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Repository Data: Upper Jurassic Peñasquitos Formation – forearc basin western wallrock of the Peninsular Ranges batholith

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ZIRCON U-Pb GEOCHRONOLOGY

Zircon was separated from 2-10 kg rock samples by standard crushing, density and magnetic separation techniques at San Diego State University. Extremely small zircon yields for the Peñasquitos Formation and Rancho Valencia canyon samples required handpicking of zircon grains from non-magnetic methylene iodide residues under a binocular microscope using a short wavelength UV lamp (254 nm) to locate suitable grains for analysis. For the Lusardi canyon detrital zircon sample a bulk aliquot was poured into a mounting tube. All samples were mounted along with standards in 1” diameter epoxy plugs and polished with 3000 grit sandpaper. Mounts were then cleaned with soap and water and immersed in a cleaning solution (2% HNO3 and 1% HCl) in an ultrasonic cleaner for a few minutes, followed by rinsing with water and final cleaning with isopropyl alcohol using a Kimwipe.

Zircons were analyzed at the University of Arizona LaserChron Center (Gillis et al., 2005; Gehrels et al., 2006, 2008). Samples analyzed prior to February 2009 (PQ053, CD0501, CD0502, VRSFTC) were analyzed with a Multicollector Inductively Coupled Plasma Mass Spectrometer (GVI Isoprobe); later sample (Lusardi) was analyzed with a Nu HR ICPMS.

The GVI Isoprobe instrument is equipped with nine faraday collectors, an axial Daly detector, and four ion-counting channels. The mass spectrometer is coupled to a New Wave Instruments Excimer laser ablation system which has an emission wavelength of 193 nm. The laser output energy was ~32mJ with a repetition rate of 8 hz. Analyses were conducted on 35 microns spots and the depth of each ablation pit was ~20 microns. Each analysis consisted of one 20-s integration on backgrounds (on peak centers with no laser firing) and twenty 1-s integrations on peaks with the laser firing. The collector configuration allows simultaneous measurement of ^{204}Pb in a secondary electron multiplier while ^{206}Pb, ^{207}Pb, ^{208}Pb, ^{232}Th, and ^{238}U are measured with Faraday detectors. All analyses were conducted in static mode. (cf. Gillis et al., 2005). Hg contributions to ^{204}Pb were removed by measuring onpeak backgrounds.

The Nu HR ICPMS measures U, Th, and Pb isotopes simultaneously in static mode, using Faraday detectors with 3x10^{11} ohm resistors for ^{238}U, ^{232}Th, ^{208}Pb-^{206}Pb, and discrete dynode ion counters for ^{204}Pb and ^{202}Hg. Ion yields are ~0.8 mv per ppm. Each analysis consists of one 15-second integration on peaks with the laser off (for backgrounds), 15 one-second integrations with the laser firing, and a 30 second delay to purge the previous sample and prepare for the next analysis. The analyses involve ablation of zircon with a New Wave UP193HE Excimer laser (operating at a wavelength of 193 nm) The ablation pit is typically 30 microns in diameter and ~15 microns in depth. For each analysis, the errors in determining ^{206}Pb/^{238}U and ^{206}Pb/^{204}Pb result in a measurement error of ~1-2% (at 2-sigma level) in the ^{206}Pb/^{238}U age. The errors in measurement of $^{206}Pb/^{207}Pb$ and $^{206}Pb/^{204}Pb$ also result in ~1-2% (at 2-sigma level) uncertainty in age for grains that are >1.0 Ga, but are substantially larger for younger grains due to low intensity of the ^{207}Pb signal. For most analyses, the cross-over in precision of $^{206}Pb/^{238}U$ and $^{206}Pb/^{207}Pb$ ages occurs at ~1.0 Ga.

^{204}Hg interference with ^{204}Pb is accounted for measurement of ^{202}Hg during laser ablation and subtraction of ^{204}Hg according to the natural $^{202}Hg/^{204}Hg$ of 4.35. This Hg is correction is not significant for most analyses because Hg backgrounds in the Nu instrument are low (generally ~150 cps at mass 204). Common Pb correction is accomplished by using the Hg-corrected ^{204}Pb and assuming an initial Pb composition from Stacey and Kramers (1975). Uncertainties of 1.5 for $^{206}Pb/^{204}Pb$ and 0.3 for $^{207}Pb/^{204}Pb$ are applied to these compositional values based on the variation in Pb isotopic composition in modern crystal rocks.

Inter-element fractionation of Pb/U is generally ~5%, whereas apparent fractionation of Pb isotopes is generally <0.2%. In-run analysis of fragments of a large zircon crystal (generally every fifth measurement) with known age of 563.5 ± 3.2 Ma (2-sigma error) is used to correct for this fractionation. The uncertainty resulting from the calibration correction is generally 1-2% (2-sigma) for both $^{206}Pb/^{207}Pb$ and $^{206}Pb/^{238}U$ ages. Concentrations of U and Th are calibrated relative to the Sri Lanka zircon standard, which contains ~518 ppm of U and 68 ppm Th.

Inter-element fractionation for both the GVI Isoprobe and Nu HR ICPMS instrument measurements were monitored by reference to a concordant Sri Lanka zircon standard with a known (ID-TIMS) age of 563.5 ± 3.2 Ma (2-sigma). The standard zircon was analyzed once for every four unknowns for the magmatic samples, and once for every five unknowns for the Lusardi detrital zircon sample for which a protocol was established to ensure random selection of grains. In this study, interpreted ages are based on $^{206}Pb/^{207}Pb$ ratios for grains >900 Ma, and $^{206}Pb/^{238}U$ ratios for grains <900 Ma.

The analytical data are reported in Table 3 below. Uncertainties shown in the table are at the 1-sigma level, and include only measurement errors. The resulting interpreted ages are shown on U/Pb age-frequency spectra and relative age-probability diagrams using the routines in Isoplot (Ludwig, 2008). The age-probability diagrams show each age and its uncertainty (for measurement error only) as a normal distribution, and sum all ages from a sample into a single curve.

X-RAY FLUORESCENCE SPECTROMETRY WHOLE ROCK DATA

Major and trace element analyses for nineteen samples were obtained at the San Diego State University analytical facilities by X-ray fluorescence spectrometry. A RockLabs® hydraulic crusher/splitter was employed to break up samples and select ~150 grams of fresh (least weathered) chips. Whole-rock powders were prepared from this material using a tungsten carbide shatter box. Powders for major and minor elements were dried for 24 hours in an oven at ~100º C. Powders for major elements were mixed with lithium tetraborate in a 6:1 ratio and formed into fused glass discs using a HD Electronik auto fuser. Trace elements were analyzed by mixing dried powder with elvacite that was then pressed into pellets using a Spex Certiprep press model 3264B. Loss on ignition (LOI) was performed at ~1000º C on samples initially dried at ~100º C for 24 hours.

Elemental concentrations on glass discs and pellets were measured using an automated Philips MagiX Pro X-ray spectrometer. The Magix Pro is equipped with a 4kW light element super-sharp RH target end window X-ray tube, close-coupled optics for maximum signal strength, a full set of analyzer crystals for the analysis of elements in the range of O-U, 3 detectors (a flow and a sealed proportional detector in tandem, plus a scintillation detector in parallel), a 4kW/ 125mA solid state X-ray generator, and automatic 36 sample changer. The system utilizes the Philips SuperQ Data Collection and Evaluation Software, v3.0; the IQ+ Standardless Analysis Software; and ProTrace. The instrument is calibrated using international rock standards including AGV-1, AGV-2, BCR-2, BHVO-2, BIR-1, DNC-1, DTS-1, GSP-1,GSP-2, MAG-1, PCC-1, QLO-1, RGM-1, SCo-1, SDC-1, STM-1 W-2, LKSD-2, STSD-2, SY-4, TILL-2 and TILL-3. Precision and accuracy is demonstrated by comparison to accepted values of standard samples and comparison of values acquired in other laboratories.

