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Origin of compositional variations of Taupo Volcanic Zone (TVZ) eruption products: crustal differentiation or subduction *mélange* diapirism?

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The Pleistocene to Holocene Taupo Volcanic Zone (TVZ) is dominated by felsic volcanism with more than 95% of the total eruptive volume corresponding to rhyolitic magmas. To generate such volumes of intermediate and felsic magma compositions, crustal assimilation and fractional crystallisation (AFC) of primary basalt has previously been invoked as a necessary means to generate the chemical and isotopic characteristics of these magmas; is it energetically possible that dominantly felsic volcanism is generated by AFC of a mafic magma in the TVZ? Here, we present a complete set of geochemical data from a suite of basaltic to rhyolitic samples representative of the entire TVZ with respect to geographical distribution and age. Major oxides, trace elements and Sr-Pb isotopic ratios were modelled for AFC using the energy- and mass-constrained Magma Chamber Simulator (MCS) and the local Permian to Early Jurassic Torlesse composite terrane basement as principal assimilant. We find that regardless of the intensive parameters employed, an energy- and mass-constrained model cannot realistically reproduce the required combined major oxide, trace element, and isotopic systematics of our sample set. At New Zealand's active margin, subduction erosion has been previously reported based on geophysical data. However, no links of crustal recycling by tectonic erosion to TVZ magmatism has been established to date. Lead isotopic ratios reveal a tight linear trend that cannot be reproduced by AFC with a Torlesse component. Instead, the Pb isotopic trend can be reproduced by two component mixing of (i) composite consisting of Torlesse subterrane (representative of eroded forearc crust) and global subducting sediments (GLOSS-II), and (ii) a primitive basalt, which represents the subarc mantle. We therefore propose that the compositional variations in TVZ volcanic products and the genesis of voluminous rhyolites are primarily linked to melting of subduction *mélange* diapirs as the source of this magmatism, with differentiation processes within the overriding crust being subordinate.