DR2004157

APPENDIX DR1: GEOCHRONOLOGIC METHODS AND DATA

The Rome samples were analyzed by laser-ablation multicollector ICP mass spectrometry using a Micromass Isoprobe and New Wave Research DUV 193 Excimer laser system (methods described by Dickinson and Gehrels, 2003). Analyses were conducted in static mode on randomly selected grains, using a spot diameter of 25 microns. Correction for common Pb is accomplished from the measured $^{206}Pb/^{204}Pb$ assuming a common Pb composition from Stacey and Kramers (1975) and uncertainties of 1.0% for $^{206}Pb/^{204}Pb$ and 0.3% for $^{207}Pb/^{204}Pb$. Fractionation of $^{206}Pb/^{238}U$ and $^{206}Pb/^{207}Pb$ is constrained by analysis of fragments of a large zircon crystal with known age of 564 ± 4 Ma, which contributes a systematic error of ~3% (2-sigma) to all ages. Ages used for provenance interpretations are based on $^{206}Pb/^{238}U$ for <1.2 Ga ages and $^{206}Pb/^{207}Pb$ for >1.2 Ga ages, and analyses with >20% discordance or >10% reverse discordance are ignored. The data are reported in Table DR1 and displayed on concordia diagrams in Figure DR1.

For the Cerro Totora Formation, zircons were separated by standard hydraulic, gravimetric, and magnetic methods. Analyses were conducted on grains from the 6 degree, non-magnetic fraction that were not sized prior to mounting for ion probe analysis. U-Pb isotopic analyses used the SHRIMP-RG ion probe at the U.S.G.S.-Stanford Microanalytical Center. Analysis and data reduction procedures are discussed in Compston et al. (1984) and Compston and Williams (1992). Not all analyses resulted in concordant data. Because we are not attempting to actually date the occurrence of a

particular geologic event, but rather to outline general times of crustal growth, we have restricted our interpretations to those analyses that are <20% discordant or <10% reverse discordant, a useful and practical approach (Mueller et al., 1994, 1998). The data are reported in Table DR1 and displayed on concordia diagrams in Figure DR1.

References Cited in Appendix

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Figure DR1. Concordia diagrams for detrital zircons from sandstones of Rome and Cerro Totora Formations. Uncertainties are shown at the 1-sigma level.

Table DR1. U-Pb geochronologic analyses of detrital zircons from sandstones of Rome and Cerro Totora Formations.

