

A new $^{40}\text{Ar}/^{39}\text{Ar}$ eruption age for the Mount Widderin volcano, Newer Volcanic Province, Australia, with implications for eruption frequency in the region.

E. L. MATCHAN, E. B. JOYCE, AND D. PHILLIPS

School of Earth Sciences, The University of Melbourne, VIC 3010, Australia.

*Corresponding author: ematchan@unimelb.edu.au

SUPPLEMENTARY PAPERS

Australian Journal of Earth Sciences (2016) **63**,
<http://dx.doi.org/10.1080/08120099.2016.1156576>

Copies of Supplementary Papers may be obtained from the Geological Society of Australia's website (www.gsa.org.au), the Australian Journal of Earth Sciences website (www.ajes.com.au) or from the National Library of Australia's Pandora archive (<http://nla.gov.au/nla.arc-25194>).

SUPPLEMENTARY PAPERS

Table A1. ARGUSVI $^{40}\text{Ar}/^{39}\text{Ar}$ laser step-heating analytical results for NVP26 groundmass.

Table A2. $^{40}\text{Ar}/^{39}\text{Ar}$ ARGUSVI data and blank values for laser step-heating analysis of sample NVP26 excluding interference corrections.

Figure A1. $^{40}\text{Ar}/^{39}\text{Ar}$ age spectra and inverse isochron diagrams for individual NVP26 groundmass aliquants. Error symbols are 1σ . Grey symbols are excluded from age calculation results. In inverse isochron diagrams, solid lines represent preferred isochron results and dashed lines indicate position of inverse isochrons constructed from all data points. Step numbers are indicated.

Appendix B Supplementary information related to the contact between lava flows from Mount Widderin and Mount Elephant.

Table A1. ARGUSVI ⁴⁰Ar/³⁹Ar laser step-heating analytical results for NVP26 groundmass.^{a,b,c,d}

