Ultra-depletion of the mantle and the development of boninite on the initiation of subduction

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Boninite was amongst the earliest magma type produced when western Pacific subduction started beneath the Australian sector of East Gondwana at 514 Ma [1]. This was also true for parts of the Iapetus margin preserved in the Taconic Orogen in the Iapetus margin in the Appalachians of Newfoundland. Boninite is the product of low pressure, wet melting of refractory highly depleted harzburgite [2]. New Nd isotopic results reported suggest this refractory source existed for < 100Ma prior to the onset of subduction. A question is what is the origin of this highly depleted mantle?

Neoproterozoic and Early Cambrian rift-related mafic magmatism occurred repeatedly in the Gondwanan passive margin of the early Pacific [1,3]. These events formed depleted residual mantle whose declining density must have led to increased lithosphere-upper asthenosphere coupling. One can suggest there is a causal link between stagnant highly depleted mantle developed beneath the trailing passive continental margin, and localisation of subduction initiation and direct followed by boninite generation.

Based on the Mid Cambrian Heazelwood layered ultramafic cumulate complex in western Tasmania [4,5], this research suggests a link between mantle evolution during the pre-subduction passive margin stage and the generation of the refractory very low Ti, highly LREE-depleted source to the boninites. Using fresh CPX and primary magmatic amphibole in harzburgite and gabbro-norite samples, this work permits the resolution of the impact of pre-subduction mantle depletion and identifies the LIL influx associated with the production of the first fluids from the new slab.

References

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