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Supporting Information for

U-Pb age constraints on the Jurassic succession and paleoflora of Mount Flora, Antarctic Peninsula

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Introduction

Supporting information includes field and laboratory lithological descriptions of the ·"tuffaceous interval" of Mount Flora Formation, Botany Bay Group, Antarctic Peninsula, used for interpreting the depositional processes and the sedimentary environments of this part of the column, as well as petrographic descriptions of the dated samples. The dated zircon crystals are also illustrated and the U-Pb isotopic data for analyzed zircons are shown in a table.

Text S1.

The Tuffaceous interval of Mount Flora Formation

The tuffaceous interval is part of the lower member (Miembro Conglomerados of Montes et al., 2019) of the Mount Flora Formation (Fig. 2B) and consists of ignimbrite, a variety of tuffs, lapilli tuffs, volcanic breccias and conglomerates, which can be traced along the northern face of Mount Flora overlooking Hope Bay. It reaches 43 m in thickness in its most expanded outcrop at the measured Mount Flora section, where it occurs 150 m above the base of the section, and progressively thins out westward. As in the rest of the column, the rocks are hard, compact and lack of porosity. The matrix and some clasts show evidence of complete recystallization and silicification being composed by chlorite, sericite, quartz and feldspar. The same mineral association is present in the shales (Scasso et al., 1991). Silicification and recrystallization result from the emplacement of dikes and small intrusive bodies of Jurassic and Cretaceous age (e.g. Montes et al., 2019).

The tuffaceous interval itself is divided into lower, middle and upper parts for better characterization (Fig. S1). The lower part of is about 15 m thick and it is composed of well-stratified volcanic breccias, tuffs and lapilli tuffs (Figs. S1, 3a). This interval thins out laterally over a few tens of meters to the NW and seems to be absent from the rest of the the Mount Flora outcrops. Beds are about 1 m thick and some breccias show erosive base and normal grading. Breccia are matrix-supported and contain clasts about 10 cm and up to 40 cm. These are bright-coloured, angular, clasts of felsic volcanic rocks with microgranular and porcelaneous fabrics. A few beds show some welding and contain fiammes. A 4.3 m thick bed in the mid shows a diffusely stratified alternation of tuff and lapilli tuff in lensoidal beds. All these beds offer a sharp compositional contrast with the underlying conglomerate beds, which are entirely formed by clasts of leptometamorphic, fine-grained, sandstones and shales of the Hope Bay Formation (Trinity Peninsula Group), with no volcanic clasts.

The middle part is a 12 m thick interval consisting of clast-supported conglomerates with fining-upward beds with erosive bases ranging in thickness from 1 to 2 m (Fig. 3a). The base of this body is strongly erosive and laterally cuts down into most of the underlying lower part. Subrounded, equidimensional blocks up to 80 cm in diameter consist of the typical dark-grey, fine sandstones of the Hope Bay Formation or of angular blocks of volcanic rocks. The matrix is enriched in tuffaceous material. Whitish, silicified wood logs are common.

The 25 m thick upper part is composed of 9 m of breccias in beds about 2 m thick, which display reverse to normal grading and contain angular blocks up to 30 cm long. The blocks are a mix of volcanic rocks and the typical Hope Bay Formation lithologies. The matrix is enriched in tuffaceous material. The breccias are overlain by a 16 m thick, lapilli tuff with coarser-grained base and top (Fig. 3a). Its base is a reverse-graded, clast-to-matrix supported volcanic breccia about 1 m thick (Fig. 3c) with clasts up to 5 cm in diameter, transitioning upward to a 14 m thick, crudely stratified, partially welded lapilli tuff with angular clasts that may reach up to 2 cm in diameter (Fig. 3d). Sample 22-1-18-5 was collected from this interval. Another 50 cm thick breccia rich in dark sandstone clasts up to 5 cm in diameter caps the ignimbrite bed (Fig. 3a).

Alluvial sandstones and conglomerates above the ignimbrite are again rich in clasts of the Hope Bay Formation and volcanic clasts are less abundant. 1.5 m above the top of the ignimbrite a normally-graded conglomerate contains large, dark-coloured, fragmented petrified wood logs concentrated at its base (Fig. 3b).