Sample ID	Step No	Laser Power	⁴⁰ Ar ±1σ (fA)	³⁹ Ar ±1σ (fA) ^b	³⁸ Ar ±1σ (fA)	³⁷ Ar ±1σ (fA) ^b	³⁶ Ar ±1σ (fA)	³⁹ Ar (x10 ⁻¹⁴ mol) ^d	Ca/K	±1σ	% ⁴⁰ Ar*	⁴⁰ Ar*/ ³⁹ Ar ±1σ	Cum.% ³⁹ Ar	Apparent Age (ka)	±1σ	±1σ (%)						
NVP26-1			101.3 mg																			
NVP26-1a	1	4%	345.50	0.08	63.788	0.045	0.1344	0.0006	99.1	2.9	0.7128	0.0031	0.2264	2.719	0.081	38.41	2.080	0.015	17.98	401.604	2.8	0.7
NVP26-1b	2	6%	501.14	0.22	105.177	0.043	0.1812	0.0008	132.7	3.0	0.9615	0.0043	0.3734	2.208	0.050	42.72	2.035	0.012	47.63	392.884	2.4	0.6
NVP26-1c	3	9%	530.49	0.13	104.603	0.076	0.2008	0.0006	138.7	4.1	1.0655	0.0029	0.3713	2.320	0.068	40.03	2.030	0.009	77.12	391.926	1.7	0.4
NVP26-1d	4	12%	316.81	0.07	52.986	0.037	0.1329	0.0004	88.9	3.1	0.7050	0.0022	0.1881	2.937	0.104	33.56	2.007	0.013	92.06	387.339	2.4	0.6
NVP26-1e	5	18%	279.59	0.07	28.168	0.046	0.1422	0.0003	110.9	1.8	0.7542	0.0016	0.1000	6.888	0.110	19.46	1.932	0.017	100.00	372.937	3.4	0.9
Total gas age: 391.8 ± 4.7 (2σ)																						
NVP26-2			71.5 mg																			
NVP26-2a	1	4%	645.08	0.34	106.061	0.078	0.2676	0.0006	173.3	2.5	1.4197	0.0031	0.3765	2.859	0.041	34.29	2.086	0.009	18.78	402.608	1.8	0.5
NVP26-2b	2	6%	702.98	0.29	144.297	0.108	0.2572	0.0004	191.8	2.0	1.3645	0.0023	0.5123	2.327	0.025	42.05	2.049	0.005	44.33	395.444	1.0	0.3
NVP26-2c	3	8%	563.02	0.16	117.904	0.060	0.2037	0.0006	142.5	2.3	1.0804	0.0031	0.4186	2.115	0.034	42.71	2.039	0.008	65.20	393.696	1.6	0.4
NVP26-2d	4	10%	450.09	0.10	86.882	0.030	0.1731	0.0006	113.1	4.0	0.9182	0.0032	0.3084	2.278	0.081	39.09	2.025	0.011	80.59	390.944	2.2	0.6
NVP26-2e	5	14%	447.18	0.12	65.464	0.035	0.1992	0.0004	133.7	2.3	1.0570	0.0021	0.2324	3.575	0.061	29.43	2.010	0.010	92.18	388.052	1.9	0.5
NVP26-2f	6	20%	341.33	0.09	30.637	0.042	0.1757	0.0005	139.1	2.6	0.9319	0.0027	0.1088	7.948	0.146	18.49	2.060	0.026	97.60	397.680	5.1	1.3
NVP26-2g	7	30%	199.01	0.06	13.555	0.032	0.1060	0.0004	99.1	2.3	0.5625	0.0019	0.0481	12.794	0.302	15.61	2.292	0.043	100.00	442.346	8.3	1.9
Total gas age: 396.1 ± 4.0 (2σ)																						
NVP26-3			76.0 mg																			
NVP26-3a	1	4%	399.93	0.13	68.267	0.040	0.1644	0.0004	101.9	2.4	0.8724	0.0021	0.2423	2.613	0.063	34.87	2.043	0.009	16.45	394.387	1.8	0.5
NVP26-3b	2	6%	516.57	0.33	103.661	0.042	0.1942	0.0005	136.2	2.1	1.0303	0.0025	0.3680	2.299	0.036	40.45	2.016	0.008	41.42	389.151	1.5	0.4
