EGU2020-11435, updated on 08 Dec 2022
https://doi.org/10.5194/egusphere-egu2020-11435
EGU General Assembly 2020
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Non-lithostatic pressure in North American core complexes

Andrew Zuza[1], Drew Levy[1], Christopher Henry[2], Sean Long[1], and Seth Dee[1]
[1]Nevada Bureau of Mines and Geology, Unviersity of Nevada, Reno, Nevada, United States of America
[2]School of the Environment, Washington State University, Pullman, Washington, United States of America

The core complexes of western North America are generally thought to exhume deeply buried rocks (as much as 30 km) from the Cordilleran infrastructure, from beneath an inferred orogenic plateau to the surface today. However, how deep these rocks were buried has been intensely debated over the past three decades, especially for the Ruby Mountain-East Humboldt Range (RER) and northern Snake Range core complexes, eastern Nevada: published thermobarometry calculations, including robust modern techniques, suggest deep burial to 2-3x stratigraphic depths (as much as 30 km), whereas generations of field studies support burial only to roughly stratigraphic depths (~12-15 km). This has led to fierce debate that either field geologists are missing major structures or geobarometric estimates may neglect important considerations, such as reaction overstepping. Here we propose that a model of non-lithostatic conditions can resolve both field and petrologic datasets, and therefore the North American core complexes represent an example of tectonic overpressure. Western North America is covered by a remarkably well-characterized ~12-15-km-thick passive margin sequence that allows for careful structural reconstructions. Our observations focus on the RER geology, including new detailed geologic mapping (1:24,000 scale), structural traverses, thermochronology, and peak temperature (Tp) estimates. In particular, peak P-T conditions that suggest deep burial require (1) relatively low geothermal gradients of ≤20°C/km and (2) enigmatic structures that are not observed and would be atypical of other Cordilleran fold-thrust belts or even other analogous intra-plateau thrust systems. Instead, our Tp compilation (e.g., Raman spectroscopy of carbonaceous material, Conodont color alteration index, thermochronology) across continuous stratigraphy suggests high geothermal gradients (≥40°C/km) that are consistent with the region being extensively intruded and mineralized—i.e., the region underwent major Jurassic, Cretaceous, and Eocene intrusive episodes and hosts an Eocene(?) world-class Carlin-type gold deposit—and matches thermal gradients observed in other eastern Nevada studies and analogous orogens. Systematic mapping does not reveal any structural break across a section of Neoproterozoic to undeformed Permian passive margin strata that was supposedly deeply buried beneath an additional entire stratigraphic section. The approach of using a Tp traverse to test deep burial models allows for self-consistent evaluation of the data. That is, interpretations are based on a trend of temperature variations deduced from numerous measurements rather than relying on a single (or few) pressure data point(s). Our observations suggest that non-lithostatic pressure may have affected Cordilleran core complexes. We explore how the local rheologically heterogeneous rock types and specific tectonic setting may have created conditions favorable for tectonic overpressure in North

American core complexes. For example, paleo-stress estimates from across several shear zones demonstrate significant strength variations that may have facilitated mean stress (pressure) perturbations.