Comprehensive lithospheric structures of France: joint inversion of seismic, gravity, and gradiometry data

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Résumé

French lithosphere, as a part of the Western Mediterranean region, encompasses a range of tectonic zones, each characterized by distinct geological histories and features, including the Armorican Massif in the west, the Paris Basin, the Upper Rhine Graben (URG) in the northeast, the Pyrénées range in the southwest, the Alps range in the southeast, and Corsica Island in the Mediterranean Sea. The geological evolution of France results from a sequence of major tectonic events, notably the Variscan orogeny (Paleozoic) and the Alpine orogeny (mid-Mesozoic to mid-Cenozoic), punctuated by an intense episode of extensional tectonics during the Mesozoic and Cenozoic. The French lithosphere is then characterized by a significant heterogeneity at scales of a few tens to a few hundreds of kilometres, presenting a challenge to image at the scale of the whole domain.
We present here a comprehensive model of lithospheric structures extending to 300 km beneath various tectonic domains in France, derived from a joint inversion approach, based on the EPOS-France datasets and that integrates seismology, gravity, and gradiometry.

Our analysis incorporates 27,935 relative travel time residuals sourced from the 193 French permanent seismic stations (EPOS-France), alongside 30,351 terrestrial gravity measurements and the complete gravity gradient tensor from GOCE satellite mission. The integration of these three complementary datasets enhances our understanding of lithospheric structures.
We will discuss our results in the light of previous local and regional studies, in particular in the Alps where the Ivrea body is well imaged between 10 and 40 km depth, and in the Massif Central, where a low-density low-velocity body is followed from the surface down to 80 km depth. We will present the benefit of combining long gradiometry wavelength with shorter terrestrial wavelength anomalies.

Mots-Clés: Lithospheric structures, Joint inversion, Tomography, Gravity, Gradiometry.

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