**VESPA Dating Study Supplemental Files**

**Supplemental File 1.** Analytical methods. Details of sample preparation, and analytical instruments and procedures for whole rock analyses, and Ar/Ar, U/Pb and micropaleontological dating.

**Supplemental File 2.** Optical microscope image catalogue of all dated VESPA samples reported in this paper.

**Supplemental File 3**. Electron probe microanalysis information in support of Ar/Ar dating of the groundmass of eight VESPA samples. Comprises major element X-ray element maps and wavelength dispersive spot analyses of groundmass minerals.

**Supplemental File 4.** Petrographic observations, photomicrographs, K and Ca element maps, mineral and K-reservoir modes, argon spectra and interpretive comments for eight VESPA samples. Some data taken from Supplemental Files 2, 3 and 4.

**Supplemental File 5.** Summary table of all 49 individual mineral and/or groundmass Ar/Ar age results from the 33 rocks reported in Table 1 of the main paper. Information listed is dredge #, GNS Petrology collection #, UCSB irradiation #, interpreted igneous suite, sample location, rock description including Munsell colour, % vesicles, % phenocrysts, phenocryst minerals, % glass, groundmass minerals, qualitative alteration index (1=least, 3=most), alteration minerals, material dated, preferred (interpreted) age in Ma with two sigma error, % of spectrum gas on which preferred age is based, quality of interpreted age (A=best, D=worst), summary of plateau, isochron and total fusion ages, K/Ca range, % radiogenic gas and short comments on Ar-Ar spectrum.

**Supplemental File 6.** Raw Ar-Ar data tables, step-heating age spectra, K/Ca plots and isochron plots for all dated mineral and groundmass material listed in Supplemental File 5.

**Supplemental File 7.** Zircon cathodoluminescence images and U/Pb analytical data for DR26Fiii granite and DR15Cii sandstone.

**Supplemental File 8.** Micropaleontological report on VESPA dredge samples (Crundwell et al. 2016).