NVP26-3c	3	8%	430.47	0.18	89.732	0.060	0.1588	0.0005	109.2	2.2	0.8426	0.0027	0.3185	2.130	0.044	41.56	1.994	0.009	63.04	384.867	1.8	0.5
NVP26-3d	4	10%	325.98	0.08	64.475	0.052	0.1243	0.0004	85.5	2.0	0.6592	0.0019	0.2289	2.322	0.054	39.62	2.003	0.009	78.57	386.710	1.7	0.4
NVP26-3e	5	14%	340.29	0.08	52.219	0.043	0.1488	0.0005	100.8	3.2	0.7895	0.0028	0.1854	3.377	0.108	30.73	2.002	0.016	91.15	386.548	3.1	0.8
NVP26-3f	6	30%	445.42	0.07	36.739	0.068	0.2361	0.0005	185.6	2.7	1.2523	0.0028	0.1304	8.842	0.128	16.06	1.947	0.023	100.00	375.808	4.5	1.2
Total gas age: 387.2 ± 4.3 (2σ)																						
NVP26-4			101.1 mg																			
NVP26-4a	1	4%	632.41	0.24	108.707	0.046	0.2586	0.0008	172.1	2.5	1.3720	0.0043	0.3859	2.771	0.040	35.23	2.050	0.012	19.72	395.637	2.3	0.6
NVP26-4b	2	6%	723.03	0.30	152.589	0.092	0.2607	0.0005	197.1	1.6	1.3828	0.0028	0.5417	2.260	0.019	42.90	2.033	0.006	47.40	392.419	1.1	0.3
NVP26-4c	3	8%	571.53	0.17	122.726	0.065	0.2054	0.0006	143.8	2.1	1.0895	0.0031	0.4357	2.051	0.030	43.09	2.007	0.008	69.67	387.349	1.5	0.4
NVP26-4d	4	10%	398.11	0.12	76.565	0.041	0.1559	0.0005	92.6	3.0	0.8271	0.0025	0.2718	2.116	0.070	37.97	1.974	0.010	83.56	381.126	1.9	0.5
NVP26-4e	5	14%	427.80	0.09	58.687	0.036	0.1977	0.0004	129.7	2.8	1.0487	0.0021	0.2083	3.868	0.084	26.82	1.955	0.011	94.21	377.346	2.1	0.6
NVP26-4f	6	30%	486.47	0.19	31.927	0.036	0.2690	0.0008	215.2	2.3	1.4270	0.0041	0.1133	11.798	0.128	12.42	1.892	0.039	100.00	365.248	7.5	2.0
Total gas age: 387.2 ± 4.1 (2σ)																						
NVP26-5			101.0 mg																			
NVP26-5a	1	4%	740.37	0.26	128.485	0.073	0.3001	0.0007	208.2	3.1	1.5920	0.0037	0.4561	2.836	0.042	35.80	2.063	0.009	22.89	398.219	1.7	0.4
NVP26-5b	2	6%	783.34	0.27	168.031	0.077	0.2798	0.0007	206.6	1.3	1.4843	0.0035	0.5965	2.152	0.013	43.43	2.025	0.007	52.83	390.826	1.3	0.3
NVP26-5c	3	8%	575.39	0.10	121.589	0.051	0.2090	0.0005	141.9	2.6	1.1088	0.0025	0.4316	2.043	0.037	42.47	2.010	0.006	74.50	387.942	1.2	0.3
NVP26-5d	4	10%	391.34	0.08	71.175	0.049	0.1575	0.0006	102.9	4.8	0.8358	0.0029	0.2527	2.529	0.118	36.24	1.992	0.012	87.18	384.597	2.4	0.6
NVP26-5e	5	14%	408.08	0.10	47.829	0.035	0.1968	0.0006	135.1	2.7	1.0439	0.0031	0.1698	4.944	0.098	23.63	2.016	0.019	95.70	389.134	3.7	1.0
NVP26-5f	6	30%	414.33	0.13	24.106	0.043	0.2322	0.0004	187.5	3.7	1.2321	0.0024	0.0856	13.612	0.270	11.22	1.928	0.030	100.00	372.221	5.8	1.6
Total gas age: 390.2 ± 3.8 (2σ)																						

