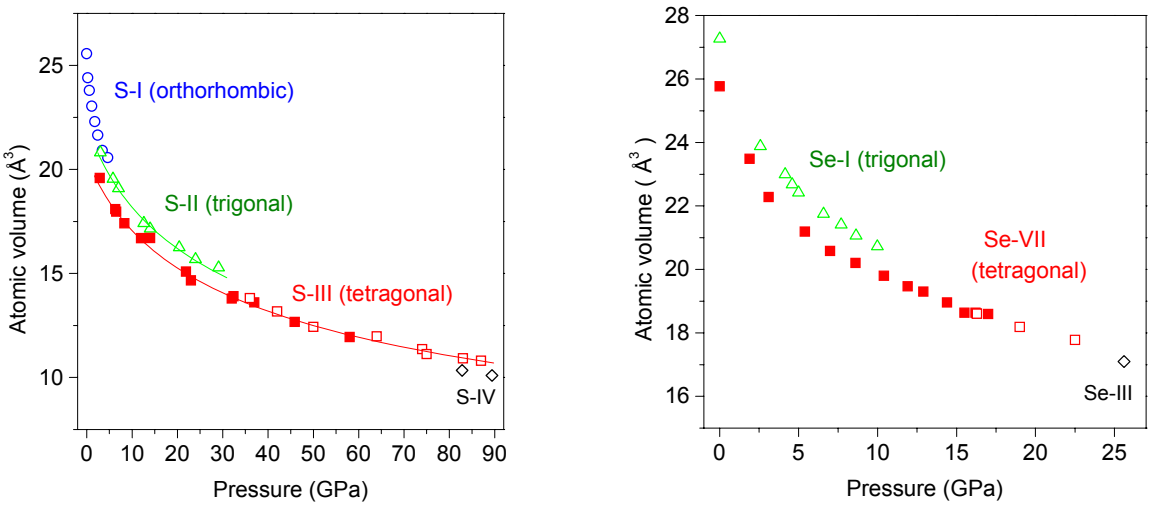

Supplementary Figure 1. **Equations of state for S and Se.** Data on S-I (blue circles), S-II (green triangles), S-III and Se-VII (red squares) are from present work. Data for Se-I (green triangles) are taken from Ref. [1]; data for S-IV and Se-III are taken from Ref [2] and [3], respectively. The data collected on pressure increase are shown with open symbols, data collected on pressure decrease are shown with solid symbols. The fitting of the pressure-volume data with the second-order Birch-Murnaghan equation of state (shown by solid lines) gives for S-II Ko= 34(2)GPa, V/Vo=0.867(1), and for S-III Ko=37(1)GPa, V/Vo=0.804(1), with Vo=25.56Å and Ko' = 4 for both phases. The volume difference between the S-II and S-III phases is 6.5% at 6.2 GPa, and between the Se-I and Se-VII phases, it is 5.6% at ambient pressure.

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[2] Y. Akahama, M. Kobayashi, H. Kawamura, Pressure-induced structural phase transition in sulfur at 83 GPa, *Phys. Rev. B* **48**, 6862 (1993).
[3] C. Hejny and M.I. McMahon, Complex crystal structures of Te-II and Se-III at high pressure, *Phys. Rev. B* **70**, 184109 (2004).