The sample 24-1-18-1 was collected from a shorter section of the Mount Flora Formation about 300 m to the west (Fig. 2a). The sampled bed is a crystal lithic lapilli tuff, which occurs 16 m above the base of the local section. This section lacks the lower part of the tuffaceous interval suggesting that the sampled rock is likely a lateral facies variation of the upper part of the main section.

Petrographic descriptions of the dated samples and separated zircons

Sample 24-1-18-1 (63°24'47.20"S, 57°1'33.30"W) is a well-consolidated, dark grey, crystal lithic lapilli tuff composed of 85% clasts and 15% matrix. Clasts reach up to 2 cm in diameter and are mostly bad sorted, angular lithoclasts of volcanic rocks with microcrystalline matrix composed of equidimensional feldspar, chlorite, quartz and rare opaque minerals; they show phenocrysts of subhedral K-feldspar partially altered to clays and/or sericite, of 0.06 to 0.8 mm long plagioclase laths with moderate sericite and argillaceous alteration, and of 0.06 to 0.5 mm long, embayed quartz with evidence of resorption and with rare inclusions (Fig. S2a, b). The matrix in some volcanic lithoclasts is almost entirely replaced by sericite and chlorite. Lithic fragments of leptometamorphic sandstones, as well as rare zircon crystals were observed. Small crystals of feldspar and quartz similar to the phenocrysts in the volcanic lithic fragments are also present in the tuff's matrix (Fig. S2a, b) together with sericite, muscovite and rare biotite crystals.

Sample 22-1-18-5 (63°24'46.70"S, 57° 1'12.30"W) is a light grey, crystal vitric lapilli tuff from the upper part of the tuffaceous interval. It is composed of 65% clasts and 35% matrix. Phenoclasts reach up to 0.8 cm in diameter. They consist of altered pumice, quartz, plagioclase, K-feldspar and lithic fragments (Fig. S2c). Pumice shows evidence of plastic deformation and is replaced by sericite, chlorite, zeolite and microcrystalline quartz. Pumice fragments may contain embayed quartz, plagioclase and K-feldspar as well as vesicles filled with zeolite spherules, muscovite and small apatite (Fig. S2d). Angular quartz crystals, 0.01 mm to 0.1 mm in length, with embayed outlines and undulatory extinction are abundant. Subhedral plagioclase and K-feldspar crystals are altered to sericite and calcite. Lithic fragments of sandstones, tuffs and felsic volcanic rocks are locally present. The clasts are welded by a matrix of microcrystalline quartz, feldspar and sericite.

The ignimbrite and crystal lithic lapilli tuff samples from Mount Flora contained abundant prismatic zircon with pyramidal terminations and with aspect rations ranging from 1:5 to 1:10 (Fig. S3). Zircons are multifaceted and clear with uniform crystal habits and no evidence of sedimentary rounding. Clear glass (melt) inclusions are common and typically run along the entire length of the crystals. Some inclusions are more opaque and show evidence of glass devitrification. Type or paste text here. This should be additional explanatory text, such as: extended descriptions of results, full details of models, extended lists of acknowledgements etc. It should not be additional discussion, analysis, interpretation or critique. It should not be an additional scientific experiment or paper.