^a Data are corrected for mass spectrometer backgrounds, discrimination, radioactive decay and interference corrections (see Table A.2 for values excluding the interference correction). Errors are one sigma uncertainties and exclude uncertainty in the J-value.

^b Interference corrections: (³⁶Ar/³⁷Ar)_{Ca} = (2.5713 ± 0.0023) × 10⁻⁴; (³⁹Ar/³⁷Ar)_{Ca} = (6.6200 ± 0.0801) × 10⁻⁴; (⁴⁰Ar/³⁹Ar)_K = (1.00 ± 0.05) × 10⁻¹⁰; (³⁸Ar/³⁹Ar)_K = (1.2136 ± 0.0016) × 10⁻²

^c J-value is 0.0001070135 ± 0.0000000648 (0.061%;1σ), based on an age of 1.1811 ± 0.0006 Ma (1σ) for AC sanidine (Phillips et al., submitted)

^d Sensitivity = 3.55 × 10⁻¹⁷ mol/fA

Table A1. ARG

		Background correction										
Sample ID	Step No	Blank no.	⁴⁰ Ar ±1σ (fA)	³⁹ Ar ±1σ (fA)	³⁸ Ar ±1σ (fA)	³⁷ Ar ±1σ (fA)	³⁶ Ar ±1σ (fA)					
NVP26-1												
NVP26-1a	1	EXB#74	7.276	0.011	0.085	0.019	-0.121	0.043	0.020	0.027	0.03095	0.00053
NVP26-1b	2	EXB#75	7.787	0.024	0.056	0.017	-0.055	0.030	-0.002	0.032	0.03330	0.00021
NVP26-1c	3	EXB#75	7.787	0.024	0.056	0.017	-0.055	0.030	-0.002	0.032	0.03330	0.00021
NVP26-1d	4	EXB#76	7.792	0.013	0.086	0.022	-0.062	0.020	0.025	0.011	0.03381	0.00035
NVP26-1e	5	EXB#76	7.792	0.013	0.086	0.022	-0.062	0.020	0.025	0.011	0.03381	0.00035
NVP26-2												
NVP26-2a	1	EXB#82	3.336	0.016	0.060	0.018	-0.008	0.021	-0.014	0.015	0.01726	0.00011
NVP26-2b	2	EXB#82	3.336	0.016	0.060	0.018	-0.008	0.021	-0.014	0.015	0.01726	0.00011
NVP26-2c	3	EXB#83	3.393	0.019	0.092	0.017	-0.003	0.020	-0.009	0.015	0.01881	0.00014
NVP26-2d	4	EXB#83	3.393	0.019	0.092	0.017	-0.003	0.020	-0.009	0.015	0.01881	0.00014
NVP26-2e	5	EXB#83	3.393	0.019	0.092	0.017	-0.003	0.020	-0.009	0.015	0.01881	0.00014
NVP26-2f	6	EXB#84	3.429	0.010	0.102	0.022	-0.044	0.022	0.020	0.014	0.01812	0.00036
NVP26-2g	7	EXB#84	3.429	0.010	0.102	0.022	-0.044	0.022	0.020	0.014	0.01812	0.00036
NVP26-3												
NVP26-3a	1	EXB#89	2.515	0.025	0.081	0.008	-0.083	0.017	0.035	0.014	0.01532	0.00035
NVP26-3b	2	EXB#89	2.515	0.025	0.081	0.008	-0.083	0.017	0.035	0.014	0.01532	0.00035
NVP26-3c	3	EXB#89	2.515	0.025	0.081	0.008	-0.083	0.017	0.035	0.014	0.01532	0.00035
NVP26-3d	4	EXB#90	2.707	0.029	0.092	0.023	-0.093	0.012	0.012	0.012	0.01736	0.00047
NVP26-3e	5	EXB#90	2.707	0.029	0.092	0.023	-0.093	0.012	0.012	0.012	0.01736	0.00047
NVP26-3f	6	EXB#90	2.707	0.029	0.092	0.023	-0.093	0.012	0.012	0.012	0.01736	0.00047
NVP26-4												
NVP26-4a	1	EXB#91	3.219	0.017	0.088	0.022	-0.079	0.036	-0.012	0.013	0.01936	0.00012
NVP26-4b	2	EXB#91	3.219	0.017	0.088	0.022	-0.079	0.036	-0.012	0.013	0.01936	0.00012
NVP26-4c	3	EXB#91	3.219	0.017	0.088	0.022	-0.079	0.036	-0.012	0.013	0.01936	0.00012
NVP26-4d	4	EXB#92	3.523	0.014	0.081	0.004	-0.067	0.026	0.051	0.019	0.02015	0.00044
NVP26-4e	5	EXB#92	3.523	0.014	0.081	0.004	-0.067	0.026	0.051	0.019	0.02015	0.00044
NVP26-4f	6	EXB#92	3.523	0.014	0.081	0.004	-0.067	0.026	0.051	0.019	0.02015	0.00044
NVP26-5												
NVP26-5a	1	EXB#94	2.449	0.015	0.036	0.017	-0.051	0.013	-0.023	0.007	0.01431	0.00031
NVP26-5b	2	EXB#94	2.449	0.015	0.036	0.017	-0.051	0.013	-0.023	0.007	0.01431	0.00031
NVP26-5c	3	EXB#94	2.449	0.015	0.036	0.017	-0.051	0.013	-0.023	0.007	0.01431	0.00031
NVP26-5d	4	EXB#95	2.554	0.027	0.081	0.010	-0.040	0.011	0.018	0.020	0.01585	0.00021
NVP26-5e	5	EXB#95	2.554	0.027	0.081	0.010	-0.040	0.011	0.018	0.020	0.01585	0.00021
NVP26-5f	6	EXB#95	2.554	0.027	0.081	0.010	-0.040	0.011	0.018	0.020	0.01585	0.00021