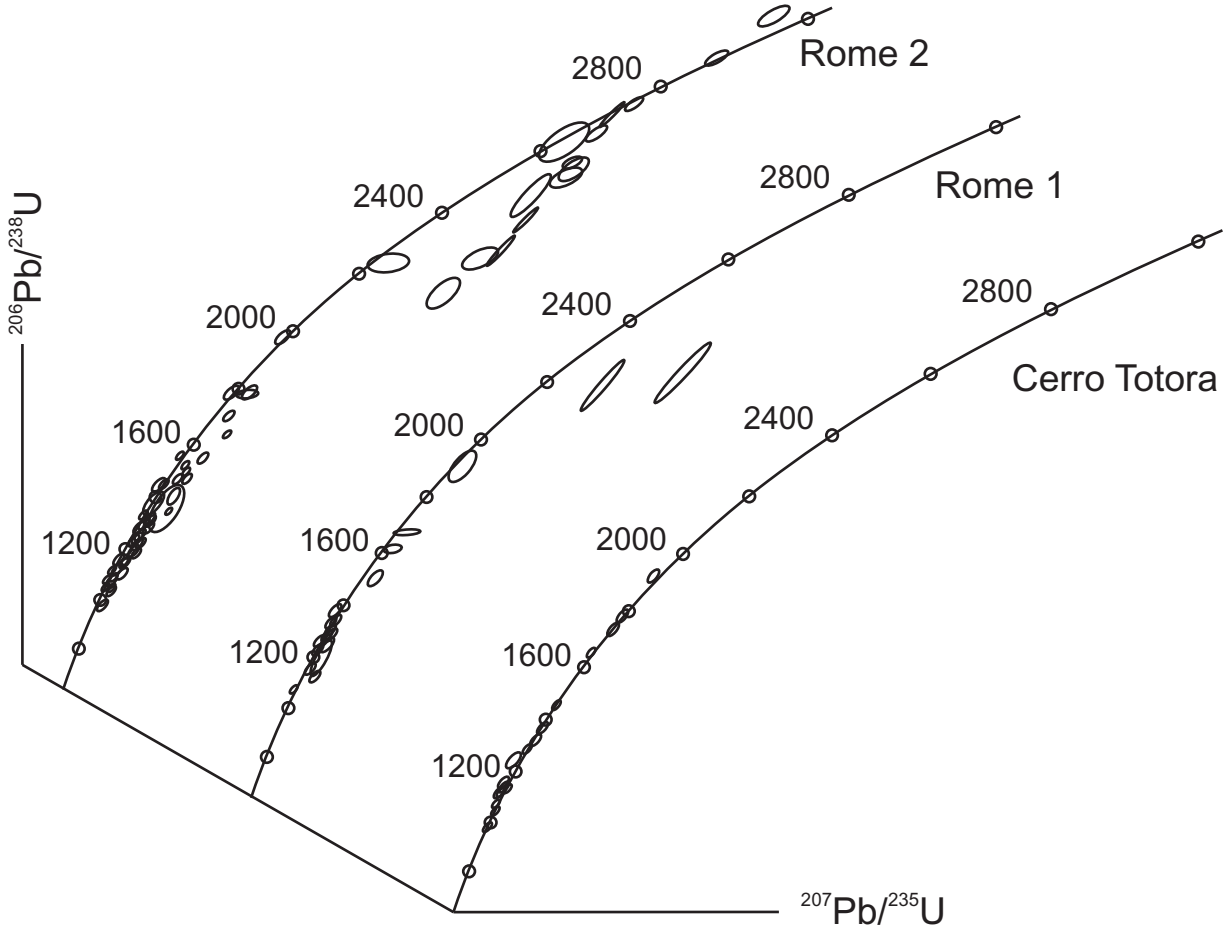

Figure DR1 - Thomas, Astini, Mueller, Gehrels, Wooden

Table DR1. U-Pb geochronologic analyses of detrital zircons from sandstones of Rome and Cerro Totora Formations.