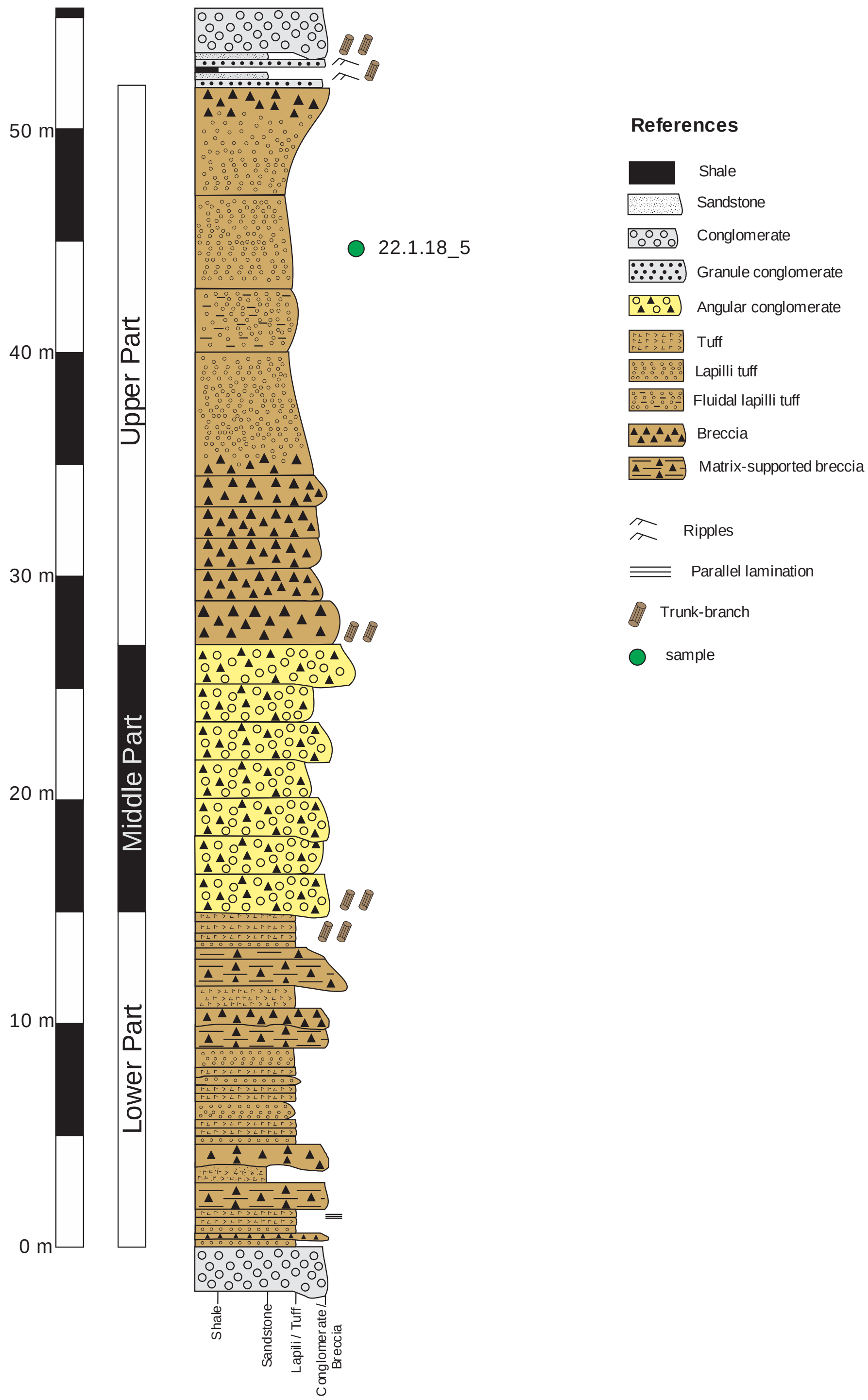

Figure S1. Sedimentological section of the tuffaceous interval. The position of the dated sample is indicated.