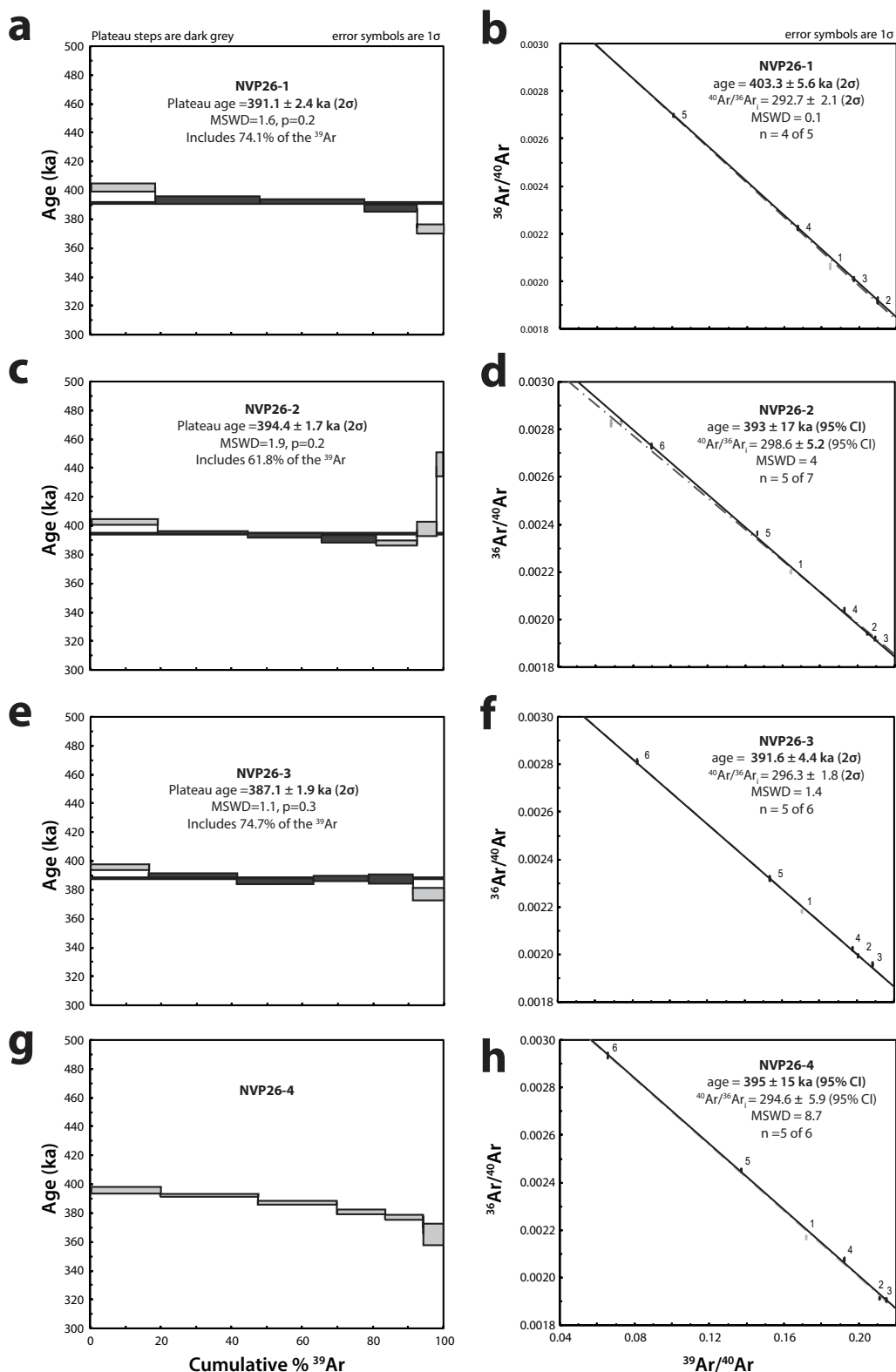


Figure A1. $^{40}\text{Ar}/^{39}\text{Ar}$ age spectra and inverse isochron diagrams for individual NVP26 groundmass aliquants. Errors symbols are 1 σ . Grey symbols are excluded from age calculation results. In inverse isochron diagrams, solid lines represent preferred isochron results and dashed lines indicate position of inverse isochrons constructed from all data points. Step numbers are indicated.

