Curtin University

Exploration Geodynamics & Earth’s Evolution:

Research frontiers, technology boundaries, & applications

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Whether or not the Earth has transitioned from an earlier archaic mode of tectonics, into modern plate tectonics, is one of the fundamental questions in geology.

Geodynamics simulations suggest a transition from an earlier stagnant-lid regime, to an ‘episodic’ mode characterized by repeated lid-overturn events, and finally into a later plate-tectonic regime.

This tectonic trajectory is finding support in modern geochemical, geophysical, and tectonic observations.

Problematically, though, is the recent suggestion that tectonic regime is not solely a function of the thermal state of a planet, but also of its history. Constraining Earth’s evolution, then, requires a better understanding of Earth’s initial thermal state and configuration.

The problem has economic consequences. World-class ore-deposits, such as Olympic Dam, for instance, are lithospheric-scale systems, and the tectonic evolution of the lithosphere, its construction, architecture, fluid pathways, and fluid flux events, are crucial to their development. The knowledge to understand, and predict, the next generation of large economic deposits is predicated on constraining the tectonics of the time, and the evolution of the lithosphere, and the dynamics of mantle fluids, under such a regime.
Three case studies will be presented which encapsulate both the frontier research, technical development, and applications of geodynamic simulations.

1. Summary of our recent work on the evidence, both from numerical simulations and ^{142}Nd measurements, to support stagnant-lid convection in the Hadean.
2. New and novel technique to calculate the interior state of an early accreting planet, using GPU-accelerated smooth-particle hydrodynamic simulations.
3. Demonstration of how the release of water from subducting slabs in various tectonic settings exerts a fundamental control on metallogenesis, and speculate on how this

9 am Thursday 12 February — Building 210 Room 104—Elizabeth Jolley Case Study Room