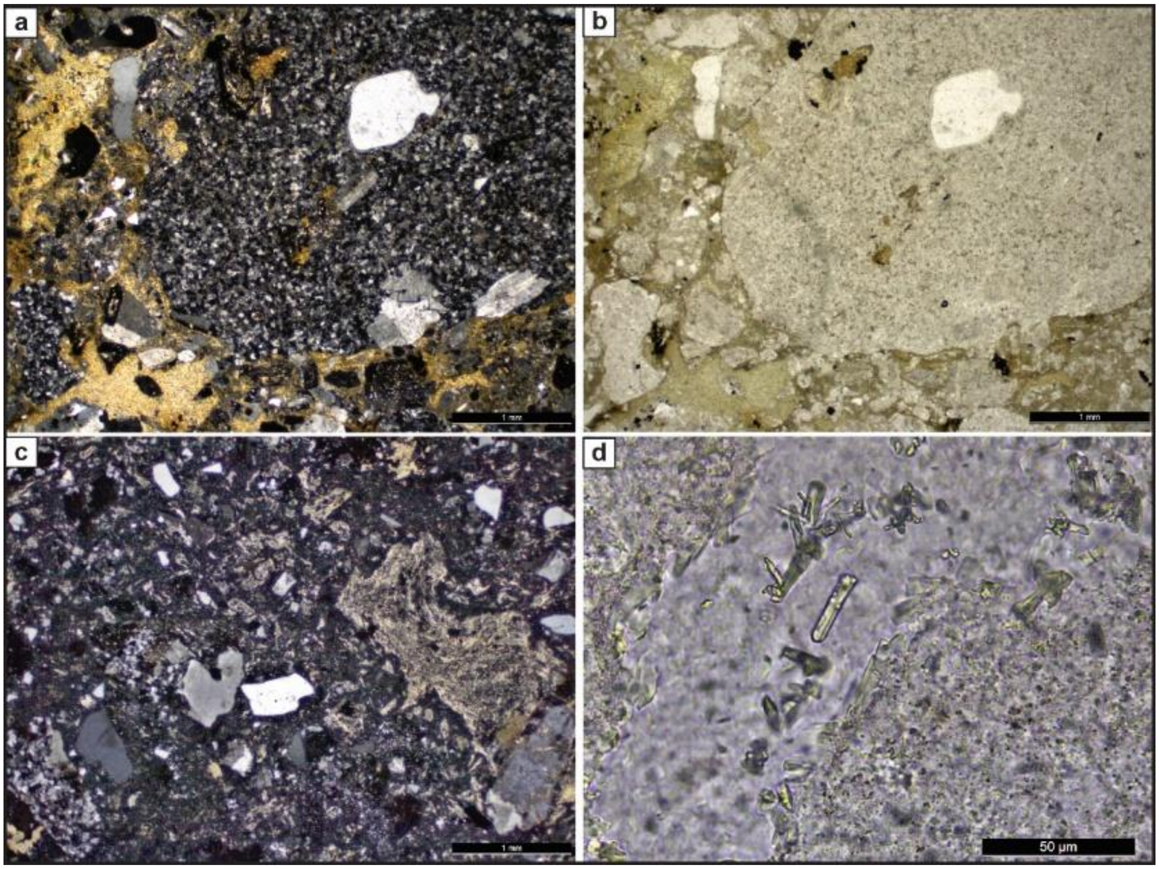

Figure S2. Photomicrograph of sample 24-1-18-1 (a and b), a crystal lithic lapilli tuff with felsic volcanic phenoclasts consisting of resorbed quartz and feldspar in a microgranular, quartzofeldspathic matrix. Some clasts and the matrix are altered to sericite and chlorite. a) Crossed polars; b) Plain polarized light. Photomicrograph of sample 22-1-18-5 (c and d); c shows a lapilli tuff with phenoclasts of angular and resorbed quartz, feldspar and plastically deformed pumice fragments (replaced by sericite), in a fine-grained matrix (crossed polars). D shows small apatite crystals inside a pumice fragment in plain polarized light.

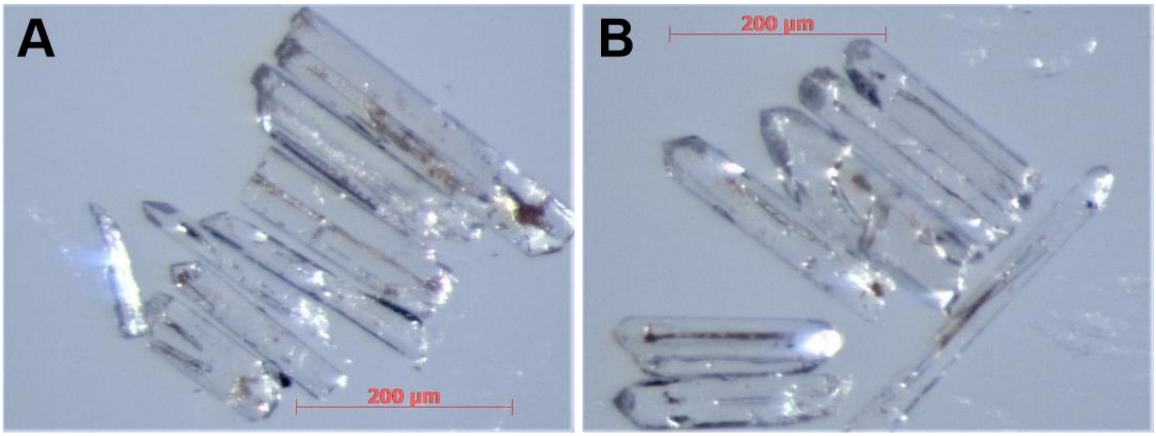

Figure S3 Microscope images of zircon separated from samples 22-1-18-5 (A) and 24-1-18-1 (B). Note similar zircon morphologies between the two samples and the abundant and partially devitrified glass (melt) inclusions in the core of the crystals**.**

