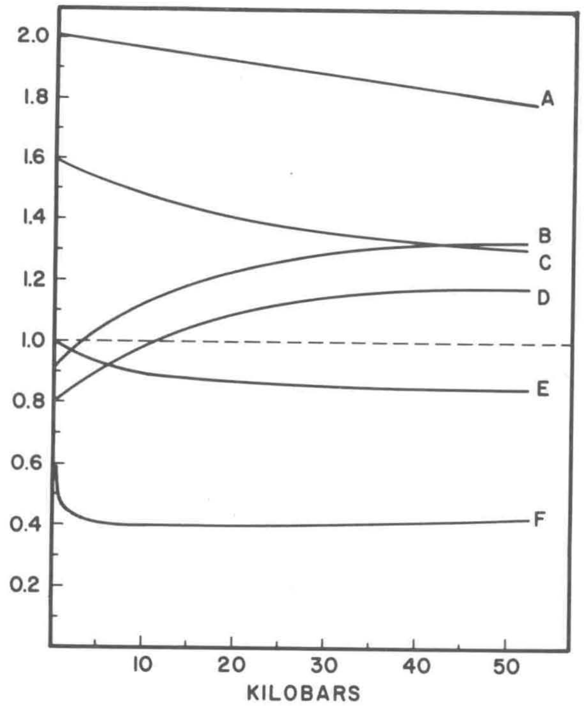

Fig. 12 Labeled curves represent following comparative ratios for equivalent cylinders of pyrophyllite and NaCl: Curve A = moduli of compression according to pyrophyllite/NaCl. Curve B = Poisson's ratios according to pyrophyllite/NaCl. Curve C = Young's moduli according to pyrophyllite/NaCl. Curve D = moduli of rigidity according to pyrophyllite/NaCl. Curve F = radial displacement, U_R, according to NaCl/pyrophyllite. Curve E = ratio P_i/P_e for case of a solid cylindrical core of NaCl enclosed by a pyrophyllite shell subjected to an external hydrostatic pressure, P_e

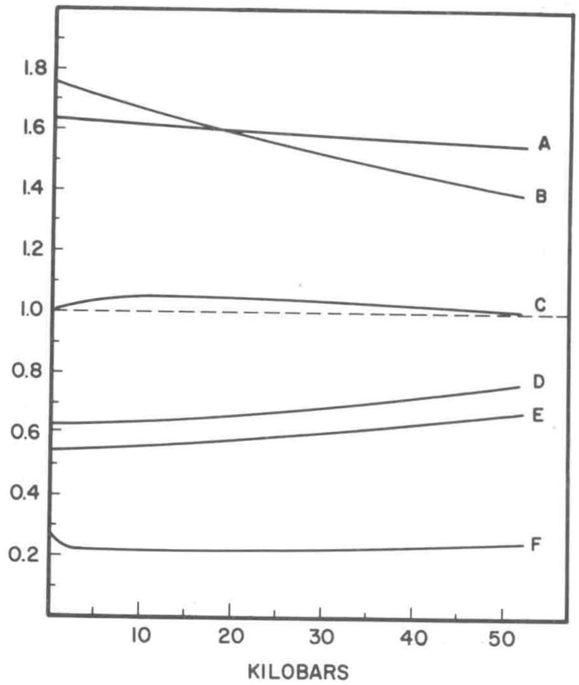

Fig. 13 Labeled curves represent following comparative ratios for equivalent cylinders of AgCl and NaCl: Curve A = Poisson's ratios according to AgCl/ NaCl. Curve B = moduli of compression according to AgCl/NaCl. Curve D = Young's moduli according to AgCl/NaCl. Curve E = moduli of rigidity according to AgCl/NaCl. Curve F = radial displacement, U_R, according to NaCl/AgCl. Curve C = ratio P_i/P_e for case of a solid cylindrical core of NaCl enclosed by a cylindrical shell of AgCl which is subjected to an external hydrostatic pressure, P_e

12, 13, 14, and 15. A summary of pressure-difference ratios is given in Fig.16.

Depending upon the combination of materials and respective elastic constants, calculated pressure-difference ratios for the model are found to yield enhancements of pressure upon the core as high as approximately 1.6 of the externally applied pressure, and degenerations as great as 0.3. The greatest rate of change is found to occur within the first 10 kilobars. The effect of the coil is negligible and was not included. The effect of dimensional change was not extensively explored, but it is easily seen that changes such as increasing the thickness of the enclosing shell would provide additional pressure enhancement, whereas reduction would produce an attenuation in internal pressure. The effects are limited to the differential yield limits of the materials in their environment.

As mentioned earlier, the basic assumption of elastic isotropy, and the doubtful extensions of elastic data qualify the results of this analysis as only approximations. The magnitude of the effect, however, clearly establishes this source of error as one of considerable potential.

One obvious solution is the use of mechanically homogeneous experimental assemblies. An understanding of the phenomenon, however, opens the door to advantageous exploitation of the effect. This has been demonstrated already by the "best experimental arrangement" selections used with the inductive-coil technique. Consistent agreements in data have been achieved on a variety of materials to within a surprisingly small margin by empirical dexterous balancing of dimensions and known material properties. Maximum quantitative utilization of the pressure-difference effect, whether for the measurement of compressibility by the inductive-coil technique, or in the interpretation of pressure-calibration data from the measurement of the electrical resistance of certain metals in wire or strip form, will require knowledge of the pressure derivatives of needed elastic constants.

