

DEPARTMENT OF EARTH AND PLANETARY SCIENCES

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Subject : Elastic Properties of Olivine: A Critical Look at  
the Geophysical Literature

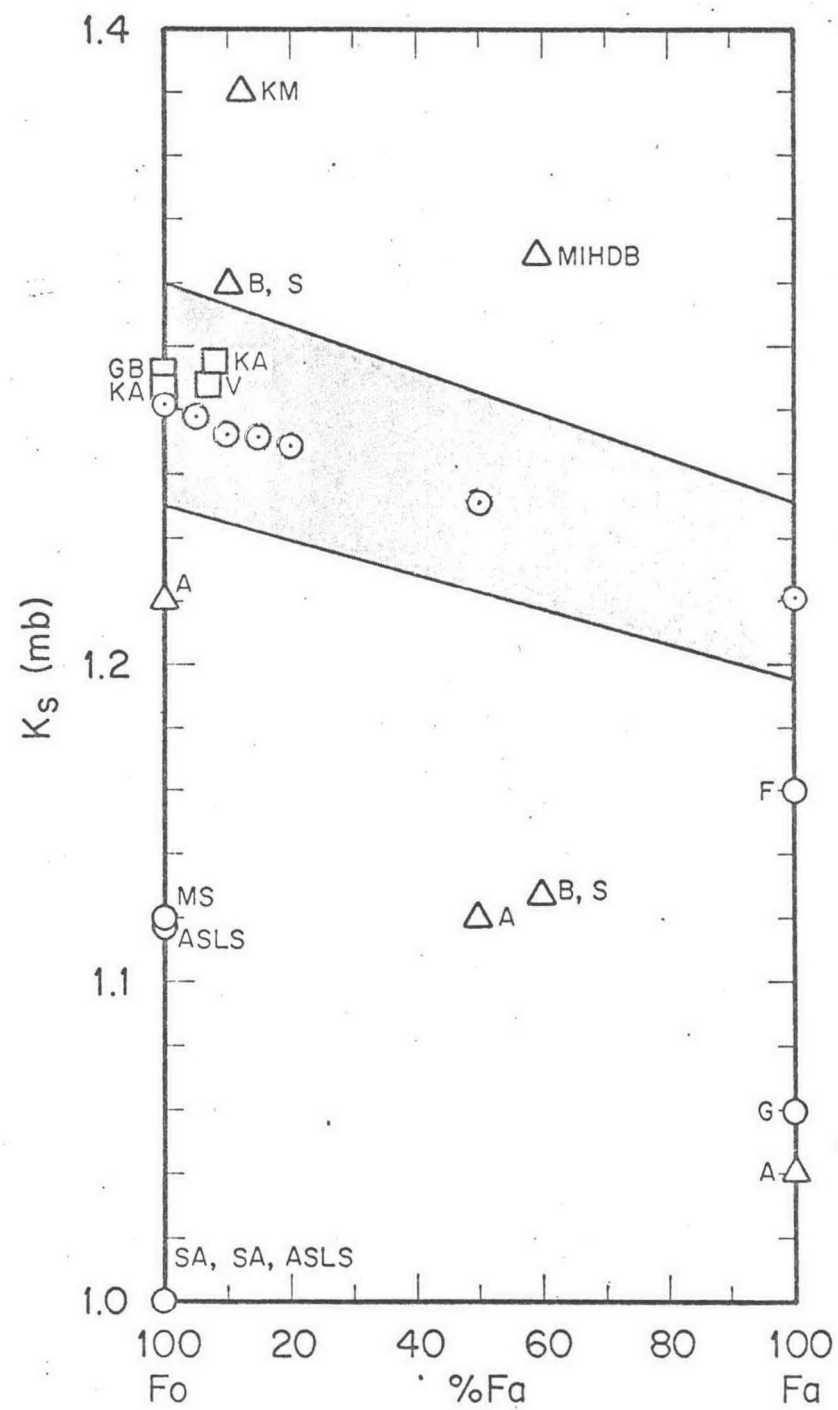
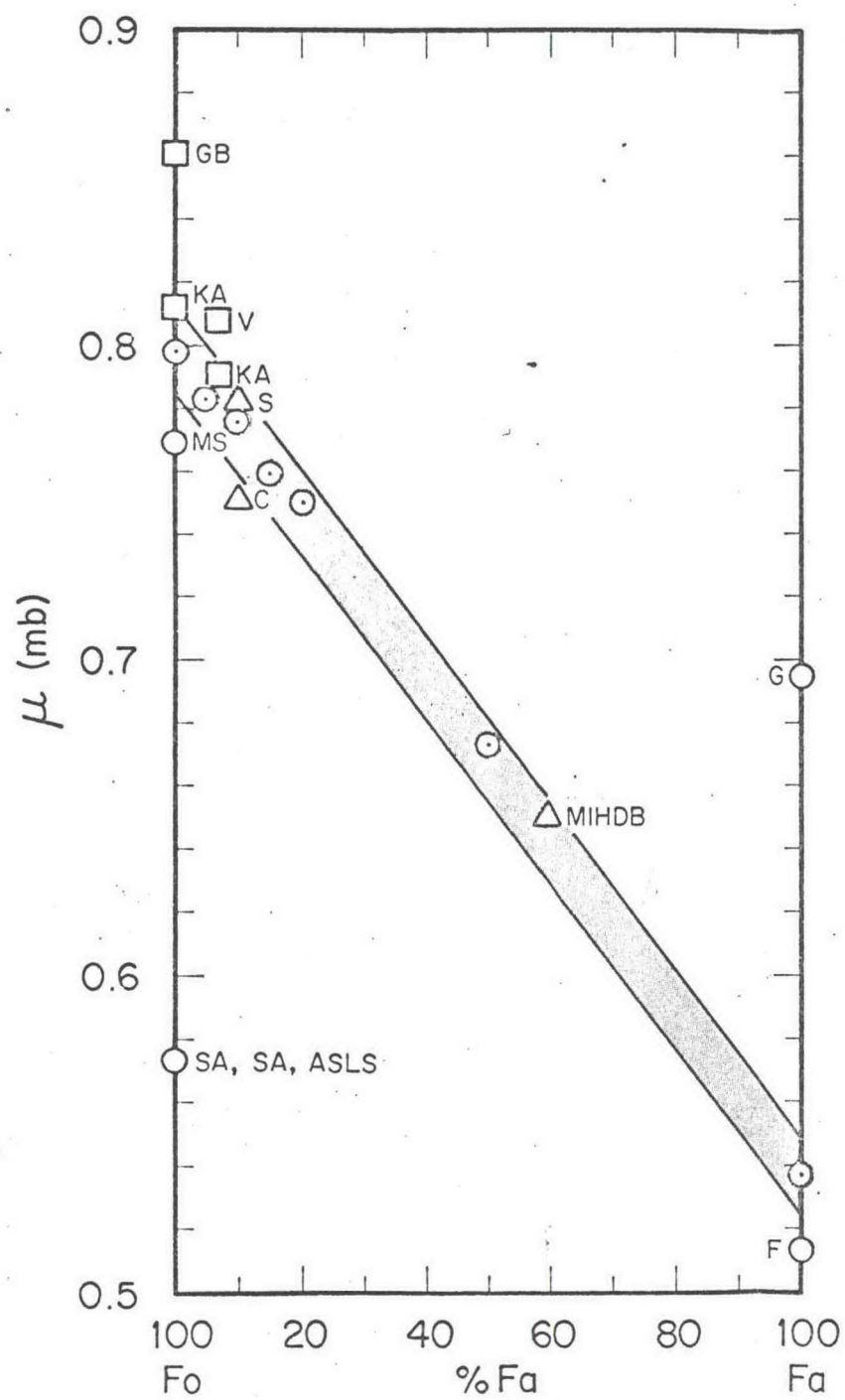
Date : December 1971

