# Insights on Hadean Geodynamics from diamond stability constraints

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## Hadean Diamonds

The recent discovery of diamond inclusions in zircons of Hadean age (4.4-4.0Ga) poses a paradox. The zircons are preserved in younger (Archaean) assemblages in the Jack Hills, Western Australia. Their oxygen isotopes suggest they formed in shallow, probably hydrated, felsic magma chambers, at temperatures of ~680$^{o}$C [1, 2]. These shallow, hot conditions are not consistent with the stability of diamond. Recent examples of diamond inclusions in zircon come from ultra-high pressure massifs in Kazakhstan, where diamond replaced the original graphite [3].

A number of scenarios for exist for explaining their coexistence under Hadean conditions. We examine a number of tectonic scenarios, the most plausible involve some form of subduction, sagduction (vertical tectonism), or a whole-scale mantle overturn event.

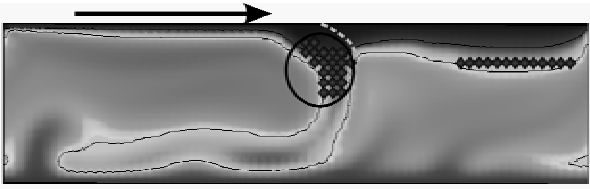

**Figure 1**: Finite element model of subduction under early conditions, showing the stability of diamonds in the downthrust lithosphere (circle) despite high surface heat flux.

## Geodynamic Simulations

We use a Lagrangian intergration point finite element method to recreate candidate scenarios for graphite->diamond conversion for thermal conditions appropriate for the Hadean. The PT path of near-surface zircons into the diamond stability field, and their exhumation to the surface, provides an important constraint on Hadean lithospheric dynamics. These scenarios have contemporary analogues in exhumed continental subduction zones such as western Norway. We discuss the key features and similarities of each geodynamic model, and summarize physically plausible models for the global Hadean tectonic regime.

[1] Menneken M. *et al*. (2007) *Nature* **448**, 917-920. [2] Mojzsis *et al.* (2001) *Nature* **409**, 178-181. [3] De Corte (2000) *Island Arc* **9**, 428-438.