			Isotopic ratios					Apparent ages (Ma)						
U (ppm)	$^{206}Pb/^{204}Pb$	U/Th	$^{207}Pb^*/^{235}U$	± (%)	$^{206}Pb^*/^{238}U$	± (%)	error corr.	$^{206}Pb^*/^{238}U$	± (Ma)	$^{207}Pb^*/^{235}U$	± (Ma)	$^{206}Pb^*/^{207}Pb^*$	± (Ma)	% disc
Rome sample 2 (map coordinates, 33º 17' 01.7"N, 86º 50' 14.0"W, Helena 7.5-minute quadrangle, Alabama, USA)														
26	6564	2	1.74096	2.34	0.16256	1.05	0.45	**971**	**11**	1024	41	1139	21	15
6	1950	5	1.67971	2.47	0.16280	1.13	0.46	**972**	**12**	1001	41	1064	22	9
33	7087	2	1.77355	2.38	0.16662	0.52	0.22	**993**	**6**	1036	42	1126	23	12
47	14095	11	1.83097	1.56	0.16848	1.02	0.66	**1004**	**11**	1057	29	1168	12	14
25	17912	4	1.87488	1.50	0.17444	0.68	0.46	**1037**	**8**	1072	28	1146	13	10
13	8834	6	1.90377	3.41	0.17444	1.06	0.31	**1037**	**12**	1082	64	1176	32	12
6	3091	24	1.77125	3.34	0.17470	0.59	0.18	**1038**	**7**	1035	58	1029	33	-1
6	2942	6	1.93685	3.83	0.17488	1.46	0.38	**1039**	**16**	1094	73	1205	35	14
66	7697	10	2.00282	1.18	0.17566	1.09	0.92	**1043**	**12**	1117	24	1262	4	17
23	12720	2	1.90259	1.97	0.17590	1.03	0.52	**1045**	**12**	1082	38	1158	17	10
21	5448	9	1.85852	3.45	0.17837	1.12	0.33	**1058**	**13**	1067	63	1084	33	2
16	8557	6	1.84850	3.68	0.18148	1.17	0.32	**1075**	**14**	1063	67	1038	35	-4
37	15078	7	1.99788	2.45	0.18412	1.43	0.59	**1090**	**17**	1115	48	1165	20	6
9	3781	6	2.16391	4.35	0.18720	1.17	0.27	**1106**	**14**	1170	91	1289	41	14
22	9530	12	2.20510	3.22	0.18802	2.35	0.73	**1111**	**28**	1183	70	1317	21	16
10	6416	4	1.97149	2.63	0.18818	0.57	0.22	**1112**	**7**	1106	51	1095	26	-2
43	13534	8	2.09908	1.81	0.18904	1.16	0.64	**1116**	**14**	1149	38	1210	14	8
13	3386	6	2.23697	3.31	0.19350	1.49	0.45	**1140**	**19**	1193	73	1289	29	12
6	3345	5	2.19373	2.68	0.19378	1.46	0.54	**1142**	**18**	1179	58	1248	22	9
23	4956	3	2.11919	2.08	0.19546	1.30	0.62	**1151**	**16**	1155	44	1163	16	1
6	2304	31	2.17521	5.65	0.19548	0.95	0.17	**1151**	**12**	1173	118	1214	55	5
9	3799	30	2.28700	3.39	0.19555	0.92	0.27	**1151**	**12**	1208	76	1311	32	12
30	6285	11	2.26291	2.75	0.19657	2.29	0.83	**1157**	**29**	1201	61	1281	15	10
11	3295	5	2.22735	4.20	0.19956	0.85	0.20	**1173**	**11**	1190	91	1220	40	4
27	8729	4	2.26539	1.59	0.20036	1.09	0.69	**1177**	**14**	1202	36	1246	11	6
33	13989	3	2.44912	1.57	0.20148	0.62	0.40	**1183**	**8**	1257	38	1386	14	15
9	5917	8	2.50323	4.95	0.20199	1.46	0.29	**1186**	**19**	1273	119	1423	45	17
6	1746	3	2.48158	4.60	0.20373	1.93	0.42	**1195**	**25**	1267	110	1390	40	14
9	4034	4	2.34934	4.41	0.20348	0.64	0.15	1194	8	1227	100	**1286**	**42**	7
30	14976	13	2.43100	2.16	0.21004	1.14	0.53	1229	15	1252	52	**1291**	**18**	5
6	3132	6	2.39542	5.71	0.20476	0.81	0.14	1201	11	1241	130	**1312**	**55**	8