A perusal of geophysical literature concerning the elasticity of olivine and the constitution of the earth's mantle reveals a widespread range of the elastic properties of this material. The attached figure is a summary of all the literature data to date on the shear modulus  $\mu$  and the adiabatic bulk modulus  $K_s$  of olivine. Explanation of symbols used and reference to each datum point is herewith enclosed for your information.

Clearly shown is the fact that the state-of-the art report on the elasticity of olivine (an important mineral in geophysics) is undergoing a severe revision. Any further use of "old" data should be discouraged in the realistic discussion of the earth's mantle. All the earlier discussions relating the old elasticity data to the earth should be re-examined before being accepted.

Those data within the shaded area are still good, and they should have important applications to geophysics.

I hope this memorandum becomes of some use to you and your work related to "olivine" and discussion on the earth's mantle.



### Explanation of Symbols:

- △ designates the elasticity data obtained on olivine rock-samples.
- designates the elasticity data obtained on gem-quality olivine single-crystals.
- designates the elasticity data obtained on synthetic polycrystalline olivine samples. Our data (RE: JGR 75, 7353-7361, 1970) at MIT are shown with the symbols (⊙); Geophys. J. R. Astr. Soc. 25, 511-538 (1971).

### Reference Code:

- A: L.H. Adams (1931), Gerl. Beitr. Geophysik, 31, 315-321.
- B: F. Birch (1960a,b), JGR, 65, 1083-1102 and JGR, 66, 2199-2224.
- C: N.I. Christensen (1966), JGR, 71, 5921-5931.
- F: H. Fujisawa (1970), Trans AGU, 51, 418 (Abstract only).
- G: E.K. Graham (1970), Geophys. J., 20, 285-302.
- GB: E.K. Graham and G.R. Barsch (1969), JGR, 74, 5949-5960.
- KA: M. Kumasawa and O.L. Anderson (1969), JGR, 74, 5961-5972.
- KM: H. Kanamori and H. Mizutani (1965), Bull. Earthquake Res. Ins., (Japan), 43, 173-194.
- MIHDB: N. Mao, J. Ito, J.F. Hays, J. Drake, and F. Birch (1970), JGR, 75, 4071-4076.
- MS: S.P. Marsh and H. <sup>n</sup>Sheiberg (1969), AEC/ARPA Tech. Rept. no. 1124 (Los Alamos Scientific Laboratories).
- S: G. Simmons (1964), JGR, 69, 1123-1130.
- SA: E. Schreiber and O.L. Anderson (1967), JGR, 72, 762-764 and for corrections, see JGR, 72, 3751.
- SA: N. Soga and O.L. Anderson (1967), J. Am. Ceram. Soc., 50, 239-242.
- ASLS: O.L. Anderson, E. Schreiber, R.C. Liebermann, and N. Soga, (1968), Rev. Geophys., 6, 491-524.

### Note:

The shaded area corresponds to the maximum experimental errors assigned by D. H. Chung. The data points within the shaded area are acceptable, and they may be used in geophysical discussions.