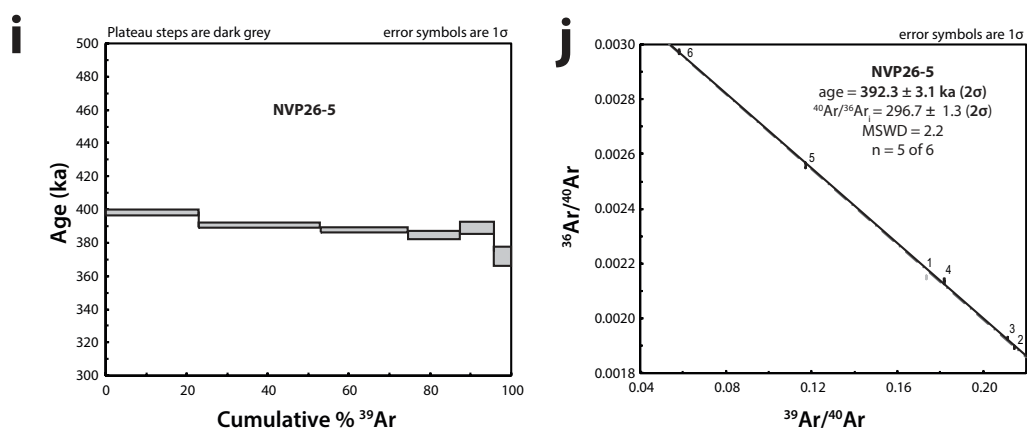


Figure A1 (cont.). $^{40}\text{Ar}/^{39}\text{Ar}$ age spectra and inverse isochron diagrams for individual NVP26 groundmass aliquants. Errors symbols are 1σ. Grey symbols are excluded from age calculation results. In inverse isochron diagrams, solid lines represent preferred isochron results and dashed lines indicate position of inverse isochrons constructed from all data points. Step numbers are indicated.

APPENDIX B

Supplementary information related to the contact between lava flows from Mount Widderin and Mount Elephant.

