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# Short-term episodicity of Archaean subduction?

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The viability and style of plate tectonics in the early Earth has since long been debated. A basic ingredient for plate tectonics is the operation of subduction. Here, we combine geodynamically, petrological, and structural data and evidence to obtain better insight in this process. A hotter mantle leads to two features that are important for subduction dynamics: 1) viscosity is lower, leading to faster mantle motions, but also weaker lithospheric plates and 2) more melt is produced at spreading centers, which in a plate tectonic setting will lead to thicker buoyant oceanic crust and harzburgite layers. Although compositional buoyancy resulting from these thick crust and harzburgite might be a serious limitation for subduction initiation, modelling results show that eclogitization significantly relaxes this limitation for a developed, ongoing subduction process. The combined buoyancy and weakness of plates, however, results in the absence of the long-lived and stable subduction we observe today. Instead repeated slab break-off on a Myr to 10-Myr timescale and intermittent plate movement are the result.

The formation of the most common Archaean igneous rocks (tonalites, trondjemites and granodiorites, or TTGs) are commonly interpreted as the product of the deep melting of a mafic protolith such as a basalt under hydrous conditions; in some case, geochemistry suggests melting depth in excess of 20 kbar, such that melting of a subducting oceanic crust forms an attractive setting. But these ‘arc’-derived TTGs are commonly found near, and interstratified with, komatiites and tholeites that might have a more ‘plume’-like origin. In Western Abitibi, ‘arc’ and ‘plume’ events are recorded as short, discrete events of 5-10 Myr duration. In other cratons (East and West Pilbara, and Barberton), similarly short-lived ‘arc’ events of less than 20 Myr are recognized.

This short-lived, episodic subduction events are in contrast with the much longer lived subduction periods of the Phanerozoic. We propose that due to a change in the weakness and buoyancy of subducting slabs, the dominant subduction style changed from episodic subduction bursts with a Myr to 20-Myr duration to more smooth and long-lived subduction episodes in the Phanerozoic. This scenario also provides an explanation for the absence of ultrahigh-pressure metamorphism (UHPM) and blueschists in most of the Precambrian: early slabs were too weak to provide a mechanism for UHPM and exhumation.