15	73363	7	2.68693	2.91	0.22869	0.96	0.33	1328	14	1325	76	**1320**	**27**	-1
13	5714	5	2.58106	2.28	0.21862	0.79	0.34	1275	11	1295	58	**1330**	**21**	4
7	3127	5	2.85232	4.30	0.23923	2.29	0.53	1383	35	1369	118	**1349**	**35**	-2
15	10280	4	2.60203	2.93	0.21657	1.81	0.62	1264	25	1301	75	**1364**	**22**	7
31	11680	9	2.53275	2.22	0.21048	1.91	0.86	1231	26	1282	56	**1367**	**11**	10
11	6723	9	2.54422	2.98	0.20991	0.74	0.25	1228	10	1285	74	**1380**	**28**	11
15	6097	6	3.06517	3.93	0.24879	1.82	0.46	1432	29	1424	116	**1412**	**33**	-1
13	2694	8	2.53322	2.47	0.20466	0.97	0.39	1200	13	1282	62	**1421**	**22**	16
15	8105	8	2.85282	2.32	0.23015	1.00	0.43	1335	15	1370	65	**1423**	**20**	6
15	7062	6	2.75597	3.48	0.22226	2.19	0.63	1294	31	1344	93	**1424**	**26**	9
15	8556	8	2.76346	2.52	0.22219	1.62	0.64	1294	23	1346	68	**1430**	**18**	10
18	7164	6	2.93151	2.12	0.23442	0.78	0.37	1358	12	1390	61	**1440**	**19**	6
22	16150	7	3.08557	1.52	0.24669	0.69	0.45	1421	11	1429	47	**1441**	**13**	1
17	430389	3	3.14819	1.66	0.25093	0.76	0.46	1443	12	1445	52	**1446**	**14**	0
17	4929	12	2.63555	2.61	0.20908	1.12	0.43	1224	15	1311	68	**1455**	**22**	16
10	70662	4	3.19319	2.41	0.25251	0.46	0.19	1451	8	1456	75	**1461**	**22**	1
17	12549	3	3.16571	1.44	0.25023	0.96	0.67	1440	15	1449	45	**1462**	**10**	2
17	10255	7	3.21028	1.69	0.25318	0.68	0.40	1455	11	1460	54	**1467**	**15**	1
23	11379	6	3.00908	2.39	0.23597	1.43	0.60	1366	22	1410	71	**1477**	**18**	8
17	5128	4	2.86936	2.69	0.22331	2.06	0.76	1299	30	1374	76	**1492**	**16**	13
22	21035	3	3.54364	1.22	0.27340	0.78	0.65	1558	14	1537	43	**1508**	**9**	-3
32	35058	4	3.56625	0.98	0.27147	0.56	0.58	1548	10	1542	35	**1534**	**8**	-1
15	10698	6	3.49586	1.81	0.25516	0.77	0.42	1465	13	1526	63	**1612**	**15**	9
19	5030	4	3.67168	1.42	0.26544	0.82	0.58	1518	14	1565	52	**1630**	**11**	7
2	609	88	3.24978	9.88	0.23385	5.16	0.52	1355	77	1469	283	**1639**	**78**	17
25	8949	6	3.40303	2.43	0.24353	1.95	0.80	1405	31	1505	81	**1649**	**13**	15
24	6060	8	3.25960	0.93	0.23123	0.46	0.50	1341	7	1472	30	**1665**	**7**	19
20	14814	3	3.69616	1.70	0.26041	0.95	0.56	1492	16	1571	62	**1678**	**13**	11
11	5974	7	3.70671	2.00	0.25574	1.02	0.51	1468	17	1573	73	**1716**	**16**	14
8	2598	17	4.77922	2.39	0.32191	0.53	0.22	1799	11	1781	110	**1760**	**21**	-2
13	6843	21	4.05853	1.47	0.27077	1.21	0.82	1545	21	1646	59	**1778**	**8**	13
31	17529	19	4.68973	1.19	0.30282	0.98	0.82	1705	19	1765	55	**1837**	**6**	7
7	6347	10	5.08761	2.62	0.31822	0.87	0.33	1781	18	1834	127	**1895**	**22**	6
18	8030	4	4.65453	1.54	0.28919	0.58	0.38	1638	11	1759	71	**1907**	**13**	14
7	6736	5	5.17591	2.44	0.31731	0.87	0.36	1777	18	1849	121	**1931**	**20**	8
11	14125	2	5.96099	1.39	0.35974	1.03	0.74	1981	24	1970	81	**1959**	**8**	-1
2	2288	9	8.37898	4.05	0.41319	1.05	0.26	2230	28	2273	297	**2312**	**34**	4

