

METHODOLOGICAL NOTES

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Reply to comment by V N Zharkov "On estimating the molecular viscosity of the Earth's outer core"

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Our paper, "Direct observations of the viscosity of Earth's outer core and extrapolation of measurements of the viscosity of liquid iron", (*Usp. Fiz. Nauk* **179** 91 (2009) [*Phys. Usp.* **52** 93 (2009)]) used gravimetry and nutation observation data to estimate the viscosity of Earth's outer core. While these estimates are surely open to critical analysis and discussion (as is any interpretation of indirect experimental data), we argue that their underlying data are consistent with the current understanding of physics of the Earth. The unexpectedly high values of the viscosity of Earth's core obtained from our data are consistent with earlier empirical estimates available for the viscosity of iron melt at megabar pressures.

In his paper, V N Zharkov does not question the seismic data we relied on in making our estimates and focuses instead on criticizing an Arrhenius type empirical model. In doing so, V N Zharkov uses estimates from his own, equally empirical, models as counterarguments. Without going into their detailed analysis here, note that the well-known vitrification of isothermically compressed molecular liquids clearly demonstrates the limited nature of these models. That hundreds of molecular liquids show a viscosity increase of more than ten orders of magnitude when isothermically compressed by 20–40 vol.% is at odds with V N Zharkov's formulas (C2) and (C6).

The only thing the comment argues — and this is where we fully agree with the author — is that using empirical models to extrapolate the viscosity of a liquid to a high pressure is a poor approach for achieving a definitive result.

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