Cold avalanche, “super subduction”, mantle overturn, followed by buoyant subduction of an oceanic plateau and the formation of TTG’s during the Eocene in Viti Levu, Fiji islands

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Tonalite, Trondhjemite, Granodiorite (TTG) rocks in Viti Levu, Fiji islands formed through hydrous melting of gabbroic oceanic crust at low-pressure amphibolite-facies conditions caused by flat subduction of an oceanic plateau from Yavuna creek. During mid Miocene time, magmatic underplating took place and a Qtz-diorite unit was formed out of the gabbro under granulite-facies conditions. The investigated TTG’s occur as stocks and veins within the older gabbroic unit of the Yavuna Pluton.

Zircon ages show the parental gabbro to be ~47.5 Ma in age, whereas the TTG’s, which can be subdivided into a tonalite and a Qtz-diorite suite, are ~37.1 Ma and ~16.5 Ma, old respectively. The average d¹⁸O value of ~4.8 in zircon selected from the parental gabbro and the tonalite suggest a very homogenous mantle source. However, about 50% of the analyzed zircons from the gabbroic and tonalitic rock samples showing lower d¹⁸O values, and these are interpreted as reflecting interaction of hydrothermally altered seafloor with the deep depleted mantle source. eHf in zircon values of ~13 in the analyzed TTG’s are interpreted as reflecting typical juvenile continental crust. PerpleX whole-rock calculations suggest that the tonalite formed by melting of the gabbro through decompression under water-saturated amphibolite-facies conditions at a temperature of ~770 °C and a pressure of ~3.8 kbar, whereas the Qtz-diorite formed at a temperature up to ~900 °C at very shallow depth close to the Earth's surface caused by the emplacement of a magmatic underplate during the mid Miocene. Our investigation provides new evidence for episodic growth of continental crust < 0.1 Ga in the South Pacific region.