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Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETERY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U (ppm)	206Pb 204Pb	U/Th	206Pb 207Pb	± (%)	207Pb* 235U	± (%)	206Pb* 238U	± (%)	error corr.	206Pb* 238U	± (Ma)	207Pb* 235U	± (Ma)	206Pb* 207Pb*	± (Ma)	Best age (Ma)	± (Ma)
VRSFTC																		
VRSFTC-1	100	1159	2.2	16.520	8.3	0.13081	10.4	0.02015	3.4	0.33	128.6	4.3	124.8	12.2	53	234.5	128.6	4.3
VRSFTC-2	87	1138	2.3	15.605	7.8	0.14088	10.0	0.02028	3.6	0.36	129.4	4.6	133.8	12.5	213	216.1	129.4	4.6
VRSFTC-3	66	883	2.5	13.956	11.4	0.15246	14.0	0.02038	3.2	0.23	130.0	4.1	144.1	18.8	382	307.1	130.0	4.1
VRSFTC-7	100	1494	1.4	16.171	5.4	0.14381	7.5	0.02040	1.9	0.25	130.2	2.4	136.4	9.6	247	167.7	130.2	2.4
VRSFTC-5	230	2891	1.7	18.781	2.6	0.13421	4.2	0.02057	1.5	0.35	131.2	1.9	127.9	5.1	66	93.9	131.2	1.9
VRSFTC-11	206	2733	1.6	17.519	4.1	0.14447	5.2	0.02060	2.2	0.43	131.4	2.9	137.0	6.6	235	107.3	131.4	2.9
VRSFTC-4	102	1099	2.1	16.134	4.4	0.13600	6.0	0.02062	1.8	0.30	131.6	2.3	129.5	7.3	91	136.6	131.6	2.3
VRSFTC-9	178	2924	1.3	17.376	3.4	0.14779	4.8	0.02074	2.1	0.43	132.3	2.7	140.0	6.3	272	100.0	132.3	2.7
VRSFTC-16	126	1475	1.7	16.315	4.5	0.14447	6.7	0.02078	3.8	0.57	132.6	5.0	137.0	8.6	214	127.5	132.6	5.0
VRSFTC-61	316	4570	2.6	18.835	3.4	0.14098	4.3	0.02088	1.3	0.29	133.2	1.7	133.9	5.4	147	97.5	133.2	1.7
VRSFTC-8	206	4020	1.3	18.050	4.3	0.14696	5.6	0.02095	2.4	0.43	133.7	3.1	139.2	7.2	235	116.1	133.7	3.1
VRSFTC-10	147	1300	2.3	17.546	7.6	0.12996	17.4	0.02100	3.0	0.17	134.0	4.0	124.1	20.4	-62	421.7	134.0	4.0
VRSFTC-15	209	4332	1.3	18.133	4.5	0.14724	5.2	0.02101	2.4	0.46	134.0	3.2	139.5	6.8	233	107.5	134.0	3.2
VRSFTC-12	148	2681	2.4	17.508	3.9	0.14770	5.5	0.02108	3.1	0.57	134.5	4.2	139.9	7.3	232	105.6	134.5	4.2
VRSFTC-14	142	2552	2.1	17.368	9.3	0.14836	10.3	0.02114	3.7	0.36	134.9	5.0	140.5	13.5	236	221.7	134.9	5.0
VRSFTC-6	111	1902	2.2	15.904	5.9	0.16316	7.7	0.02181	1.8	0.23	139.1	2.5	153.5	10.9	382	167.8	139.1	2.5
PQ053																		
T0514-PQ053-3	101	1303	2.6	17.073	30.8	0.12110	31.1	0.02230	3.4	0.11	142.1	4.8	116.1	34.1	-391	820.1	142.1	4.8
T0514-PQ053-11	80	896	2.1	18.080	33.7	0.09465	34.7	0.02234	5.2	0.15	142.5	7.3	91.8	30.5	-1086	1061.4	142.5	7.3
T0514-PQ053-12	69	962	2.3	11.388	19.2	0.18961	20.0	0.02242	4.3	0.21	142.9	6.0	176.3	32.4	651	423.0	142.9	6.0
T0514-PQ053-21	116	1567	2.2	14.498	18.8	0.15878	19.2	0.02252	2.6	0.14	143.5	3.7	149.6	26.7	247	441.8	143.5	3.7
T0514-PQ053-9	40	639	3.3	3.943	236.5	0.61888	236.6	0.02264	6.9	0.03	144.3	9.9	489.1	1519.1	2812	282.1	144.3	9.9
T0514-PQ053-9	57	863	2.5	15.087	56.8	0.12148	57.5	0.02270	6.2	0.11	144.7	8.9	116.4	63.3	-429	1620.3	144.7	8.9
T0514-PQ053-2	49	701	2.6	8.515	34.4	0.25318	35.3	0.02272	7.0	0.20	144.8	10.0	229.2	72.6	1217	702.0	144.8	10.0
T0514-PQ053-10	46	696	2.4	13.426	60.9	0.13273	61.7	0.02279	6.1	0.10	145.3	8.7	126.6	73.6	-212	1695.5	145.3	8.7
T0514-PQ053-15	37	511	3.5	5.195	141.9	0.43526	142.1	0.02280	5.8	0.04	145.3	8.4	366.9	468.0	2208	250.2	145.3	8.4
T0514-PQ053-24	330	3383	1.4	16.248	14.0	0.16213	14.1	0.02282	1.2	0.08	145.5	1.7	152.6	20.0	264	323.5	145.5	1.7
T0514-PQ053-14	31	528	3.4	8.196	67.2	0.24477	67.8	0.02295	7.4	0.11	146.3	10.8	222.3	136.3	1130	1547.5	146.3	10.8
T0514-PQ053-4	45	708	3.6	6.340	21.5	0.37540	22.4	0.02304	6.1	0.27	146.8	8.9	323.6	62.3	1929	391.8	146.8	8.9
T0514-PQ053-13	70	1072	2.6	12.061	21.3	0.18581	22.0	0.02316	4.6	0.21	147.6	6.7	173.0	35.0	537	476.0	147.6	6.7
T0514-PQ053-16	37	534	2.4	8.903	46.2	0.21910	46.7	0.02326	6.5	0.14	148.2	9.5	201.2	85.5	878	1012.7	148.2	9.5
T0514-PQ053-7	59	768	3.3	13.474	37.7	0.14199	38.2	0.02343	2.7	0.07	149.3	4.0	134.8	48.3	-113	969.0	149.3	4.0
T0514-PQ053-22	29	483	3.4	14.573	91.0	0.08634	93.3	0.02345	8.1	0.09	149.4	11.9	84.1	75.5	-1532	1915.4	149.4	11.9
T0514-PQ053-18	61	928	3.7	13.464	44.8	0.15740	45.1	0.02353	3.3	0.07	149.9	4.9	148.4	62.3	124	1109.9	149.9	4.9
T0514-PQ053-23	78	1161	2.8	14.023	36.2	0.16013	36.5	0.02354	3.2	0.09	150.0	4.8	150.8	51.2	164	875.0	150.0	4.8
T0514-PQ053-17	110	905	2.6	13.725	22.9	0.15542	23.5	0.02357	3.0	0.13	150.2	4.4	146.7	32.2	91	559.9	150.2	4.4
T0514-PQ053-19	39	725	2.5	7.683	24.8	0.30229	26.7	0.02377	9.3	0.35	151.4	14.0	268.2	62.9	1472	481.6	151.4	14.0
T0514-PQ053-25	38	540	1.9	11.001	34.4	0.16510	35.8	0.02378	8.5	0.24	151.5	12.7	155.2	51.5	212	827.2	151.5	12.7
T0514-PQ053-10	25	359	3.6	7.061	119.2	0.26424	119.8	0.02378	9.3	0.08	151.5	13.9	238.1	259.7	1211	288.2	151.5	13.9
T0514-PQ053-8	38	547	4.0	8.405	26.3	0.24963	27.1	0.02388	6.0	0.22	152.1	9.0	226.3	55.1	1090	539.7	152.1	9.0
T0514-PQ053-1	54	866	4.2	10.948	31.3	0.20322	31.9	0.02396	4.9	0.15	152.6	7.4	187.8	54.7	657	691.0	152.6	7.4
T0514-PQ053-7	27	435	3.5	5.692	34.9	0.40452	36.2	0.02432	9.0	0.25	154.9	13.8	344.9	106.2	1966	646.5	154.9	13.8
T0514-PQ053-5	109	1729	1.6	16.819	15.9	0.15805	16.2	0.02632	2.4	0.15	167.5	4.0	149.0	22.5	-136	399.6	167.5	4.0
CD0502																		
T0514-CD0502-5	87	1082	2.7	14.496	48.8	0.14244	49.2	0.02223	3.4	0.07	141.7	4.8	135.2	62.3	22	1246.3	141.7	4.8
T0514-CD0502-15	219	2631	0.9	15.608	9.4	0.15974	9.4	0.02236	0.7	0.07	142.5	1.0	150.5	13.2	277	216.1	142.5	1.0
T0514-CD0502-7	146	1860	1.6	13.749	13.5	0.17879	14.2	0.02283	3.7	0.26	145.5	5.3	167.0	21.8	483	302.8	145.5	5.3

Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETRY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U	206Pb	U/Th	206Pb	±	207Pb*	±	206Pb*	±	error	206Pb*	±	207Pb*	±	206Pb*	±	Best age	±
	(ppm)	204Pb		207Pb	(%)	235U	(%)	238U	(%)	corr.	238U	(Ma)	235U	(Ma)	207Pb*	(Ma)	(Ma)	(Ma)
T0514-CD0502-8	219	2159	1.3	16.616	11.9	0.14795	12.1	0.02284	1.7	0.14	145.6	2.4	140.1	15.8	48	286.1	145.6	2.4
T0514-CD0502-9	57	994	3.3	11.829	58.6	0.18303	59.0	0.02298	5.0	0.08	146.4	7.2	170.7	92.9	521	1415.2	146.4	7.2
T0514-CD0502-2	69	909	3.1	11.208	26.8	0.19647	27.1	0.02327	2.5	0.09	148.3	3.7	182.1	45.3	648	590.1	148.3	3.7
T0514-CD0502-14	125	1479	2.0	14.757	28.9	0.15936	29.0	0.02331	2.1	0.07	148.6	3.0	150.1	40.5	175	688.1	148.6	3.0
T0514-CD0502-13	119	1688	2.0	13.801	19.0	0.17917	19.3	0.02352	2.2	0.11	149.9	3.2	167.3	29.8	422	432.3	149.9	3.2
T0514-CD0502-12	55	764	2.1	12.846	33.8	0.15348	34.7	0.02354	5.8	0.17	150.0	8.5	145.0	46.9	64	835.8	150.0	8.5
T0514-CD0502-4	57	813	2.6	11.673	37.7	0.18427	38.3	0.02391	4.5	0.12	152.3	6.8	171.7	60.5	448	873.8	152.3	6.8
T0514-CD0502-3	52	870	2.7	7.135	143.9	0.34044	144.0	0.02395	5.2	0.04	152.6	7.8	297.5	389.5	1680	105.7	152.6	7.8
T0514-CD0502-11	87	1499	1.5	16.217	36.8	0.14605	37.1	0.02430	4.2	0.11	154.8	6.4	138.4	48.0	-134	939.5	154.8	6.4
T0514-CD0502-10	142	1934	1.7	18.072	19.0	0.15237	20.3	0.02685	6.6	0.33	170.8	11.1	144.0	27.2	-278	491.4	170.8	11.1
CD0501																		
T0514-CD0501-6	63	689	1.4	8.627	34.8	0.23438	35.6	0.02104	6.0	0.17	134.2	7.9	213.8	68.7	1216	711.5	134.2	7.9
T0514-CD0501-7	253	2720	1.7	16.818	18.5	0.14082	18.6	0.02134	1.9	0.10	136.1	2.5	133.8	23.3	92	441.1	136.1	2.5
T0514-CD0501-10	74	549	3.4	9.966	32.3	0.18198	33.0	0.02157	4.8	0.15	137.6	6.5	169.8	51.7	646	720.6	137.6	6.5
T0514-CD0501-5	68	803	1.9	9.674	20.1	0.22103	20.4	0.02223	2.9	0.14	141.7	4.1	202.8	37.5	989	414.6	141.7	4.1
T0514-CD0501-3	580	4794	1.4	17.026	8.7	0.16006	10.9	0.02264	6.5	0.60	144.3	9.2	150.8	15.2	254	201.0	144.3	9.2
T0514-CD0501-9	421	4576	2.1	19.167	16.5	0.13890	16.6	0.02273	1.3	0.08	144.9	1.8	132.1	20.6	-93	408.7	144.9	1.8
T0514-CD0501-1	53	560	2.6	11.179	24.7	0.16263	28.8	0.02327	5.4	0.19	148.3	8.0	153.0	40.9	227	665.4	148.3	8.0
T0514-CD0501-8	47	671	2.1	8.674	56.1	0.25332	56.5	0.02334	5.1	0.09	148.7	7.4	229.3	116.5	1165	1221.0	148.7	7.4
T0514-CD0501-4	35	620	2.1	6.924	25.7	0.33283	26.8	0.02348	6.3	0.24	149.6	9.4	291.7	68.1	1675	490.4	149.6	9.4
T0514-CD0501-13	166	1800	0.4	17.585	32.0	0.13752	32.3	0.02376	3.3	0.10	151.4	4.9	130.8	39.6	-228	826.8	151.4	4.9
T0514-CD0501-12	605	6721	1.2	18.776	5.1	0.15592	6.7	0.02401	4.3	0.64	153.0	6.4	147.1	9.2	54	123.1	153.0	6.4
T0514-CD0501-2	309	3246	7.4	16.413	10.7	0.17329	10.9	0.02475	1.7	0.15	157.6	2.6	162.3	16.4	231	249.4	157.6	2.6
Peñasquitos Formation n = 83																		
LUSARDICYN-58	158	3724	0.8	21.1805	17.7	0.1383	17.8	0.0213	1.8	0.10	135.6	2.5	131.6	22.0	60	425.2	135.6	2.5
LUSARDICYN-31	366	13490	1.0	20.8120	10.9	0.1496	11.0	0.0226	1.6	0.14	143.9	2.2	141.5	14.6	102	258.9	143.9	2.2
LUSARDICYN-50	350	3961	2.0	22.3804	6.0	0.1405	6.2	0.0228	1.5	0.24	145.3	2.2	133.5	7.8	-73	147.6	145.3	2.2
LUSARDICYN-18	106	3211	1.7	19.5952	18.0	0.1611	18.1	0.0229	2.2	0.12	146.0	3.2	151.7	25.6	242	417.5	146.0	3.2
LUSARDICYN-97	475	9233	1.9	20.9329	5.5	0.1540	6.1	0.0234	2.6	0.42	149.0	3.8	145.4	8.3	88	131.5	149.0	3.8
LUSARDICYN-13	466	12120	0.7	20.6622	5.2	0.1565	5.5	0.0234	1.9	0.35	149.4	2.9	147.6	7.6	119	122.3	149.4	2.9
LUSARDICYN-99	290	8737	0.9	21.2468	7.0	0.1542	7.3	0.0238	2.2	0.30	151.4	3.3	145.6	9.9	53	167.2	151.4	3.3
LUSARDICYN-47	300	5244	1.2	21.6594	6.4	0.1545	6.6	0.0243	1.5	0.23	154.6	2.3	145.9	9.0	6	154.8	154.6	2.3
LUSARDICYN-62	189	6669	1.2	20.7505	13.5	0.1628	13.6	0.0245	0.8	0.06	156.0	1.2	153.2	19.3	109	321.0	156.0	1.2
LUSARDICYN-57	137	3576	33.9	20.8543	19.8	0.1628	20.0	0.0246	2.8	0.14	156.8	4.3	153.2	28.5	97	473.1	156.8	4.3
LUSARDICYN-92	299	4550	2.1	21.2431	7.0	0.1607	7.4	0.0248	2.2	0.30	157.6	3.4	151.3	10.4	53	168.4	157.6	3.4
LUSARDICYN-82	414	3113	1.7	21.6190	3.6	0.1611	4.4	0.0253	2.5	0.58	160.8	4.0	151.7	6.2	11	85.9	160.8	4.0
LUSARDICYN-60	323	5077	2.1	20.0456	8.2	0.1748	8.3	0.0254	1.4	0.17	161.7	2.3	163.5	12.5	190	190.3	161.7	2.3
LUSARDICYN-79	437	4846	1.0	20.8218	3.5	0.1685	4.1	0.0254	2.2	0.53	162.0	3.5	158.1	6.0	101	82.8	162.0	3.5
LUSARDICYN-80	378	3753	2.7	21.9514	4.7	0.1610	5.0	0.0256	1.9	0.38	163.2	3.1	151.6	7.1	-26	113.2	163.2	3.1
LUSARDICYN-81	186	2070	1.7	26.4602	10.2	0.1341	10.3	0.0257	1.0	0.09	163.8	1.5	127.8	12.3	-500	272.6	163.8	1.5
LUSARDICYN-46	245	4776	3.1	22.5831	8.7	0.1759	8.9	0.0288	2.1	0.23	183.1	3.7	164.5	13.6	-95	213.6	183.1	3.7
LUSARDICYN-19	91	6652	1.7	20.2504	10.2	0.1981	10.4	0.0291	2.0	0.19	184.9	3.7	183.5	17.5	166	240.0	184.9	3.7
LUSARDICYN-1	180	4104	4.3	18.8419	7.1	0.2244	7.2	0.0307	1.0	0.14	194.7	1.9	205.6	13.4	332	161.8	194.7	1.9
LUSARDICYN-66	117	2323	0.9	18.8791	9.7	0.2319	10.0	0.0318	2.3	0.23	201.5	4.5	211.8	19.1	327	220.9	201.5	4.5
LUSARDICYN-11	293	13379	0.8	20.6691	4.7	0.2321	4.9	0.0348	1.2	0.26	220.5	2.7	211.9	9.3	118	111.4	220.5	2.7
LUSARDICYN-67	487	13270	2.0	19.8891	1.7	0.2669	3.8	0.0385	3.4	0.90	243.6	8.1	240.2	8.1	208	38.9	243.6	8.1
LUSARDICYN-48	153	1429	1.4	21.3619	12.2	0.2673	12.5	0.0414	2.3	0.18	261.6	5.9	240.5	26.7	40	293.9	261.6	5.9
LUSARDICYN-4	106	5923	1.4	22.0281	7.3	0.2989	7.5	0.0477	1.9	0.26	300.7	5.7	265.5	17.6	-34	176.9	300.7	5.7
LUSARDICYN-21	1137	107638	15.7	18.7936	0.9	0.3883	2.3	0.0529	2.1	0.91	332.4	6.7	333.1	6.4	338	21.2	332.4	6.7
LUSARDICYN-55	159	2318	1.7	18.9836	6.9	0.4000	7.1	0.0551	1.7	0.24	345.6	5.6	341.7	20.6	315	157.0	345.6	5.6
LUSARDICYN-87	89	5311	2.0	17.8503	5.0	0.4702	5.2	0.0609	1.4	0.26	380.9	5.0	391.3	17.0	453	112.1	380.9	5.0
LUSARDICYN-28	583	46059	1.6	18.1627	1.5	0.4633	2.0	0.0610	1.3	0.65	381.9	4.8	386.6	6.3	415	33.2	381.9	4.8
LUSARDICYN-45	682	55660	2.3	18.4727	1.1	0.4648	1.6	0.0623	1.1	0.71	389.4	4.3	387.6	5.1	377	25.2	389.4	4.3
LUSARDICYN-85	474	12815	27.5	17.4078	1.6	0.4988	2.4	0.0630	1.8	0.76	393.7	6.9	410.9	8.1	509	34.2	393.7	6.9
LUSARDICYN-36	232	17982	9.3	18.2312	2.4	0.4897	3.4	0.0647	2.5	0.72	404.4	9.6	404.7	11.4	406	53.1	404.4	9.6
LUSARDICYN-25	233	13965	0.9	18.1774	2.5	0.5360	2.7	0.0707	1.0	0.37	440.1	4.3	435.8	9.6	413	56.5	440.1	4.3

Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETERY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U (ppm)	206Pb/204Pb	U/Th	206Pb/207Pb	± (%)	207Pb*/235U	± (%)	206Pb*/238U	± (%)	error corr.	206Pb*/238U	± (Ma)	207Pb*/235U	± (Ma)	206Pb*/207Pb*	± (Ma)	Best age (Ma)	± (Ma)
LUSARDICYN-90	730	23577	2.1	17.7335	1.2	0.5825	2.5	0.0749	2.2	0.88	465.7	10.0	466.0	9.4	468	25.9	465.7	10.0
LUSARDICYN-35	175	19108	3.2	17.7779	2.8	0.5890	3.4	0.0759	2.0	0.59	471.9	9.1	470.2	12.9	462	61.4	471.9	9.1
LUSARDICYN-33	244	62536	4.1	16.9915	0.7	0.6968	1.6	0.0859	1.4	0.90	531.1	7.4	536.9	6.7	562	15.5	531.1	7.4
LUSARDICYN-59	181	18508	1.8	16.6942	3.8	0.7640	3.9	0.0925	0.8	0.21	570.3	4.4	576.3	17.1	600	82.6	570.3	4.4
LUSARDICYN-30	152	15522	0.4	16.5537	2.3	0.7849	2.4	0.0942	0.8	0.33	580.6	4.3	588.3	10.7	618	48.7	580.6	4.3
LUSARDICYN-16	169	18915	0.6	16.8216	4.5	0.7854	4.7	0.0958	1.3	0.28	589.8	7.5	588.5	21.2	584	98.8	589.8	7.5
LUSARDICYN-10	232	37781	0.8	16.6838	1.5	0.8024	2.8	0.0971	2.4	0.85	597.3	13.6	598.2	12.7	601	32.1	597.3	13.6
LUSARDICYN-61	372	49597	2.0	16.5592	1.0	0.8334	3.8	0.1001	3.6	0.96	615.0	21.4	615.5	17.5	618	22.6	615.0	21.4
LUSARDICYN-24	90	9959	0.4	15.9616	4.1	0.8808	5.1	0.1020	3.1	0.60	625.9	18.5	641.4	24.5	696	87.4	625.9	18.5
LUSARDICYN-27	174	21887	0.8	16.5042	4.4	0.8733	4.6	0.1045	1.5	0.32	640.9	8.9	637.4	21.8	625	94.2	640.9	8.9
LUSARDICYN-64	189	17470	2.4	15.0666	2.2	1.1174	4.3	0.1221	3.7	0.86	742.6	25.9	761.7	23.0	818	45.5	742.6	25.9
LUSARDICYN-86	243	30968	2.8	14.1936	1.1	1.4690	1.6	0.1512	1.1	0.72	907.8	9.5	917.7	9.4	942	22.0	941.6	22.0
LUSARDICYN-84	55	8114	1.8	14.0767	3.4	1.6792	4.1	0.1714	2.2	0.53	1020.0	20.4	1000.7	25.9	959	70.4	958.5	70.4
LUSARDICYN-91	152	15140	2.6	13.9490	0.8	1.5042	2.6	0.1522	2.5	0.96	913.1	21.4	932.1	16.1	977	15.9	977.1	15.9
LUSARDICYN-72	239	30076	3.8	13.9119	1.2	1.5697	2.2	0.1584	1.8	0.83	947.7	15.8	958.3	13.4	983	24.5	982.6	24.5
LUSARDICYN-43	76	14445	2.9	13.8103	1.5	1.7213	2.1	0.1724	1.4	0.68	1025.3	13.3	1016.5	13.2	997	30.7	997.5	30.7
LUSARDICYN-101	355	74161	8.9	13.7493	0.5	1.7080	2.5	0.1703	2.5	0.98	1013.9	23.5	1011.5	16.3	1006	9.5	1006.5	9.5
LUSARDICYN-7	135	48456	1.9	13.7183	0.8	1.7257	2.2	0.1717	2.0	0.92	1021.5	19.3	1018.2	14.2	1011	17.1	1011.0	17.1
LUSARDICYN-37	1242	104106	2.0	13.6794	0.4	1.6178	3.1	0.1605	3.1	0.99	959.6	27.4	977.2	19.5	1017	7.7	1016.8	7.7
LUSARDICYN-95	372	28368	11.3	13.6726	1.0	1.5462	1.8	0.1533	1.5	0.84	919.6	13.1	949.0	11.2	1018	20.1	1017.8	20.1
LUSARDICYN-68	325	38090	6.2	13.5859	0.4	1.6979	1.8	0.1673	1.7	0.98	997.2	16.1	1007.7	11.4	1031	7.1	1030.7	7.1
LUSARDICYN-44	98	30539	1.7	13.5275	1.8	1.8161	3.1	0.1782	2.5	0.81	1057.0	24.8	1051.3	20.5	1039	37.0	1039.4	37.0
LUSARDICYN-73	371	34644	1.9	13.4997	0.9	1.7101	3.1	0.1674	3.0	0.96	998.0	27.8	1012.3	20.2	1044	18.7	1043.5	18.7
LUSARDICYN-9	720	60991	2.4	13.3156	2.3	1.8297	2.9	0.1767	1.7	0.59	1048.9	16.7	1056.2	19.1	1071	47.2	1071.2	47.2
LUSARDICYN-2	130	14513	4.5	13.2772	4.1	1.8786	5.7	0.1809	4.0	0.70	1071.9	39.8	1073.6	38.1	1077	82.3	1077.0	82.3
LUSARDICYN-17	149	35091	1.1	13.2162	1.7	1.8927	2.7	0.1814	2.1	0.77	1074.8	20.6	1078.5	18.0	1086	34.9	1086.2	34.9
LUSARDICYN-103	82	21921	0.8	13.0073	0.9	1.9346	3.3	0.1825	3.1	0.96	1080.6	31.0	1093.1	21.8	1118	18.9	1118.1	18.9
