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# INFERRING SHALLOW MANTLE TEMPERATURES UNDER IRANIAN PLATEAU FROM INVERSION OF SHEAR-WAVE VELOCITY MODEL

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Temperature is one of the key parameters controlling the dynamics and rheology of the crust and upper mantle. Knowing the temperature distribution with depth can help interpret the origin of the density heterogeneities. Recent attempts have been made to infer thermal structure from seismic velocity model using forward modeling, derived from laboratory studies on crustal and mantle minerals or inverse approaches. In this study, we invert the shear wave velocities of the Iranian lithosphere (Namvaran et al., 2019-under review) into temperature using the thermodynamic modeling codes, to generate synthetic P and S-wave velocities corresponding to the physical conditions of the upper mantle. In this way, physical properties are computed at regular intervals within a chosen range of pressure (P) and temperature (T) by performing a Gibbs free-energy minimization to determine the mineral phase relations at each (P, T) point in the model. The numerical code computes the bulk elastic properties of the mineral assemblage via an equation of state (Connolly, 2005). We used the equation of state of Stixrude and Lithgow-Bertelloni (2005) based on Mie–Gruneisen formulation. This equation is suitable for the upper mantle depths and the composition inferred in terms of percentage of the main oxides ($Na_2O$–$CaO$–$FeO$–$MgO$–$Al_2O_3$–$SiO_2$, NCFMAS system) is consistent with that of a peridotite of Phanerozoic age (Lee, 2003). The choice of the composition is in agreement with the age of the Zagros and Alborz Mountains (<50 Myr), and the main tectonic features of the study area (Stern and Johnson, 2010). In this way, we obtained the stable mineral phases and temperature due to the anharmonic effect in the chosen range of P, corresponding at depths between 60 km and 200 km and T between 0 and 1800 °C (Figure 1). We also evaluated the anelasticity effect, by using a model, which is representative of an upper mantle characterized by average hydrous conditions (Cammarano et al., 2011), as that beneath the Iranian micro continent. By comparing the obtained synthetic velocities with the shear wave velocities (Namvaran et al., 2019-under review), we estimated the temperature in the upper mantle beneath the seismic stations located in west Zagros, Sanandaj-Sirjan Zone (SSZ) – Urumieh Dokhtar Magmatic Arc (UDMA) and Central Iran. Therefore, using the estimated relation between synthetic velocity and temperature (as illustrated in Figure 1), the 1D-velocity models beneath each seismic station is converted to temperature. Hence, we converted 8, 13 and 10 1D-velocity models for west Zagros, east Zagros, and Central Iran, respectively (Figure 2). The temperature distributions are consistent with those obtained by recent global thermal models (e.g., Cammarano et al., 2011). Furthermore, very hot shallow lithosphere (at depths between 80 to 120 km) is observed in correspondence of the SSZ and UDMA stations (1000-1100°C), which can likely reflect the effect of the magmatic activities occurred in this area.

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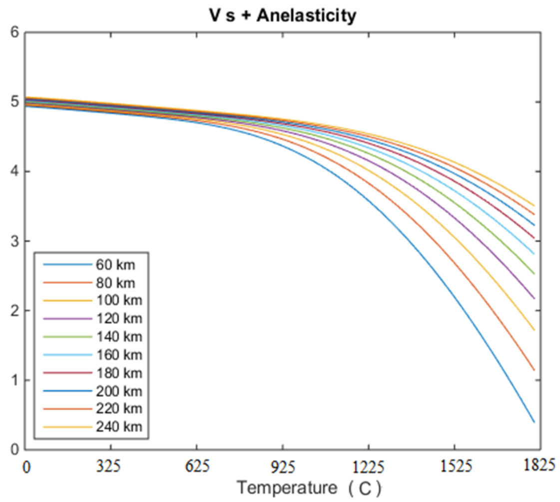


*Figure 1. Dependence of synthetic velocity on temperature, estimated considering the anharmonic (linear) and anelasticity (non-linear) effect. The anelasticity starts to have a significant effect on seismic velocities at temperature larger than 900 °C and grows with the temperature increase.*

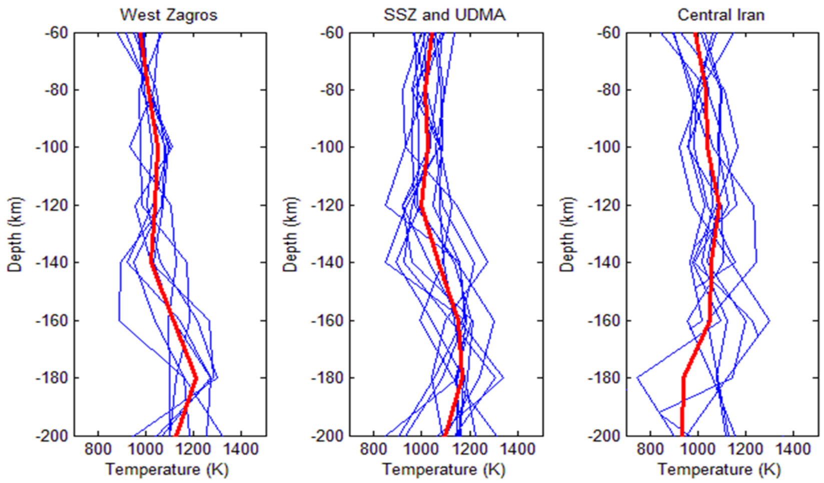


*Figure 2. Thermal model of upper mantle at a depth between 60 and 200 km obtained from inversion of 1D seismic velocity models beneath seismic stations located in west Zagros, east Zagros and Central Iran (blue lines). The red line shows the average thermal model.*