Thermochemical structure of Gondwana terrains from multi-observable probabilistic inversion

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Abstract

The supercontinent Gondwana broke up 200 Myrs ago in smaller continents known today as South America, Africa, India, Australia, Antarctica. In the last twenty years, extensive petrological, geochemical, and geophysical studies were done in Australia and South Africa. Still, models of the post-Gondwana lithospheric mantle evolution are constrained by sparse geochemical analysis and/or numerical modelling. Access to different scale geophysical datasets allow applying joint inversion framework to better constrain the present-day physical state of cratonic lithosphere.

Here we use a 3D multi-observable inversion method based on a probabilistic (Bayesian) formalism. This approach constrains the present-day thermochemical structure (temperature and major element composition) of the mantle using the sensitivity of multi-geophysical datasets within a thermodynamically consistent Bayesian framework, solved with state-of-the-art Markov Chain Monte Carlo algorithms. This presentation will show recent thermochemical tomography of central-southern Africa, Antarctica, South America, and Australia at a resolution of 1°x1°. We will show new thermal lithospheric thickness and the average chemical composition of the lithospheric mantle maps beneath these Gondwana terranes. We will discuss the evolution of cratonic lithosphere derived from our modelling and previously suggested by comparing it with external observables (xenolith/xenocrysts thermo-barometry analysis, hotspot tracks reconstruction, volcanism).

This contribution will address the following questions:

1. How thick, cold and depleted is the cratonic lithosphere beneath Gondwana terranes?
2. How did mantle plumes affect the thermochemical structure in the last 200 Myrs?
3. What can geophysical data and paleo reconstruction tell us about the evolution of the cratonic lithosphere?