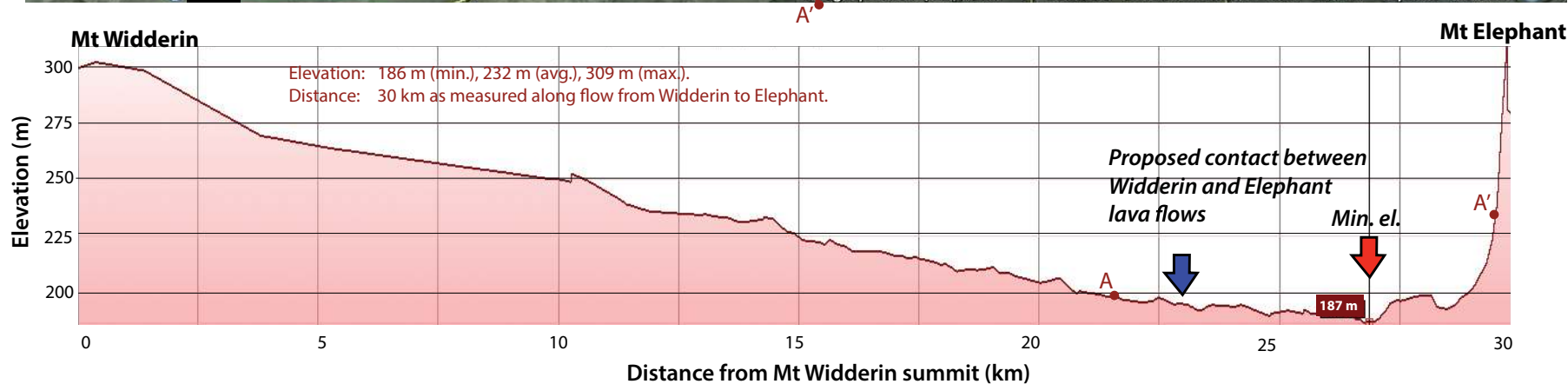
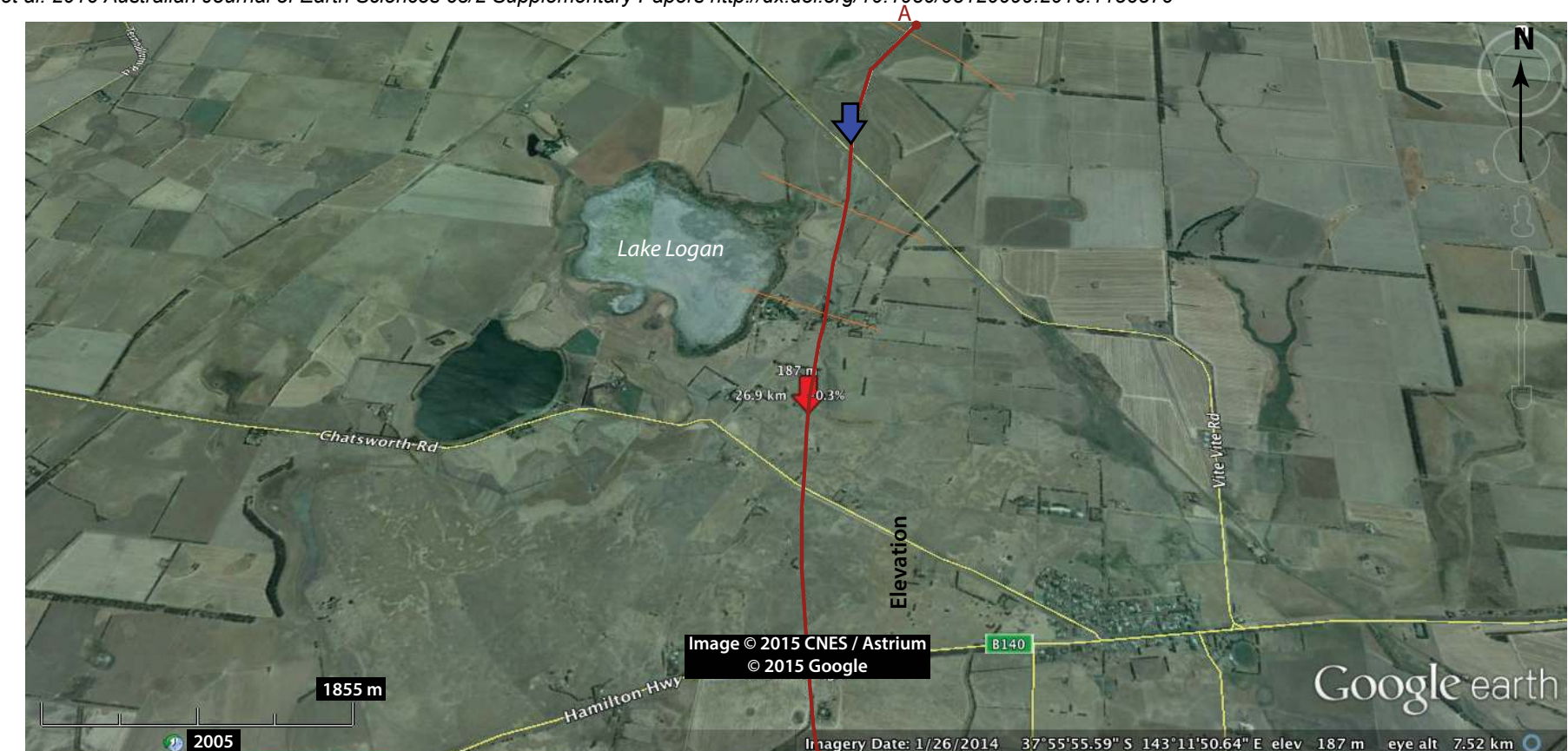


Figure B1. Satellite image (GoogleEarth) of area containing the southernmost extent of the main Widderin basalt flow and the northernmost extent of stony rises from Mt Elephant. Red line indicates location of topographic section. The topographic section is taken from the summit of Mt Widderin to Mt Elephant, tracing the path of the main Widderin flow. Vertical exaggeration is 50x. The location of the observed termination of the Widderin basalt is indicated by blue arrow (north of Vite Vite Rd, see Fig B2).

