On mantle chemical and thermal heterogeneities and anisotropy as mapped by inversion of global surface wave data

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We invert global observations of fundamental and higher order Love and Rayleigh surface-wave dispersion data jointly at selected locations for 1D radial profiles of Earth's mantle composition, thermal state and anisotropic structure using a stochastic sampling algorithm. Considering mantle compositions as equilibrium assemblages of basalt and harzburgite, we employ a self-consistent thermodynamic method to compute their phase equilibria and bulk physical properties (P, S wave velocity and density). Combining these with locally varying anisotropy profiles, we determine anisotropic P and S wave velocities to calculate dispersion curves for comparison with observations. Models fitting data within uncertainties, provide us with a range of profiles of composition, temperature and anisotropy. This methodology presents an important complement to conventional seismic tomograpy methods.

Our results indicate radial and lateral gradients in basalt fraction, with basalt depletion in the upper and enrichment in the lower mantle, in agreement with results from geodynamical calculations, melting processes at mid-ocean ridges and subduction of a chemically stratified lithosphere. Compared with PREM and seismic tomography models, our velocity models are generally faster in the upper transition zone (TZ), and slower in the lower TZ, implying a steeper velocity gradient. While less dense than PREM, density gradients in the TZ are also steeper. Mantle geotherms are generally adiabatic in the TZ, whereas in the lower mantle stronger lateral variations are observed. The combined compositional/thermal variations showed up clearly in TZ structure, explaining lateral variations in location and size of the '410' and '660' that are observed in various seismological studies

The retrieved anistropy structure agrees with previous studies indicating positive as well as laterally varying upper mantle anisotropy, while there is little evidence for anisotropy in and below the TZ.

Lack of any strong compositional discontinuities, and associated thermal boundary layers, in the present study, is evidence in support of whole-mantle over layered-mantle convection.

Spatial distribution of Arsenic in groundwater and its impact on human health

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Introduction

It is now well recognized that people in Bangladesh are exposed to arsenic (As) primarily through the dietary ingestion pathway which includes intake principally through drinking As contaminated water.

Objective

The main objective of this study was to evaluate the dietary intake of As through drinking water and the consequential impact on human health.

Method

To achieve the research objective individual level water ingestion pattern was collected through an interviewer-administered food frequency questionnaire (FFQ) supported by simultaneous field sampling and subsequent laboratory analysis of As concentrations in drinking water. Dietary exposure and As contamination datasets were combined into a geo-spatial environment to assess spatial distribution of As contamination and its impact on human health.

Results and Discussions

The overall estimated mean HQ and carcinogenic risk were 27.59 (n=1022) and 7.72×10^{-3}, , which correspond to high chronic and carcinogenic risk, respectively. However, the population were at no significant health risk when their drinking water As concentration was < 10 μg L^{-1}. A significant relationship was observed between As concentration in drinking water and estimated risk ($R^2 = 0.71$, $p < .001$). The spatial distribution of As and risk varied significantly between individuals living in the same household and also between household located in a close proximity.