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## effects of chemical compositions, amount of water, and implications on gravity and topography

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# Seismic velocities - density relationship for the Earth's crust: effects of chemical compositions, amount of water, and implications on gravity and topography

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Seismic velocities – density relationship for the Earth's crust: effects of chemical compositions, amount of water, and implications on gravity and topography
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A good knowledge of the Earth's crust is not only important to understand its formation and dynamics, but also essential to infer mantle seismic structure, dynamic topography and location of seismic events. Global and local crustal models available (Bassin et al., 2000; Nataf & Ricard, 1996; Molinari & Morelli, 2011) are based on VP-density empirical relationships that do not fully exploit our knowledge on mineral phases forming crustal rocks and their compositions.

We assess the effects of various average crustal chemical compositions on the conversion from seismic velocities to density, also testing the influence of water. We consider mineralogies at thermodynamic equilibrium and reference mineral assemblages at given P-T conditions to account for metastability. Stable mineral phases at equilibrium have been computed with the revised Holland and Powell (2002) EOS and thermodynamic database implemented in Perple_X (Connolly 2005).

We have computed models of physical properties for the crust following two approaches, i) calculation of seismic velocities and density by assuming the same layers structure of the model CRUST 2.0 (Bassin et al., 2000) and a 3-D thermal structure based on heat-flow measurements; ii) interpretation of the Vp model reported in CRUST 2.0 to obtain density and shear wave velocity for the crustal layers, using the Vp-density relations obtained with the thermodynamic modeling.

The obtained density models and CRUST 2.0 one have been used to calculate isostatic topography and gravity field.

Our main results consist in, i) phase transitions have a strong effect on the physical properties of crustal rocks, in particular on seismic velocities; ii) models based on different crustal chemical compositions show strong variations on both seismic properties and density; iii) the amount of water is a main factor in determining the physical properties of crustal rocks, drastically changing the phase stability in the mineralogical assemblages; iii) the differences between the various density models that we obtained, and the variations between them and CRUST2.0, translate into strong effects for the calculated isostatic topography and gravity field.

Our approach, dealing directly with chemical compositions, is suitable to quantitatively investigate compositional heterogeneity in the Earth's crust.

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