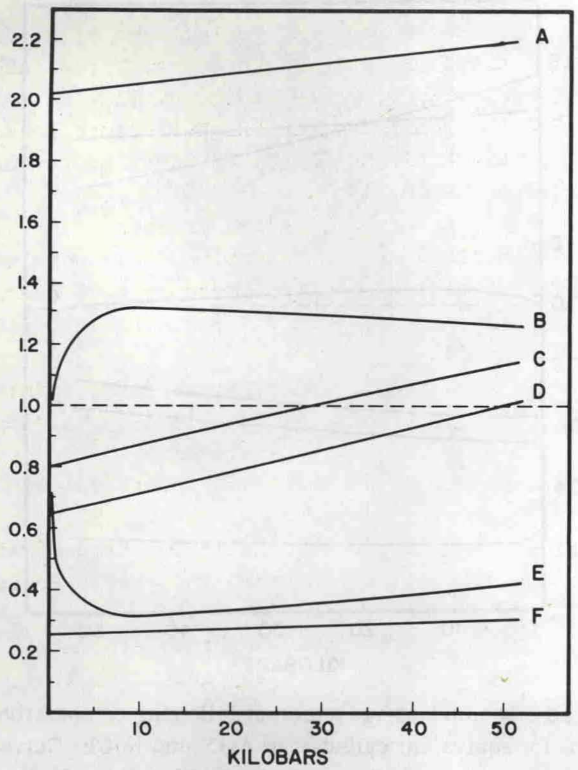

Fig. 14 Labeled curves represent following comparative ratios for equivalent cylinders of AgCl and MgO: Curve A = Poisson's ratios according to AgCl/MgO. Curve C = Young's moduli according to AgCl/MgO. Curve D = moduli of rigidity according to AgCl/MgO. Curve E = radial displacement, U_R, according to MgO/AgCl. Curve F = moduli of compression according to AgCl/MgO. Curve B = ratio P_i/P_e for case of a solid cylindrical core of MgO enclosed by a cylindrical shell of AgCl which is subjected to an external hydrostatic pressure, P_e

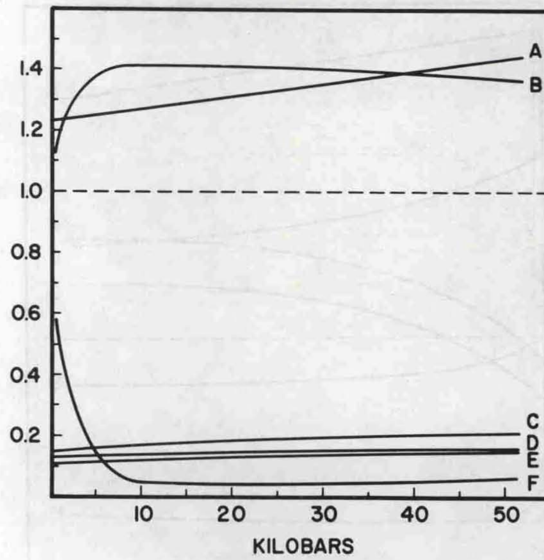

Fig. 15 Labeled curves represent following comparative ratios for equivalent cylinders of MgO and NaCl: Curve A = Poisson's ratios according to NaCl/MgO. Curve C = moduli of compression according to NaCl/MgO. Curve D = Young's moduli according to NaCl/MgO. Curve E = moduli of rigidity according to NaCl/MgO. Curve F = radial displacement, U_R, according to MgO/NaCl. Curve B = ratio P_i/P_e for case of a MgO solid cylindrical core enclosed by a NaCl cylindrical shell subjected to an external hydrostatic pressure, P_e

SUMMARY

The following principal internal sources of error of the inductive-coil technique have been treated:

(a) Mechanical tolerance between the coil wire and its receiving groove on the core.

(b) The effect of relative rigidities and yield strengths of core, coil, and enveloping solid.

(c) The generation of internal pressure differences as functions of differential elastic and dimensional values of the materials in the experimental system.

Inductive-coil technique models composed of combinations of MgO, NaCl, AgCl, and pyrophyllite have been analyzed by elastic theory on a semi-quantitative basis. Data on elastic properties, critical yield pressures, displacements and internal pressures as functions of external hydrostatic pressure, composition and geometry are given in graphical form. The existence, magnitude, and significance of inherent internal pressure differences in multicomponent solid systems has been established. Corrective measures for sources of error in the inductive-coil technique are given. Observance of recommended corrective measures is sufficient to permit potential absolute operational accuracies of 2 percent or better for the inductive-coil technique.

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REFERENCES

1 A. A. Giardini, E. H. Poindexter, and G. A. Samara, Journal of Basic Engineering, Trans. ASME, vol. 86, Series D, no. 4, 1964, p. 736.

2 A. A. Giardini, E. H. Poindexter, and G. A. Samara, Review of Scientific Instruments, vol. 35, no. 6, 1964, p. 713.