					Ratios								Ages (Ma)						
Sample Fractions†	Pb_c§ (pg)	Pb^*§ / Pb_c	U§ (pg)	Th# / U	^{206}Pb** / ^{204}Pb	^{208}Pb‡ / ^{206}Pb	^{206}Pb§§ / ^{238}U	err (2σ%)	^{207}Pb§§ / ^{235}U	err (2σ%)	^{207}Pb§§ / ^{206}Pb	err (2σ%)	^{206}Pb / ^{238}U	err (2σ)	^{207}Pb / ^{235}U	err (2σ)	^{207}Pb / ^{206}Pb	err (2σ)	corr. coef.
22-1-18-5																			
z2	0,34	7,8	90,6	0,84	441,1	0,268	0,025758	(,26)	0,18146	(2,84)	0,05112	(2,76)	163,95	0,42	169,3	4,4	245	64	0,34
z6	0,23	11,3	91,1	0,66	660,5	0,209	0,025736	(,18)	0,17831	(1,94)	0,05027	(1,88)	**163,80**	**0,29**	166,6	3,0	207	44	0,34
z3	0,21	60,7	427	0,95	3244,5	0,301	0,025700	(,07)	0,17568	(,41)	0,04960	(,39)	**163,58**	**0,11**	164,34	0,63	175,3	9,2	0,36
z4	0,61	57,1	1195	0,86	3119,4	0,272	0,025690	(,06)	0,17519	(,41)	0,04948	(,40)	**163,52**	**0,10**	163,92	0,63	169,6	9,3	0,35
z1	0,66	10,0	233	0,75	576,3	0,239	0,025664	(,26)	0,17733	(2,22)	0,05014	(2,14)	**163,35**	**0,43**	165,8	3,4	200	50	0,32
24-1-18-1																			
z1	0,48	17,3	311	0,51	1046,8	0,161	0,025743	(,14)	0,17791	(1,25)	0,05015	(1,21)	163,85	0,22	166,3	1,9	201	28	0,31
z3	0,21	55,8	434	0,51	3330,7	0,161	0,025703	(,07)	0,17618	(,42)	0,04974	(,41)	**163,60**	**0,11**	164,77	0,64	181,6	9,5	0,28
z4	0,22	52,1	431	0,51	3113,2	0,161	0,025696	(,07)	0,17524	(,44)	0,04948	(,42)	**163,56**	**0,11**	163,96	0,66	169,8	9,9	0,31
z5	0,22	102,6	875	0,42	6247,1	0,134	0,025690	(,06)	0,17502	(,24)	0,04943	(,21)	**163,51**	**0,10**	163,77	0,36	167,4	5,0	0,51
z2	0,19	82,6	575	0,61	4791,2	0,194	0,025688	(,06)	0,17482	(,30)	0,04938	(,28)	**163,51**	**0,10**	163,59	0,45	164,8	6,5	0,43

Notes: Corr. coef. = correlation coefficient. Ages calculated using the decay constants λ_{238} = 1.55125E-10 y^{-1} and λ_{235} = 9.8485E-10 y^{-1} (Jaffey et al. 1971).

†All analyses are single zircon grains and pre-treated by the thermal annealing and acid leaching (CA-TIMS) technique. Data used in date calculation are in bold.

§Pb(c) is total common-Pb in analysis. Pb* is radiogenic Pb concentration. Total sample U content in pg.

#Th content is calculated from radiogenic ^{208}Pb assuming concordance between U-Pb and Th-U systems.

**Measured ratio corrected for spike and fractionation only.

‡Radiogenic Pb ratio.

§§Corrected for fractionation, spike and blank. Also corrected for initial Th/U disequilibrium using radiogenic ^{208}Pb and $Th/U_{[magma]}$ = 2.8

Mass fractionation correction of 0.18%/amu ± 0.04%/amu (atomic mass unit) was applied to single-collector Daly analyses.

All common Pb assumed to be laboratory blank. Total procedural blank less than 0.1 pg for U.

Blank isotopic composition: $^{206}Pb/^{204}Pb$ = 18.20 ± 0.45, $^{207}Pb/^{204}Pb$ =15.29 ± 0.24, $^{208}Pb/^{204}Pb$ = 37.16 ± 0.77.

Table S1. U-Pb isotopic data for analyzed zircons from tuffaceous rocks of the Mount Flora Formation, Botany Bay Group, Antarctic Peninsula.

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