LUSARDICYN-104	78	19335	2.1	12.9291	3.5	2.0916	3.8	0.1961	1.6	0.42	1154.5	16.7	1146.1	26.1	1130	68.8	1130.1	68.8
LUSARDICYN-12	23	7131	0.8	12.9264	4.1	1.8411	8.4	0.1726	7.4	0.87	1026.4	70.0	1060.2	55.6	1131	81.6	1130.5	81.6
LUSARDICYN-88	182	22108	4.1	12.8942	1.9	1.8676	5.1	0.1747	4.7	0.93	1037.7	45.3	1069.7	33.6	1135	37.5	1135.5	37.5
LUSARDICYN-40	172	37258	2.9	12.7144	1.2	2.1042	2.5	0.1940	2.3	0.89	1143.2	23.6	1150.2	17.5	1163	23.5	1163.3	23.5
LUSARDICYN-69	156	30362	1.7	12.7102	0.9	2.1000	2.4	0.1936	2.2	0.93	1140.7	23.2	1148.8	16.4	1164	17.8	1164.0	17.8
LUSARDICYN-98	333	61003	4.2	12.6841	0.4	2.0348	2.2	0.1872	2.1	0.98	1106.1	21.7	1127.2	14.8	1168	7.7	1168.1	7.7
LUSARDICYN-3	278	54558	2.0	12.5682	0.7	2.2138	2.4	0.2018	2.3	0.96	1185.0	25.1	1185.4	17.0	1186	13.9	1186.3	13.9
LUSARDICYN-6	286	48750	4.9	12.5097	1.1	2.1468	3.8	0.1948	3.7	0.96	1147.2	38.7	1164.0	26.6	1195	21.0	1195.4	21.0
LUSARDICYN-56	56	21688	2.1	12.2369	1.8	2.3687	2.6	0.2102	1.8	0.70	1230.0	20.1	1233.2	18.3	1239	35.7	1238.8	35.7
LUSARDICYN-42	44	8947	2.5	12.1667	2.8	2.4669	3.3	0.2177	1.9	0.56	1269.6	21.5	1262.4	24.2	1250	54.3	1250.1	54.3
LUSARDICYN-96	28	8975	1.0	11.6497	4.2	2.6207	4.8	0.2214	2.4	0.50	1289.4	28.4	1306.5	35.4	1335	80.3	1334.5	80.3
LUSARDICYN-65	60	23871	2.1	11.2834	2.2	2.8665	2.8	0.2346	1.8	0.64	1358.4	21.8	1373.1	21.0	1396	41.3	1396.1	41.3
LUSARDICYN-49	86	5132	2.1	11.2734	2.2	2.8216	3.5	0.2307	2.8	0.78	1338.2	33.5	1361.3	26.5	1398	42.0	1397.8	42.0
LUSARDICYN-100	84	43303	1.2	11.0168	1.0	3.1182	2.3	0.2491	2.1	0.91	1434.1	26.7	1437.2	17.6	1442	18.5	1441.8	18.5
LUSARDICYN-75	159	46725	1.7	10.9263	0.9	3.1896	2.5	0.2528	2.3	0.93	1452.7	30.1	1454.6	19.2	1457	17.2	1457.5	17.2
LUSARDICYN-26	204	25800	1.1	10.0689	1.0	3.4352	3.8	0.2509	3.6	0.97	1442.9	47.0	1512.5	29.6	1611	18.3	1611.3	18.3
LUSARDICYN-41	62	15062	0.8	9.6233	1.2	4.3100	2.6	0.3008	2.3	0.89	1695.4	34.9	1695.3	21.7	1695	22.2	1695.2	22.2
LUSARDICYN-102	113	43158	2.7	9.5279	0.6	4.2699	1.1	0.2951	0.9	0.84	1666.8	13.9	1687.6	9.3	1714	11.5	1713.5	11.5
LUSARDICYN-20	154	71108	0.9	9.3780	0.5	4.5208	1.8	0.3075	1.7	0.96	1728.3	26.3	1734.8	15.0	1743	9.2	1742.6	9.2
LUSARDICYN-52	209	81858	77.2	9.1984	0.4	4.8144	2.4	0.3212	2.4	0.99	1795.5	36.9	1787.4	20.1	1778	7.2	1778.0	7.2
LUSARDICYN-34	436	213011	2.6	9.1366	0.3	4.7688	1.0	0.3160	0.9	0.96	1770.2	14.3	1779.4	8.1	1790	4.6	1790.3	4.6
LUSARDICYN-15	99	28317	0.9	8.8686	1.1	4.8953	1.7	0.3149	1.4	0.79	1764.6	21.3	1801.4	14.7	1844	19.3	1844.3	19.3
LUSARDICYN-29	80	33074	2.3	8.0976	0.6	6.1175	1.0	0.3593	0.7	0.78	1978.7	12.7	1992.8	8.3	2007	10.5	2007.3	10.5
LUSARDICYN-39	63	23372	1.5	7.6967	0.8	6.7205	2.4	0.3751	2.3	0.94	2053.6	39.7	2075.3	21.2	2097	14.5	2096.9	14.5
49127 standard																		
V0510-49127-1	195	3499	1.0	15.315	22.7	0.16123	22.8	0.02139	1.6	0.07	136.4	2.2	151.8	32.1	399	515.0	136.4	2.2
V0510-49127-10	160	2905	1.9	20.222	32.1	0.11267	32.3	0.02115	2.7	0.08	134.9	3.6	108.4	33.2	-441	864.9	134.9	3.6
V0510-49127-2	251	4671	1.5	18.623	14.6	0.13504	14.6	0.02160	1.0	0.07	137.7	1.4	128.6	17.6	-37	355.1	137.7	1.4
V0510-49127-3	137	2447	0.9	15.430	23.1	0.14906	23.2	0.02101	1.7	0.07	134.0	2.2	141.1	30.6	261	538.3	134.0	2.2
V0510-49127-4	154	2847	1.0	18.721	26.0	0.12504	26.1	0.02148	1.6	0.06	137.0	2.1	119.6	29.5	-214	664.3	137.0	2.1

Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETERY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U (ppm)	206Pb/204Pb	U/Th	206Pb/207Pb	± (%)	207Pb*/235U	± (%)	206Pb*/238U	± (%)	error corr.	206Pb*/238U	± (Ma)	207Pb*/235U	± (Ma)	206Pb*/207Pb*	± (Ma)	Best age (Ma)	± (Ma)
V0510-49127-5	298	5383	1.6	17.451	8.2	0.14649	8.3	0.02147	1.1	0.13	137.0	1.5	138.8	10.8	170	192.9	137.0	1.5
V0510-49127-6	127	2818	0.9	13.153	17.9	0.18424	18.0	0.02126	1.7	0.10	135.6	2.3	171.7	28.4	703	383.5	135.6	2.3
V0510-49127-7	155	3105	1.5	17.301	14.8	0.13589	14.9	0.02108	1.3	0.09	134.5	1.8	129.4	18.2	37	358.1	134.5	1.8
V0510-49127-8	1861	36560	1.7	19.772	2.5	0.14465	2.7	0.02151	1.1	0.39	137.2	1.5	137.2	3.5	137	59.3	137.2	1.5
V0510-49127-9	103	1646	1.1	18.435	49.3	0.11186	49.6	0.02104	3.7	0.07	134.3	4.9	107.7	50.7	-447	1375.3	134.3	4.9
Eugenia Formation - Punta Eugenia n = 53																		
V0510-8	67	1004	1.3	13.076	27.3	0.14336	28.0	0.01987	5.4	0.19	126.8	6.8	136.0	35.6	300	636.5	126.8	6.8
V0510-17	78	1407	2.1	13.853	39.0	0.14846	39.2	0.02039	3.5	0.09	130.1	4.5	140.6	51.5	321	919.5	130.1	4.5
V0510-30	38	750	2.1	11.388	53.0	0.15613	53.5	0.02043	5.8	0.11	130.4	7.5	147.3	73.5	429	1275.8	130.4	7.5
V0510-43	71	1159	2.0	8.103	19.7	0.27512	20.0	0.02048	3.5	0.18	130.7	4.6	246.8	43.9	1575	372.6	130.7	4.6
V0510-46	82	1346	1.8	11.792	29.7	0.18182	30.2	0.02070	3.2	0.11	132.1	4.2	169.6	47.2	732	649.5	132.1	4.2
V0510-42	160	2730	0.9	16.048	15.1	0.14257	15.7	0.02070	3.7	0.24	132.1	4.8	135.3	19.9	193	356.7	132.1	4.8
V0510-9	233	3895	1.7	17.658	20.1	0.13684	20.2	0.02083	1.7	0.08	132.9	2.2	130.2	24.7	82	482.6	132.9	2.2
V0510-59	239	4253	1.2	16.077	14.3	0.15360	14.4	0.02102	1.6	0.11	134.1	2.1	145.1	19.5	329	325.9	134.1	2.1
V0510-31	139	2556	2.0	20.226	21.5	0.10950	21.7	0.02104	1.9	0.09	134.2	2.5	105.5	21.7	-503	580.9	134.2	2.5
V0510-12	148	2888	1.0	14.231	15.5	0.16893	15.7	0.02108	2.0	0.13	134.5	2.7	158.5	23.0	534	341.7	134.5	2.7
V0510-41	82	1427	1.5	13.698	36.0	0.15516	36.3	0.02115	4.0	0.11	134.9	5.4	146.5	49.5	338	841.5	134.9	5.4
V0510-19	60	1403	1.6	19.074	51.0	0.10114	51.4	0.02120	5.2	0.10	135.2	7.0	97.8	48.0	-740	1516.4	135.2	7.0
V0510-56	170	2699	1.0	17.024	18.4	0.13817	18.5	0.02133	1.9	0.10	136.1	2.5	131.4	22.9	48	443.9	136.1	2.5
V0510-15	178	3423	1.5	16.080	11.8	0.15148	12.8	0.02136	4.7	0.36	136.3	6.3	143.2	17.2	260	276.0	136.3	6.3
V0510-48	86	1439	1.5	13.373	21.9	0.16424	22.4	0.02143	4.4	0.19	136.7	5.9	154.4	32.1	436	495.3	136.7	5.9
V0510-23	112	2423	2.5	14.927	23.9	0.15799	24.0	0.02146	2.6	0.11	136.9	3.5	148.9	33.3	345	547.7	136.9	3.5
V0510-60	123	2202	1.8	16.268	18.5	0.14204	19.2	0.02161	5.0	0.26	137.8	6.8	134.9	24.3	83	443.9	137.8	6.8
V0510-13	65	906	1.5	10.020	32.0	0.21290	32.6	0.02162	4.5	0.14	137.9	6.2	196.0	58.1	969	675.4	137.9	6.2
V0510-58	57	1157	1.7	13.852	87.1	0.14746	87.3	0.02166	5.4	0.06	138.2	7.4	139.7	114.4	165	2712.1	138.2	7.4
V0510-40	148	2523	2.7	13.623	18.7	0.17896	19.1	0.02176	3.6	0.19	138.8	4.9	167.2	29.5	591	411.3	138.8	4.9
V0510-54	45	909	1.7	15.038	37.8	0.12284	38.3	0.02188	4.1	0.11	139.5	5.6	117.6	42.6	-305	1005.6	139.5	5.6
V0510-24	83	1587	2.2	23.163	60.7	0.08422	61.0	0.02190	2.8	0.05	139.6	3.8	82.1	48.1	-1388	2142.9	139.6	3.8
V0510-37	42	821	3.5	15.485	86.7	0.11089	87.2	0.02194	6.0	0.07	139.9	8.3	106.8	88.6	-582	3047.6	139.9	8.3
V0510-4	43	872	1.4	11.808	27.1	0.17046	28.1	0.02202	6.5	0.23	140.4	9.0	159.8	41.6	458	617.7	140.4	9.0
V0510-34	125	2378	1.9	15.682	20.5	0.15249	20.8	0.02210	3.1	0.15	140.9	4.3	144.1	28.0	197	482.6	140.9	4.3
V0510-50	78	1267	2.6	10.095	18.7	0.23277	19.2	0.02212	3.8	0.20	141.1	5.4	212.5	36.8	1103	379.6	141.1	5.4
V0510-49	98	1638	1.2	15.534	26.3	0.14538	27.5	0.02214	7.7	0.28	141.2	10.8	137.8	35.4	81	635.9	141.2	10.8
V0510-2	66	811	1.2	11.253	23.3	0.18408	24.1	0.02223	4.7	0.19	141.7	6.6	171.6	38.1	606	518.1	141.7	6.6
V0510-18	65	1188	2.0	15.158	55.4	0.13860	55.7	0.02244	4.2	0.08	143.0	5.9	131.8	69.0	-66	1462.2	143.0	5.9
V0510-39	91	1672	3.4	11.014	19.6	0.22184	20.3	0.02250	5.0	0.25	143.4	7.1	203.4	37.5	972	405.7	143.4	7.1
V0510-38	40	862	2.1	12.187	45.4	0.16814	46.0	0.02265	6.0	0.13	144.4	8.5	157.8	67.3	364	1082.0	144.4	8.5
V0510-6	46	920	1.6	9.295	36.0	0.24915	36.3	0.02282	4.9	0.13	145.4	7.0	225.9	73.7	1177	736.1	145.4	7.0
V0510-3	32	728	1.7	7.981	463.8	0.28248	463.9	0.02290	7.4	0.02	146.0	10.6	252.6		1414	1905.6	146.0	10.6
V0510-1	49	1106	1.6	9.774	53.0	0.24180	53.2	0.02291	4.0	0.08	146.0	5.8	219.9	105.6	1110	1145.8	146.0	5.8
V0510-5	77	848	2.5	9.477	32.8	0.24823	33.5	0.02322	5.0	0.15	148.0	7.4	225.1	67.8	1135	678.2	148.0	7.4
V0510-53	44	823	2.9	10.999	50.1	0.19721	50.5	0.02344	5.4	0.11	149.4	7.9	182.8	84.6	640	1152.1	149.4	7.9
V0510-22	35	708	1.4	15.441	67.8	0.11049	68.5	0.02393	6.5	0.09	152.5	9.7	106.4	69.3	-834	2188.3	152.5	9.7
V0510-32	270	5416	2.9	18.261	7.4	0.16369	7.4	0.02510	0.9	0.13	159.8	1.5	153.9	10.6	65	175.6	159.8	1.5
V0510-36	177	2982	2.8	15.191	9.7	0.19128	9.8	0.02546	1.5	0.15	162.1	2.4	177.7	16.0	391	218.8	162.1	2.4
V0510-16	187	3476	3.7	16.556	9.2	0.17669	10.1	0.02548	4.1	0.41	162.2	6.6	165.2	15.4	209	214.7	162.2	6.6
V0510-7	150	1730	3.0	11.970	37.5	0.24360	38.0	0.02587	4.7	0.12	164.7	7.6	221.4	75.8	877	809.4	164.7	7.6
V0510-28	157	2350	2.2	17.228	20.5	0.16602	20.6	0.02625	1.6	0.08	167.0	2.7	156.0	29.8	-9	500.1	167.0	2.7
V0510-44	154	3161	2.3	19.150	17.0	0.15734	17.2	0.02720	2.3	0.13	173.0	3.8	148.4	23.8	-229	433.1	173.0	3.8
V0510-47	458	7140	2.9	17.522	4.3	0.19347	8.0	0.02742	6.7	0.84	174.4	11.6	179.6	13.2	248	100.0	174.4	11.6
V0510-11	134	3548	1.7	16.411	11.4	0.29499	12.4	0.04150	4.3	0.35	262.1	11.1	262.5	28.7	266	267.3	262.1	11.1
V0510-27	186	7368	1.4	15.757	2.6	0.62442	3.2	0.07791	1.8	0.57	483.6	8.4	492.6	12.4	535	57.2	483.6	8.4
V0510-35	364	23417	46.3	16.590	1.9	0.69981	2.0	0.08782	0.6	0.30	542.7	3.1	538.7	8.2	522	41.3	542.7	3.1
V0510-21	213	17676	1.4	14.732	2.8	0.94968	4.9	0.10585	4.0	0.82	648.6	24.6	677.9	24.2	777	59.4	648.6	24.6
V0510-14	250	21125	3.0	13.960	1.7	1.30353	6.6	0.13582	6.3	0.97	821.0	48.9	847.3	37.8	917	35.1	821.0	48.9
V0510-52	278	34627	2.2	13.489	1.0	1.57996	1.4	0.15694	1.0	0.71	939.7	8.8	962.4	8.8	1014	20.3	1014.4	20.3
V0510-57	243	35379	2.2	13.396	1.1	1.76323	1.4	0.17401	0.9	0.66	1034.2	8.9	1032.0	9.1	1027	21.3	1027.5	21.3

Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETERY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U (ppm)	206Pb/204Pb	U/Th	206Pb/207Pb	± (%)	207Pb*/235U	± (%)	206Pb*/238U	± (%)	error corr.	206Pb*/238U	± (Ma)	207Pb*/235U	± (Ma)	206Pb*/207Pb*	± (Ma)	Best age (Ma)	± (Ma)
V0510-33	41	5379	1.9	12.193	4.7	1.75163	5.0	0.17278	1.6	0.33	1027.4	15.6	1027.8	32.4	1028	95.7	1028.5	95.7
V0510-10	92	14484	3.0	12.227	4.0	2.01210	4.4	0.18681	2.0	0.45	1104.1	20.5	1119.6	30.2	1150	78.7	1149.8	78.7
Eugenia Formation - Arroyo La Amargura n = 95																		
V0520-59	213	2970	1.3	16.821	15.3	0.15013	15.5	0.02231	1.5	0.10	142.2	2.2	142.0	20.6	138	365.2	142.2	2.2
V0520-10	230	4230	1.6	17.953	14.3	0.14549	14.4	0.02259	1.6	0.11	144.0	2.3	137.9	18.6	34	344.7	144.0	2.3
V0520-73	124	2376	1.3	14.378	18.6	0.17306	18.8	0.02262	2.2	0.12	144.2	3.1	162.1	28.2	432	419.1	144.2	3.1
V0520-4	260	5741	1.9	19.555	10.0	0.13751	10.1	0.02288	1.2	0.12	145.9	1.7	130.8	12.4	-134	248.0	145.9	1.7
V0520-44	142	3126	2.3	15.658	22.3	0.16613	22.3	0.02302	1.3	0.06	146.7	2.0	156.1	32.3	301	513.9	146.7	2.0
V0520-53	192	3716	2.3	19.706	13.7	0.13164	13.8	0.02303	1.3	0.10	146.8	1.9	125.6	16.3	-260	349.7	146.8	1.9
V0520-49	189	3805	1.7	20.097	28.8	0.12990	28.9	0.02317	2.2	0.08	147.6	3.2	124.0	33.8	-308	751.2	147.6	3.2
V0520-15	115	2368	2.6	18.107	36.3	0.13583	36.5	0.02323	2.3	0.06	148.0	3.4	129.3	44.3	-202	939.1	148.0	3.4
V0520-91	179	3368	2.2	19.205	14.8	0.13520	14.9	0.02327	2.2	0.15	148.3	3.3	128.8	18.1	-218	372.9	148.3	3.3
V0520-38	174	3918	2.2	17.385	11.8	0.15354	12.0	0.02327	1.7	0.14	148.3	2.5	145.0	16.2	92	281.8	148.3	2.5
V0520-48	103	2229	2.3	18.183	19.6	0.13375	20.1	0.02337	2.5	0.13	148.9	3.7	127.5	24.1	-256	508.8	148.9	3.7
V0520-84	173	4014	2.0	17.214	12.8	0.15555	13.0	0.02341	1.6	0.13	149.2	2.4	146.8	17.7	109	304.8	149.2	2.4
V0520-20	123	2665	2.5	18.092	22.8	0.13930	23.1	0.02341	2.6	0.11	149.2	3.8	132.4	28.7	-159	576.9	149.2	3.8
V0520-64	134	2776	1.9	15.817	26.0	0.16439	26.4	0.02343	4.4	0.17	149.3	6.5	154.5	37.9	236	610.3	149.3	6.5
V0520-8	184	3599	1.9	14.980	16.5	0.18140	16.8	0.02346	3.1	0.19	149.5	4.6	169.3	26.2	456	368.3	149.5	4.6
V0520-66	200	3799	2.1	17.215	15.1	0.15684	15.3	0.02348	1.8	0.12	149.6	2.7	147.9	21.0	121	358.7	149.6	2.7
V0520-61	173	3292	2.1	15.861	15.3	0.16921	15.6	0.02353	3.0	0.19	149.9	4.5	158.7	22.9	292	351.5	149.9	4.5
V0520-19	125	2530	2.4	15.013	24.5	0.17399	24.6	0.02355	1.6	0.06	150.0	2.3	162.9	37.1	354	563.0	150.0	2.3
V0520-24	194	3528	1.7	17.561	8.2	0.15345	8.4	0.02360	1.4	0.17	150.4	2.2	145.0	11.3	57	196.6	150.4	2.2
V0520-68	93	1785	2.2	15.125	41.9	0.16289	42.0	0.02361	2.2	0.05	150.4	3.3	153.2	59.8	197	1015.3	150.4	3.3
V0520-16	94	1797	2.6	16.483	35.1	0.14666	35.2	0.02363	2.7	0.08	150.6	4.0	139.0	45.8	-55	878.7	150.6	4.0
V0520-54	118	2750	2.4	18.456	19.7	0.13855	19.8	0.02365	2.2	0.11	150.7	3.3	131.8	24.5	-197	497.8	150.7	3.3
V0520-1	106	2636	1.9	17.502	31.2	0.14543	31.4	0.02366	3.7	0.12	150.8	5.5	137.9	40.6	-79	780.4	150.8	5.5
V0520-56	138	3059	2.6	16.394	21.6	0.16365	21.8	0.02390	2.2	0.10	152.2	3.4	153.9	31.1	179	509.9	152.2	3.4
V0520-9	186	3518	1.9	18.476	14.4	0.14574	14.6	0.02392	2.1	0.14	152.4	3.1	138.1	18.9	-100	356.9	152.4	3.1
V0520-92	144	3630	2.8	18.128	18.6	0.14839	18.7	0.02395	1.4	0.08	152.6	2.2	140.5	24.5	-59	456.8	152.6	2.2
V0520-83	204	3854	1.4	15.712	13.0	0.17802	13.0	0.02404	1.1	0.09	153.1	1.7	166.4	20.0	359	293.9	153.1	1.7
V0520-23	90	1868	1.5	16.255	45.2	0.15323	45.3	0.02406	3.0	0.07	153.3	4.5	144.8	61.3	7	1142.3	153.3	4.5
V0520-87	141	2937	1.7	18.543	12.0	0.14237	12.2	0.02422	1.9	0.15	154.2	2.9	135.2	15.5	-189	302.8	154.2	2.9
V0520-90	144	3192	1.8	16.110	14.6	0.17020	14.9	0.02425	2.2	0.15	154.5	3.4	159.6	22.0	236	340.7	154.5	3.4
V0520-98	408	7291	1.4	19.394	9.8	0.15312	10.0	0.02428	1.8	0.18	154.7	2.8	144.7	13.4	-16	237.1	154.7	2.8
V0520-86	129	2409	2.0	17.205	24.9	0.15254	25.5	0.02445	5.3	0.21	155.7	8.1	144.2	34.3	-42	613.8	155.7	8.1
V0520-89	134	2722	2.3	18.735	44.0	0.14137	44.1	0.02448	2.5	0.06	155.9	3.8	134.3	55.5	-233	1160.1	155.9	3.8
V0520-76	67	1485	2.3	13.763	27.9	0.18115	28.4	0.02455	4.2	0.15	156.4	6.5	169.0	44.2	351	645.2	156.4	6.5
V0520-50	391	5786	0.9	17.631	6.1	0.17130	6.4	0.02485	2.0	0.30	158.2	3.1	160.5	9.6	195	142.9	158.2	3.1
V0520-6	102	1338	2.2	12.052	19.4	0.22187	20.4	0.02542	5.6	0.27	161.8	8.9	203.5	37.6	719	420.5	161.8	8.9
V0520-40	290	6870	1.9	17.465	6.5	0.22095	6.6	0.03143	0.9	0.14	199.5	1.8	202.7	12.1	240	150.4	199.5	1.8
V0520-66	387	10843	1.2	18.046	6.4	0.22927	7.6	0.03299	3.9	0.52	209.2	8.1	209.6	14.3	214	149.7	209.2	8.1
V0520-29	175	4998	2.4	16.435	11.8	0.25370	15.5	0.03496	10.1	0.65	221.5	22.0	229.6	31.9	313	269.4	221.5	22.0
V0520-43	307	11367	1.4	17.918	5.9	0.27109	6.0	0.03867	1.1	0.19	244.6	2.7	243.6	13.1	234	137.2	244.6	2.7
V0520-34	81	2750	1.2	15.737	16.7	0.28377	16.9	0.03995	2.2	0.13	252.5	5.4	253.6	38.0	264	387.6	252.5	5.4
V0520-25	498	15834	1.4	17.789	3.8	0.29126	3.9	0.04010	1.0	0.25	253.5	2.4	259.6	9.0	315	86.4	253.5	2.4
V0520-35	500	13770	1.2	18.239	4.2	0.28590	4.3	0.04052	0.4	0.11	256.1	1.1	255.3	9.6	249	97.5	256.1	1.1
V0520-96	145	4640	1.3	18.316	15.0	0.26179	15.1	0.04089	0.9	0.06	258.4	2.4	236.1	31.8	20	362.9	258.4	2.4
V0520-5	431	12055	1.1	17.898	3.6	0.29109	4.1	0.04092	2.1	0.50	258.5	5.2	259.4	9.5	267	82.6	258.5	5.2
V0520-45	193	6321	2.8	16.477	10.0	0.30279	10.1	0.04095	1.1	0.11	258.7	2.9	268.6	23.9	355	227.4	258.7	2.9
V0520-31	104	3211	2.2	15.455	15.4	0.30552	15.5	0.04109	1.5	0.09	259.6	3.8	270.7	36.9	368	350.4	259.6	3.8
V0520-51	118	4563	2.4	17.865	12.5	0.27049	12.6	0.04147	1.0	0.08	261.9	2.6	243.1	27.3	65	300.9	261.9	2.6
V0520-74	94	3183	3.2	14.908	21.8	0.31810	21.9	0.04154	1.6	0.07	262.4	4.1	280.4	53.8	434	492.7	262.4	4.1
V0520-57	176	6702	1.4	16.917	9.4	0.30452	9.6	0.04236	1.8	0.19	267.4	4.8	269.9	22.8	292	215.6	267.4	4.8
V0520-82	216	8745	1.4	16.627	6.5	0.35487	6.7	0.04758	1.4	0.21	299.6	4.1	308.4	17.8	375	147.0	299.6	4.1
V0520-85	108	4626	2.6	16.521	11.8	0.34924	12.0	0.04906	2.1	0.18	308.7	6.4	304.2	31.5	269	271.4	308.7	6.4
V0520-100	443	11763	1.0	16.768	2.3	0.55157	4.3	0.07019	3.6	0.83	437.3	15.0	446.0	15.4	491	52.4	437.3	15.0
V0520-18	308	22971	1.3	16.553	2.0	0.55767	2.1	0.07073	0.6	0.29	440.5	2.5	450.0	7.5	499	43.5	440.5	2.5

