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Recycling early supracrustal metavolcanics to the lower crust by diapiric density inversion.

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Diapirism has regained favour as an explanation for the formation of Archean granite-greenstone terrains. We have modeled the diapiric inversion of felsic crust through an insulating layer of mafic volcanics using a moving mesh thermo-mechanical visco-elastic finite-element solver. Our results show that for a likely range of non-Newtonian rheologies, thermal parameters, and supracrustal volcanic thicknesses, diapiric inversion is an easy and geologically rapid process. In particular, we find that for altered komatiitic volcanic sequences (as seen in the field and predicted by Archean thermal models) and conservative thermal inputs, well-developed dome-and-keel structure can form in $\sim$ 10 Ma or less. In addition, we find that this process is an efficient mechanism for returning significant volumes of material to the lower crust. If true, this model provides an alternative to shallow subduction for emplacing source materials for TTG melts at lower crustal depths. We suggest that, given the ubiquity of dome-and-keel structures in Archean terrains, diapirism may have been a dominant crustal process in the even hotter geological setting of the Neo-Hadean and Meso-Archean . We speculate on what the predominance of such a mechanism implies for early crustal and lithospheric evolution.