7	10461	8	9.67044	2.60	0.39169	1.81	0.70	2131	46	2404	227	**2644**	**15**	19
4	3756	3	12.45979	3.22	0.50291	2.12	0.66	2626	69	2640	342	**2650**	**20**	1
21	25734	3	11.72102	2.64	0.46304	2.45	0.93	2453	73	2582	274	**2686**	**8**	9
5	4912	2	10.59338	2.69	0.41732	1.35	0.50	2248	36	2488	255	**2690**	**19**	16
37	53754	4	11.56968	1.31	0.44594	1.28	0.98	2377	37	2570	143	**2726**	**2**	13
29	15393	5	10.98709	2.11	0.42306	2.06	0.98	2274	56	2522	212	**2728**	**4**	17
15	18894	3	13.55872	1.14	0.52150	1.09	0.96	2706	37	2719	146	**2730**	**3**	1
14	18565	3	13.23409	1.18	0.50867	0.79	0.67	2651	26	2697	148	**2731**	**7**	3
5	3877	6	12.69775	1.32	0.48774	0.60	0.45	2561	19	2658	158	**2732**	**10**	6
4	3464	5	12.51334	1.92	0.47681	0.98	0.51	2513	30	2644	219	**2745**	**14**	8
9	9610	5	12.72313	1.71	0.48345	1.36	0.80	2542	42	2659	200	**2750**	**8**	8
9	37212	7	14.10932	0.99	0.53060	0.70	0.71	2744	24	2757	133	**2767**	**6**	1
6	22380	7	16.02439	1.02	0.56424	0.73	0.72	2884	27	2878	154	**2874**	**6**	0
5	48540	7	17.41028	1.11	0.59567	0.74	0.67	3012	28	2958	180	**2921**	**7**	-3
26	*5497*	*4*	*2.58065*	*1.47*	*0.18872*	*0.80*	*0.54*	*1115*	*10*	*1295*	*38*	*1609*	*12*	*31*
12	*5231*	*10*	*2.62890*	*4.05*	*0.18899*	*1.48*	*0.37*	*1116*	*18*	*1309*	*103*	*1641*	*35*	*32*
13	*10626*	*5*	*9.22153*	*3.35*	*0.36676*	*3.22*	*0.96*	*2014*	*76*	*2360*	*273*	*2674*	*7*	*25*
14	*4265*	*4*	*2.28091*	*2.67*	*0.18599*	*1.48*	*0.55*	*1100*	*18*	*1206*	*60*	*1403*	*21*	*22*
15	*6662*	*5*	*3.53866*	*3.80*	*0.23384*	*0.87*	*0.23*	*1355*	*13*	*1536*	*128*	*1795*	*34*	*25*
76	*11689*	*5*	*7.56998*	*2.66*	*0.30462*	*2.64*	*0.99*	*1714*	*52*	*2181*	*187*	*2655*	*3*	*35*
29	*6517*	*4*	*2.61197*	*2.60*	*0.19856*	*2.14*	*0.82*	*1168*	*27*	*1304*	*67*	*1536*	*14*	*24*
Rome sample 1 (map coordinates, 34º 02' 13.5"N, 85º 36' 39.8"W, Ellisville 7.5-minute quadrangle, Alabama, USA)														
26	1026891	30	1.83954	2.14	0.18075	1.21	0.57	**1071**	**14**	1060	39	1036	18	-3
30	66212	6	2.30211	3.24	0.20530	2.08	0.64	1204	27	1213	73	**1229**	**24**	2
88	24022	18	2.39278	2.93	0.21310	2.59	0.88	1245	35	1240	69	**1232**	**13**	-1
32	63554	20	2.37931	5.39	0.20694	5.07	0.94	1213	67	1236	122	**1278**	**18**	5
115	129495	8	2.71274	3.89	0.23186	3.61	0.93	1344	54	1332	102	**1312**	**14**	-2
17	146977	38	2.75302	1.99	0.22798	0.89	0.45	1324	13	1343	54	**1373**	**17**	4
15	2630157	19	2.76696	4.33	0.22815	3.10	0.72	1325	45	1347	115	**1382**	**29**	4
87	24268	6	2.53995	7.90	0.20884	7.20	0.91	1223	96	1284	186	**1387**	**31**	12
13	47232	13	3.77882	3.57	0.26241	1.54	0.43	1502	26	1588	129	**1705**	**30**	12
27	55492	26	4.11822	3.31	0.28343	0.69	0.21	1609	13	1658	130	**1721**	**30**	7
26	143628	17	4.46072	4.47	0.29611	0.77	0.17	1672	15	1724	185	**1787**	**40**	6
62	142376	12	5.72657	3.81	0.34433	2.58	0.68	1908	57	1935	200	**1965**	**25**	3
2	2845	78	9.05266	3.05	0.40450	2.76	0.91	2190	72	2343	248	**2480**	**11**	12
4	3087	4	10.94832	7.31	0.41379	7.25	0.99	2232	190	2519	597	**2758**	**8**	19
79	*45207*	*8*	*8.56052*	*3.19*	*0.34566*	*3.08*	*0.97*	*1914*	*68*	*2292*	*245*	*2649*	*7*	*28*