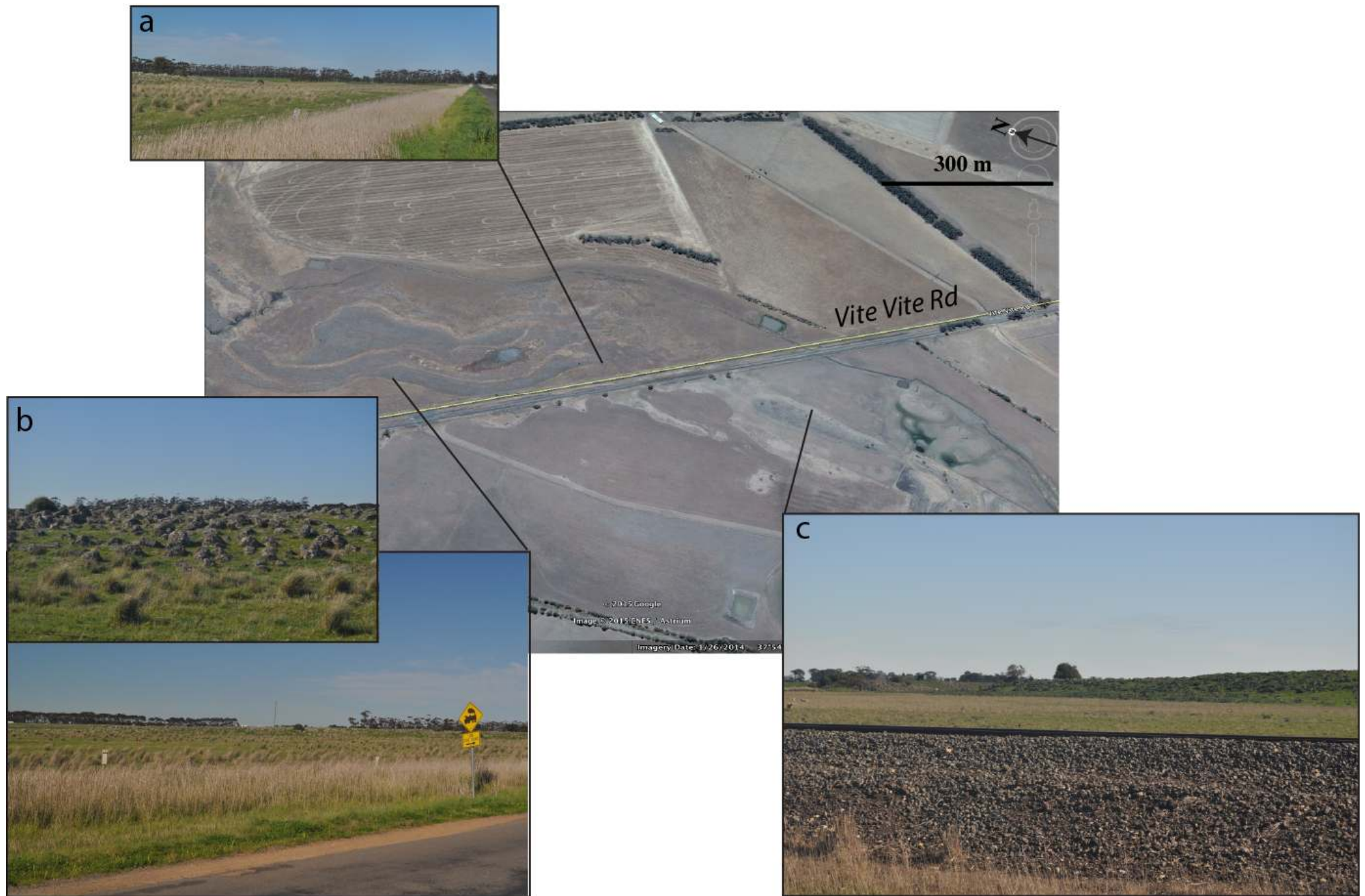


Figure B2. Contact between Widderin and Elephant lava flows, Vite Vite Rd (main image: GoogleEarth). Inset image: **(a)** End of Widderin stony rises (looking NE), basalt visibly extends along plain past end of stony rise for ~50m before being obscured by soil/swamp sediments; **(b)** Widderin stony rises (looking NNE) exhibiting rounded lava blocks; **(c)** Elephant stony rises (looking NW).