Table 3. U-Pb ZIRCON GEOCHRONOLOGIC ANALYSES BY LASER-ABLATION MULTICOLLECTOR ICP MASS SPECTROMETERY

				Isotopic ratios							Apparent ages (Ma)							
Analysis	U	206Pb	U/Th	206Pb	±	207Pb*	±	206Pb*	±	error	206Pb*	±	207Pb*	±	206Pb*	±	Best age	±
	(ppm)	204Pb		207Pb	(%)	235U	(%)	238U	(%)	corr.	238U	(Ma)	235U	(Ma)	207Pb*	(Ma)	(Ma)	(Ma)
V0520-75	29	2200	0.9	13.851	22.0	0.59190	22.1	0.07542	1.9	0.09	468.7	8.7	472.1	83.6	489	491.2	468.7	8.7
V0520-46	100	3534	1.5	12.974	20.9	0.72648	21.5	0.07790	4.5	0.21	483.6	21.1	554.5	92.0	857	440.4	483.6	21.1
V0520-58	175	11798	1.5	16.055	3.6	0.61726	3.9	0.07793	1.4	0.38	483.7	6.8	488.1	14.9	509	78.5	483.7	6.8
V0520-99	384	13531	4.4	16.662	2.2	0.63014	3.2	0.07958	2.3	0.72	493.6	11.0	496.2	12.6	508	48.8	493.6	11.0
V0520-80	456	15681	1.1	16.336	1.5	0.67582	1.9	0.08337	1.1	0.59	516.2	5.5	524.2	7.7	559	33.0	516.2	5.5
V0520-77	157	10239	1.1	15.365	2.8	0.76340	2.9	0.09255	0.5	0.19	570.6	2.9	576.0	12.6	597	60.9	570.6	2.9
V0520-26	145	10841	1.3	14.915	4.1	0.82256	4.3	0.09605	1.5	0.34	591.2	8.3	609.5	19.9	678	87.2	591.2	8.3
V0520-22	79	6877	0.7	16.123	8.9	0.75036	9.0	0.09872	1.2	0.13	606.9	6.8	568.4	39.2	417	199.5	606.9	6.8
V0520-81	35	3491	0.6	12.806	15.2	0.92681	15.5	0.10163	2.8	0.18	624.0	16.6	666.0	75.7	811	320.2	624.0	16.6
V0520-72	662	65475	2.1	16.231	1.2	0.86130	1.3	0.10205	0.6	0.46	626.4	3.7	630.8	6.3	647	25.4	626.4	3.7
V0520-21	157	12575	1.9	14.886	7.3	0.90352	9.1	0.10442	5.4	0.60	640.3	33.1	653.6	43.8	700	155.1	640.3	33.1
V0520-52	45	4119	0.9	14.929	6.9	0.88983	7.0	0.11237	1.4	0.20	686.5	9.3	646.3	33.7	508	151.9	686.5	9.3
V0520-27	604	48238	3.9	13.152	1.0	1.30359	2.3	0.12323	2.0	0.90	749.1	14.3	847.3	13.0	1114	20.0	749.1	14.3
V0520-14	192	19791	2.4	14.126	2.3	1.19369	6.1	0.12805	5.7	0.93	776.7	41.8	797.7	33.9	857	47.0	776.7	41.8
V0520-55	66	7558	1.2	14.593	6.1	1.20153	6.5	0.14063	2.3	0.36	848.2	18.6	801.3	36.3	673	130.8	848.2	18.6
V0520-7	454	48847	2.5	13.803	1.0	1.47913	2.4	0.14797	2.2	0.91	889.6	17.9	921.9	14.4	1000	20.3	889.6	17.9
V0520-17	140	18736	2.5	13.663	3.4	1.43147	4.9	0.14934	3.5	0.72	897.3	29.4	902.2	29.4	914	70.7	897.3	29.4
V0520-71	152	18357	1.8	13.661	2.4	1.55176	2.4	0.16105	0.6	0.23	962.6	4.9	951.2	15.0	925	48.6	962.6	4.9
V0520-79	83	15171	2.7	12.912	2.7	1.72228	2.8	0.17239	0.9	0.31	1025.3	8.1	1016.9	18.1	999	54.5	998.9	54.5
V0520-60	142	20630	2.6	13.440	2.9	1.68946	3.0	0.17142	0.6	0.21	1019.9	5.9	1004.6	18.9	971	59.0	1019.9	5.9
V0520-13	162	24120	1.0	13.206	2.8	1.80539	3.1	0.17868	1.5	0.47	1059.8	14.5	1047.4	20.4	1022	55.8	1021.7	55.8
V0520-36	72	9850	2.4	12.472	3.6	1.71174	3.6	0.16638	0.5	0.14	992.2	4.6	1012.9	23.3	1058	72.5	1058.1	72.5
V0520-93	273	33232	2.1	13.106	1.1	1.80447	1.6	0.17301	1.1	0.73	1028.7	10.8	1047.1	10.1	1086	21.1	1085.6	21.1
V0520-37	153	22552	1.4	12.781	2.0	1.91975	2.1	0.18334	0.6	0.28	1085.2	5.8	1088.0	14.0	1094	40.5	1093.6	40.5
V0520-30	116	18244	2.1	12.506	1.0	2.14583	4.2	0.20219	4.1	0.97	1187.1	44.6	1163.7	29.3	1120	20.0	1120.4	20.0
V0520-88	134	23169	2.2	12.452	1.6	2.15280	1.7	0.20081	0.6	0.32	1179.7	6.0	1166.0	12.0	1141	32.7	1140.5	32.7
V0520-63	126	22187	3.3	12.259	1.6	2.27135	2.0	0.20896	1.2	0.62	1223.3	13.8	1203.4	14.1	1168	31.0	1168.0	31.0
V0520-39	134	20606	1.2	12.286	2.1	2.22901	2.3	0.20440	0.8	0.35	1198.9	8.6	1190.2	15.9	1174	42.2	1174.4	42.2
V0520-97	335	43117	3.2	12.709	1.4	2.07405	1.8	0.18992	1.0	0.59	1120.9	10.7	1140.3	12.1	1177	28.1	1177.2	28.1
V0520-28	409	61843	6.3	12.630	1.1	2.10438	1.8	0.19051	1.4	0.77	1124.1	14.4	1150.2	12.4	1200	22.5	1199.8	22.5
V0520-78	509	43438	5.3	12.473	1.1	2.09862	2.3	0.18914	2.0	0.87	1116.7	20.6	1148.4	15.9	1209	22.3	1208.6	22.3
V0520-42	160	20141	1.6	11.919	1.4	2.38095	1.5	0.20999	0.6	0.38	1228.8	6.2	1236.9	10.5	1251	26.5	1251.0	26.5
V0520-32	113	21082	1.1	11.700	1.5	2.36414	1.6	0.20743	0.6	0.39	1215.1	6.9	1231.8	11.5	1261	29.0	1261.2	29.0
V0520-95	187	38100	2.1	10.984	1.7	3.15103	2.3	0.25086	1.5	0.65	1442.9	19.4	1445.3	17.7	1449	33.1	1448.7	33.1
V0520-65	128	36221	1.4	10.741	1.8	3.12282	1.9	0.24768	0.8	0.42	1426.5	10.5	1438.3	14.9	1456	33.3	1455.8	33.3
V0520-3	203	52263	1.7	10.898	1.0	3.24863	1.2	0.25593	0.6	0.53	1469.0	8.1	1468.8	9.1	1469	19.0	1468.7	19.0
V0520-2	47	13796	0.7	8.586	1.9	4.96962	2.0	0.32299	0.7	0.33	1804.3	10.5	1814.2	17.0	1825	34.4	1825.5	34.4
V0520-33	146	34882	1.3	8.387	1.2	5.73727	1.6	0.34572	1.1	0.67	1914.1	17.8	1937.0	13.8	1962	21.1	1961.5	21.1
V0520-69	47	15146	0.7	8.020	1.6	6.03358	2.1	0.36312	1.3	0.63	1997.0	22.5	1980.7	18.2	1964	29.0	1963.8	29.0
V0520-11	84	25618	3.8	7.422	1.0	6.77892	1.7	0.36658	1.4	0.81	2013.3	24.2	2083.0	15.2	2153	17.5	2152.6	17.5
V0520-62	113	19330	2.2	4.787	1.9	13.18956	10.9	0.45417	10.7	0.98	2413.8	215.5	2693.3	102.9	2910	30.6	2910.4	30.6
49127 standard																		
40127-1	2085	50100	1.5	20.4677	1.4	0.1426	2.2	0.0212	1.7	0.77	135.0	2.3	135.3	2.8	141	32.7	135.0	2.3
40127-2	69	2174	1.5	39.7848	67.8	0.0670	67.8	0.0193	3.1	0.05	123.4	3.8	65.8	43.3	-1740	573.3	123.4	3.8
40127-3	98	3356	1.0	23.2109	33.9	0.1203	34.0	0.0202	2.2	0.07	129.2	2.9	115.3	37.1	-163	864.6	129.2	2.9
40127-4	108	4537	0.8	20.4001	16.4	0.1374	16.9	0.0203	4.2	0.25	129.7	5.4	130.7	20.8	149	387.1	129.7	5.4
40127-5	68	2502	1.4	19.8753	37.1	0.1429	37.1	0.0206	1.5	0.04	131.5	2.0	135.7	47.2	210	887.2	131.5	2.0

Notes: All uncertainties are reported at the 1-sigma level, and include only measurement errors

Isotope ratios are corrected for Pb / U fractionation by comparison with standard zircon with an age of 564 ± 4 Ma.

Analyses with >10% uncertainty (1-sigma) in 206Pb/238U age are not included in calculation of weighted means for magmatic ages.

Analyses with >10% uncertainty (1-sigma) in 206Pb/207Pb age are not included, unless 206Pb/238U age is <500 Ma.

Best age is determined from 206Pb/238U age for analyses with 206Pb/238U age <900 Ma and from 206Pb/207Pb age for analyses with 206Pb/238Uage > 900 Ma.

Systematic errors (at 2-sigma level): [~2.5% (206Pb/238U) & ~1.4% (206Pb/207Pb)] These values are reported on cells U1 and W1 of NUagecalc.

U concentration and U/Th are calibrated relative to Sri Lanka zircon standard and are accurate to ~25%.

Common Pb correction is from measured 204Pb with common Pb composition interpreted from Stacey and Kramers (1975).

Common Pb composition assigned uncertainties of 1.5 for 206Pb/204Pb, 0.3 for 207Pb/204Pb, and 2.0 for 208Pb/204Pb.

U/Pb and 206Pb/207Pb fractionation is calibrated relative to fragments of a large Sri Lanka zircon of 563.5 ± 3.2 Ma (2-sigma).

U decay constants and composition as follows: 238U = 9.8485 x 10-10, 235U = 1.55125 x 10-10, 238U/235U = 137.88.