71	*65936*	*10*	*9.37926*	*4.56*	*0.37598*	*4.44*	*0.97*	*2058*	*107*	*2376*	*362*	*2661*	*9*	*23*
68	*7022*	*9*	*5.00304*	*8.21*	*0.20240*	*8.20*	*1.00*	*1188*	*106*	*1820*	*349*	*2646*	*3*	*55*
Cerro Totora (GPS coordinates, 29º 28' 32.8"S, 68º 39' 52.3"W, La Rioja Province, Argentina)														
133	9091	20	1.59627	2.29	0.16228	1.07	0.47	**969**	**10**	969	37	967	41	0
1165	27778	10	1.72379	0.71	0.16702	0.35	0.48	**996**	**3**	1017	12	1065	13	7
333	55556	3	1.71432	1.30	0.16859	0.65	0.50	**1004**	**6**	1014	22	1035	23	3
621	15625	13	1.73675	1.06	0.17203	0.49	0.46	**1023**	**5**	1022	19	1020	19	0
189	7692	8	1.77923	2.11	0.17335	0.90	0.43	**1031**	**9**	1038	37	1053	38	2
151	5882	3	1.90642	3.42	0.18518	1.02	0.30	**1095**	**10**	1083	64	1059	66	-3
433	10000	3	1.98177	1.28	0.18535	0.58	0.45	**1096**	**6**	1109	25	1135	23	3
175	8333	3	1.92897	1.90	0.18735	0.92	0.49	**1107**	**9**	1091	37	1060	34	-4
107	3333	1	1.88597	2.61	0.18767	1.17	0.45	**1109**	**12**	1076	49	1011	47	-10
166	14706	2	1.92978	1.84	0.18907	0.93	0.51	**1116**	**10**	1092	35	1042	32	-7
111	10204	2	2.10625	2.50	0.19119	1.13	0.45	**1128**	**12**	1151	52	1195	44	6
605	20833	3	2.07508	0.98	0.19246	0.49	0.50	**1135**	**5**	1141	20	1152	17	2
319	9091	2	2.05700	1.50	0.19288	0.66	0.44	**1137**	**7**	1135	31	1130	27	-1
146	3448	2	2.03780	3.52	0.19588	0.99	0.28	**1153**	**10**	1128	70	1081	68	-7
38	2174	1	2.26153	5.72	0.21091	1.96	0.34	1234	22	1200	124	**1141**	**107**	-8
213	8333	1	2.56638	1.65	0.21968	0.79	0.48	1280	9	1291	42	**1309**	**28**	2
115	NA	2	2.71073	1.90	0.22657	1.08	0.57	1317	13	1331	51	**1355**	**30**	3
401	13514	2	2.96888	1.09	0.24224	0.56	0.51	1398	7	1400	32	**1402**	**18**	0
103	12658	2	2.91202	2.04	0.23525	1.20	0.59	1362	15	1385	59	**1421**	**32**	4
215	25000	2	3.21446	1.36	0.25276	0.76	0.56	1453	10	1461	43	**1472**	**21**	1
432	24390	2	3.22308	0.95	0.25122	0.56	0.59	1445	7	1463	31	**1489**	**15**	3
335	24390	2	4.05265	0.98	0.29141	0.61	0.63	1649	9	1645	40	**1640**	**14**	-1
255	34483	6	4.56259	1.10	0.30832	0.69	0.63	1732	10	1743	50	**1755**	**16**	1
187	13514	2	4.77309	1.51	0.31750	0.82	0.54	1778	13	1780	71	**1783**	**23**	0
200	NA	3	5.50878	1.18	0.34669	0.80	0.67	1919	13	1902	64	**1884**	**16**	-2
105	*1136*	*2*	*1.42148*	*6.81*	*0.15646*	*1.27*	*0.19*	*937*	*11*	*898*	*94*	*803*	*140*	*-17*

$^{206}Pb/^{204}Pb$ is measured ratio.

% disc is the percent discordance, calculated from comparison of $^{206}Pb/^{238}U$ and $^{206}Pb/^{207}Pb$ ages.

All uncertainties are at the 1-sigma level and include only random (measurement) errors.

Ages for probability plots are based on $^{206}Pb/^{238}U$ for <1.2 Ga ages and on $^{206}Pb/^{207}Pb$ for >1.2 Ga ages.

Ages in bold are interpreted to be the best estimates of crystallization age.

Ages in italics are not incuded in probability plots because of >20% discordance or >10% reverse discordance.

U concentration and U/Th have uncertainties of ~25%.

Decay constants: $^{235}U=9.8485x10^{-10}$, $^{238}U=1.55125x10^{-10}$; $^{238}U/^{235}U=137.88$.
Rome samples analyzed by laser-ablation multicollector ICPMS.
Cerro Totora sample analyzed by ion microprobe (SHRIMP RG).