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"Cold" intracratonic basins subside longer

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Intracratonic basins tend to subside much longer than the timescale predicted by thermal relaxation of the lithosphere. Many hypotheses have been suggested to explain their longevity, yet few have been tested using quantitative thermo-mechanical numerical model which capture the dynamic of the lithosphere. Modelling these basins is indeed a tough numerical problem because these basins display only few kilometers of subsidence over 1000 of km during period that exceed 300 Myr.
Using newly implemented mesh refinement and effective parallel numerical implementation of pTatin2D, it is now possible to design models at upper mantle scale with a resolution of 500 m at the surface.
Our study is mainly focused on the evolution of slow long-lived intracratonic basins (also called "cratonic basins", "interior cratonic basins" or "intracontinental sags") that forms above proterozoic accreted mobile belts. In these belts, different terranes both of cratonic and non cratonic origins have been accreted along large strike slip faults. Given the strike slip nature of the contact, it is very difficult to apriori assume the initial thermal state of the lithosphere at the moment of accretion. We therefore decided to use this parameter as a variable in our study.
The results of the numerical simulation show clearly that for warm initial thermal state, local isostatic re-equilibration of the terranes is achieved more rapidly than thermal re-equilibration of the lithosphere and basins subsidence stops at the end of the thermal subsidence like in regular basins. On the opposite, for colder initial thermal state, isostatic re-equilibration is only achieved regionally but the local isostatic potential survives to thermal re-equilibration.
In these conditions, the local isostatic potential is only consumed by preferential erosion of lighter blocks and preferential subsidence of the dense bloc at a rate that is controlled mainly by erosion sedimentation processes. For relatively well accepted coefficient of erosion of 1e-6 m2/s, the isostatic anomaly last longer than 300 Myr causing constant subsidence of the basins.
This process explains to first order the long-term subsidence of cratonic basins but does not capture well local acceleration of subsidence and uplift, which need to be accounted though external stimulations like new thermal events and far field tectonic stress variation. All these stimulations have different signature, which will be described at the end of the presentation.

Key words: Intracratonic basin, proterozoic accreted mobile belt, isostatic rebalancing, potential subsidence, hot thermic anomaly, cold thermic anomaly.